<u>Research Article</u>

Assessing ChatGPT Responses to Common Patient Questions on Knee Osteoarthritis

Nathan Gilmore, BS[1][a], Jared N. Kushner, BS[1][b], Anna Redden, BS[1][c], Austin W. Hansen, MS[2][d],
Payton Yerke Hansen, MD[2][e], Lisa Martinez, MD[3][f]

[1] Charles E. Schmidt College of Medicine, Florida Atlantic University, [2] Orthopedic Surgery, Louisiana State University Health Sciences Center Shreveport, [3] Integrated Medical Science, Florida Atlantic University

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Background

Patient education is an important component in providing high quality healthcare, especially in the context of orthopedic surgery. In the current era of continuous technological advancements and the adoption of artificial intelligence in healthcare, the use of online chatbots in patient education is inevitable. The purpose of this paper is to evaluate ChatGPT-3.5's effectiveness in answering common patient questions about knee osteoarthritis.

Methods

Ten frequently asked questions were collected from ten separate healthcare institution pages and input into ChatGPT-3.5. The questions were then analyzed for reliability and completeness using the DISCERN instrument and the Journal of the American Medical Association (JAMA) Benchmark criteria. The readability was analyzed using the Flesch Kincaid scoring system.

a Nathan Gilmore is a Medical Student at FAU Charles E. Schmidt College of Medicine in Boca Raton. Nathan, Medical Student, grew up in San Diego and attended college at UC Berkeley to study Toxicology. During his free time, Nathan enjoys playing soccer, traveling, and meditating. His specialty interests include interventional radiology.

Conflicts of Interest Statement for Nathan Gilmore, Medical Student

b Jared Kushner is a Medical Student at Florida Atlantic University. He is currently pursuing a career in Orthopedic Surgery.

Conflicts of Interest Statement for Jared Kushner, Medical Student

c Anna Redden is a fourth year Medical Student and aspiring Orthopaedic Surgeon.

Conflicts of Interest Statement for Anna Redden, Medical Student

d Austin Hansen is a second year Medical Student attending LSU Health Shrevport. He completed his undergrad at University of Utah and completed graduate school at Nova Southeastern University.

Visit Austin Hansen, Medical Student

Connect with Austin Hansen, Medical Student on LinkedIn

Conflicts of Interest Statement for Austin W. Hansen, Medical Student

e Dr. Payton Yerke Hansen attended medical school at Florida Atlantic University-Charles E. Schmidt College of Medicine. She currently is an Orthopedic Surgery resident at Louisiana State University Health-Shreveport.

Visit Payton Yerke Hansen, MD, Resident

Connect with Payton Yerke Hansen, MD, Resident on LinkedIn

Conflicts of Interest Statement for Payton Yerke Hansen, MD, Resident

f Lisa Martinez is an Internal Medicine physician who is passionate about preventive care and chronic disease management. She has spent her career in academic medicine, training the next generation of physicians.

Visit Lisa Martinez, M.D.

Conflicts of Interest Statement for Lisa Martinez, M.D.

Visit the Open Payments Data Page for Lisa Martinez, M.D.

Results

Of the ten questions, the average DISCERN score was 51. Three responses were considered good, six were fair, and one was poor. The JAMA Benchmark criteria was zero for all responses. The average Flesch Kincaid grade level score was 29.33, indicating a college grade reading level.

Conclusion

ChatGPT-3.5 may have the potential to be an informative tool for patients with questions about knee osteoarthritis. It was able to provide fair responses, however, some inquiries required clarification and all responses lacked reliable citations. Furthermore, the responses were written at a college grade reading level, which limits its utility. Therefore, proper patient education should be conducted by orthopedic surgeons. This highlights the need for patient education resources that are both accessible and comprehensible.

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INTRODUCTION

One of the most common conditions managed by orthopedic surgeons is knee osteoarthritis (KOA). Osteoarthritis is estimated to affect about 240 million people around the world (Katz, Arant, and Loeser 2021). Among adults in the United States age 45+, at least 19% are affected by KOA (Wallace et al. 2017). With the large prevalence of KOA, ensuring patients receive proper education on their condition is crucial. Patients frequently use the internet as a resource for medical information. It has been previously estimated that 65% of patients with orthopedic conditions who have access to the internet used it to search for information related to their condition (Fraval et al. 2012).

The use of artificial intelligence (AI) in healthcare has grown exponentially within recent years. ChatGPT is an online artificial intelligence tool that has gained over 1 billion visits since its inception (Herbold et al. 2023). Given the extensive utilization of online search engines as tools for researching medical information and the recent popularity of ChatGPT, it is reasonable to forecast that ChatGPT will become a common tool for patient education. However, ChatGPT can at times provide answers that are plausible but incorrect (Gravel, D'Amours-Gravel, and Osmanlliu 2023). Previous studies investigating the use of ChatGPT to answer patient questions have been conducted with mixed results. Some studies found the answers to be complete and accurate (Johnson et al. 2023). However, others found that its responses were inaccurate and low quality (Coskun et al. 2023; Draschl et al. 2023).

Given its prevalence, we would expect KOA to be an especially common topic researched by patients. However, it is not known how reliable the medical information provided by the chatbot on KOA is. The purpose of this study is to evaluate the effectiveness of ChatGPT in answering common patient questions about KOA.

METHODS

The KOA 'Frequently Asked Questions' (FAQs) section of ten health-care institution pages were reviewed to identify ten questions that were deemed the most common and clinically relevant (Appendix). The healthcare institution pages were all publicly available websites that were not affiliated with the authors' institutions. The questions gathered were then individually input to ChatGPT 3.5 (https://chat.openai.com/chat) ("ChatGPT," n.d.), an AI chatbot with a free online interface, on December 21, 2023. There were no follow-up questions or prompts for further clarification. Furthermore, the ChatGPT account used was new and had not been used to input questions.

The responses were critically analyzed for accuracy and reliability using the DISCERN instrument (**Table 1**) by the two senior authors (Charnock et al. 1999). Each author analyzed the responses individually and did not have access to the other author's scoring. The DISCERN scores were classified as: Excellent (scores 64-80), Good (scores 52-63), Fair (scores 41-51), Poor (scores 30-40), and Very Poor (scores 16-29) (**Table 2**) (Tahir et al. 2020). The Journal of the American Medical Association (JAMA) Benchmark criteria was used to determine if the responses utilized evidence-based material. JAMA Benchmark criteria critically evaluate healthcare websites using four key pillars- authorship, attribution, disclosure, and currency.

The readability of the responses was determined by The Flesch-Kincaid Grade Level test, which uses the verbiage complexity to assign a school grade reading level to the text (**Table 3**) (Flesch 1948; Kincaid et al. 1975). If disagree-

Table 1. The components of the DISCERN Instrument are shown.

DISCERN Instrument
1. Are the aims clear?
2. Does it achieve its aims?
3. Is it relevant?
4. Is it clear what sources of information were used to compile the publication (other than the author or producer)?
5. Is it clear when the information used or reported in the publication was produced?
6. Is it balanced and unbiased?
7. Does it provide details of additional sources of support and information?
8. Does it refer to areas of uncertainty?
9. Does it describe how each treatment works?
10. Does it describe the benefits of each treatment?
11. Does it describe the risks of each treatment?
12. Does it describe what would happen if no treatment is used?
13. Does it describe how the treatment choices affect overall quality of life?
14. Is it clear that there may be more than one possible treatment choice?
15. Does it provide support for shared decision-making?
16. Based on the answers to all of the above questions, rate the overall quality of the publication as a source of information about treatment choices

Table 2. The DISCERN ratings that correlate to the overall response rating are shown.

Response Rating	DISCERN Score
Excellent	64-80
Good	52-63
Fair	41-51
Poor	30-40
Very Poor	16-29

Table 3. Interpretation of The Flesch-Kincaid Grade Level scores

FRE Score	Reading Difficulty	Estimated FK Reading Grade Level
91-100	Very Easy	US Grade 5
81-90	Easy	US Grade 6
71-80	Fairly Easy	US Grade 7
61-70	Standard	US Grade 8-9
51-60	Fairly Difficult	US Grade 10-12
31-50	Difficult	US Grade 13-16
0-30	Very Difficult	College Graduate

ments in the grading occurred, consensus was determined through further discussion. The Cohen Kappa correlation was used to determine interrater agreeability.

RESULTS

Of the ten questions, the average DISCERN score was 51. Three responses were considered good, six were fair, and one was poor. The JAMA Benchmark criteria was zero for all responses. However, this metric was greatly limited by the lack of citations in the responses. The average Flesch Kincaid grade level score was 29.33, indicating a college level grading level. The Cohen Kappa correlation was calculated to be 0.842, indicating near perfect agreement.

QUESTION 1: WHAT CAUSES OSTEOARTHRITIS?

DISCERN Score: 36
JAMA Benchmark Criteria: 0
Flesch-Kincaid: 33.7

The ChatGPT response correctly identified many of the risk factors for KOA, including age, obesity, injury, and joint misalignment (Sharma 2021; Giorgino et al. 2023; Lespasio et al. 2017). It also accurately stated that the causes of KOA are multifactorial and likely vary between patients (Lespasio et al. 2017).

QUESTION 2: ARE THERE ANY TREATMENTS TO REPAIR KNEE CARTILAGE DAMAGE DUE TO OSTEOARTHRITIS?

DISCERN Score: 55
JAMA Benchmark Criteria: 0
Flesch-Kincaid: 32.1

ChatGPT correctly recognized that there are currently no treatments that restore the hyaline cartilage to the articular surfaces of the knee and provide long-term relief of KOA. Therefore, ChatGPT's statement that treatment for KOA is focused on improving symptoms and improving functionality of the knee joint is correct.

However, the chatbot incorrectly stated that platelet rich plasma (PRP) can be used to promote healing and provide symptomatic relief. PRP contains numerous growth factors that are involved in cell proliferation, angiogenesis, cell migration, and the production of cellular matrix. However, current literature has found that PRP's role is limited to inflammatory control and symptom improvement (Di et al. 2018; Meheux et al. 2016; Campbell et al. 2015). There has not been a robust demonstration of cartilage improvement with the use of PRP (Fuggle et al. 2020).

QUESTION 3: HOW IS KNEE OSTEOARTHRITIS TREATED?

DISCERN Score: 58
JAMA Benchmark Criteria: 0
Flesch-Kincaid: 25.0

The ChatGPT response regarding KOA treatment correctly states that the management of KOA requires a combined treatment approach that may including lifestyle modifications, non-pharmacologic, pharmacologic, and surgical options (Zhang et al. 2008; Lim and Al-Dadah 2022; Bannuru et al. 2019). It mentioned many relevant conservative treatments including weight loss, exercise, physical therapy, and assistive devices as well as the important first-line medications and procedural options available (Lim and Al-Dadah 2022). Importantly, the response includes the fact that some treatment adjuncts, like nutritional supplements, have debated effectiveness (Brophy and Fillingham 2022). Further, although the response does not offer specifics, it does appropriately state that the combination of treatments chosen will depend on severity of symptoms and individual patient factors (Bannuru et al. 2019).

However, the response does require clarification. Although the use of canes, braces, and insoles is supported by older treatment guidelines, current literature suggests that their effectiveness in symptomatic relief, clinically relevant biomechanical alterations, and improved functionality in KOA is lacking. Therefore, their recommended use is controversial (Bannuru et al. 2019; Brophy and Fillingham 2022; Lim and Al-Dadah 2022; Duivenvoorden et al. 2015; Jindasakchai et al. 2023). American Academy of Orthopedic Surgery (AAOS) and Osteoarthritis Research Society International (OARSI) guidelines specifically recommend against the use of lateral insoles and braces respectively (Bannuru et al. 2019). Lastly, the AI response includes both NSAIDs and acetaminophen as appropriate pharmacological first-line treatment. However, several updated guidelines do not recommend the use of acetaminophen alone due to lack of efficiency over placebo (Bannuru et al. 2019; Lim and Al-Dadah 2022).

QUESTION 4: DO I NEED TO STOP DOING MY NORMAL ACTIVITIES BECAUSE OF KNEE OSTEOARTHRITIS?

DISCERN Score: 50
JAMA Benchmark Criteria: 0
Flesch-Kincaid: 42.4

The ChatGPT response to this query offers an acceptable recommendation to remain active while incorporating appropriate adjustments to protect your joints when managing KOA (Kraus et al. 2019; Goh et al. 2019; Lim and Al-Dadah 2022; Brophy and Fillingham 2022; Bannuru et al. 2019; Masud et al. 2021). Exercise is listed as a first line treatment by numerous treatment guidelines and many forms of exercise (strength, aerobic, land-based, aquatic, mind-body, balance training, supervised, unsupervised) have been shown to improve pain, function, and quality of life in patients with KOA (Brophy and Fillingham 2022; Bannuru et al. 2019; Masud et al. 2021). There is no consensus on what particular exercise modality is superior. Therefore, ChatGPT's response correctly explains that an appropriate exercise regimen is individual and realistic, taking into account patient comorbidities, personal goals, and unique benefits of each modality (Brophy and Fillingham 2022; Lim and Al-Dadah 2022; Goh et al. 2019).

The AI response also includes weight management as an important reason to stay active given its ability to slow the progression of KOA (Lim and Al-Dadah 2022; Gersing et al. 2019). Furthermore, the response accurately recommends avoidance of excessive high impact activity such as running and exercise requiring prolonged kneeling or squatting (Griffin and Guilak 2005; Petrigna et al. 2022). When employing activity in the prevention and management of joint degeneration, there is an optimal balance where the joint is neither insufficiently loaded nor overloaded that facilitates optimal cartilage health (Griffin and Guilak 2005; Petrigna et al. 2022).

QUESTION 5: WHY IS LOSING WEIGHT RECOMMENDED FOR KNEE OSTEOARTHRITIS?

DISCERN Score: 55
JAMA Benchmark Criteria: 0
Flesch-Kincaid: 32.1

The ChatGPT response regarding weight loss for individuals with KOA correctly identifies some key reasons why weight loss is recommended for individuals with KOA. These reasons include reduced joint stress, pain relief, improved joint function, delaying disease progression, enhanced response to treatment, and reduced risk of complications (Messier et al. 2000, 2018; Miller et al. 2006). These reasons are supported by current medical literature, which acknowledges the benefits of weight loss in managing KOA, particularly in terms of pain reduction and improved function (Kulkarni et al. 2016).

However, the response could be improved with a clarification regarding the complexity and variability of outcomes related to weight loss in KOA (Laperche et al. 2022). While losing weight generally offers benefits, it's not guaranteed to lessen complications for all patients undergoing knee arthroplasty, particularly for those with severe obesity and/or osteoarthritis. This indicates that the impact of weight loss can vary depending on individual circumstances and disease severity. Therefore, a more elaborate discussion acknowledging these complexities would provide a more comprehensive understanding of the role of weight loss in KOA management (Godziuk et al. 2021). This nuanced understanding of the benefits and limitations of weight loss in the context of KOA is important for a comprehensive understanding of the subject.

QUESTION 6: IS IT SAFE TO EXERCISE WITH KNEE OSTEOARTHRITIS?

DISCERN Score: 51
JAMA Benchmark Criteria: 0
Flesch-Kincaid: 34.6

The ChatGPT response regarding the safety and benefits of exercise for individuals with KOA is largely accurate and aligns well with current medical understanding. ChatGPT also appropriately emphasized the importance of consulting with a healthcare provider before starting an exercise regimen for KOA (Young, Pedersen, and Bricca 2023). Exercise is recommended for KOA patients, as it can ameliorate joint function and reduce pain (Tanaka et al. 2013). The emphasis on low-impact activities, strength training, and the need for a personalized approach based on individual condition and tolerance levels is supported by current literature (Zeng et al. 2021).

However, the ChatGPT response could benefit from a slight clarification regarding the variability of exercise outcomes and the importance of tailored exercise programs (Tiffreau et al. 2007; Messier et al. 2021). For example, while exercise is generally effective in improving pain and strength in KOA patients, the evidence on its impact on function, performance, and quality of life is less clear. Additionally, while land and aquatic exercises are known to improve KOA, several specific exercise modalities such as stretching, plyometric, and proprioception training lend ambiguous results to their effectiveness in reducing KOA symptoms (Raposo, Ramos, and Lúcia Cruz 2021; Bosomworth 2009).

QUESTION 7: HOW DO CORTICOSTEROID INJECTIONS HELP WITH KNEE OSTEOARTHRITIS?

DISCERN Score: 51
JAMA Benchmark Criteria: 0
Flesch-Kincaid: 6.8

The ChatGPT response appropriately identified corticosteroid injections as a temporary measure for providing patients with KOA relief from pain and inflammation (Arroll and Goodyear-Smith 2004). Many investigations have validated the utility of intraarticular injections in managing pain and inflammation in the short-term period, with a range of appreciable improvements from two to six weeks (Arroll and Goodyear-Smith 2004; Jüni et al. 2015; Najm et al. 2021). The chatbot also provided insight on the anti-inflammatory effect of corticosteroid injections, and the proposed mechanism for pain relief (Najm et al. 2021; Martin and Browne 2019). The chatbot provided a wider range of pain relief expectations, from several weeks to a few months. Although previous studies have demonstrated the role of corticosteroid injections for long term management of KOA, recent literature has indicated its use is more appropriate for short term management (Arroll and Goodyear-Smith 2004; Najm et al. 2021; Raynauld et al. 2003; Felson 2023). Further, the chatbot appropriately highlights the role of injections in improving joint function, the potential side effects, and its capacity to minimize systemic side effects because of the localized administrative nature of the treatment (Donovan et al. 2022; Kompel et al. 2019). Moreover, the chatbot defines the role of injections as a component of larger comprehensive treatment plan and responsibly recommends physician consultation (Hsu and Siwiec 2023; Arden et al. 2021; Block and Cherny 2021).

QUESTION 8: WHEN SHOULD I CONSIDER KNEE REPLACEMENT SURGERY FOR KNEE OSTEOARTHRITIS?

DISCERN Score: 47
JAMA Benchmark Criteria: 0
Flesch-Kincaid: 20.8

The ChatGPT response regarding when to seek a surgical intervention correctly indicated that knee arthroplasties typically follow unresponsive conservative treatment options (Martel-Pelletier et al. 2019; Aweid et al. 2018; Collins, Hart, and Mills 2019; Afzali et al. 2018). The chatbot further highlights indications for surgery including pain, loss of function, deformity, cartilage loss, and joint damage (Aweid et al. 2018; Schmitt et al. 2017). Factors such as male sex, young age, African American race, diabetes, cementless fixation, preoperative limb malalignment, and coronal laxity have all been demonstrated to impact prognosis (Parvizi, Hanssen, and Spangehl 2004; Jasper et al. 2016; Julin et al. 2010; Ekhtiari et al. 2021). In this regard, the chatbot emphasizes the importance of physician consultation, touching on how variable risks and benefits should be considered on a patient-to-patient basis (Nielsen et al. 2017).

QUESTION 9: WHAT ARE THE RISKS OF KNEE REPLACEMENT SURGERIES?

DISCERN Score: 47
JAMA Benchmark Criteria: 0
Flesch-Kincaid: 34.3

The ChatGPT response accurately explained the postoperative complications including infection, thrombosis, inflammation, and stiffness (Alshammari et al. 2023). Although the chatbot provided a correct explanation of the risks for knee arthroplasties and encouraged discussion with a healthcare provider, it failed to provide the complication rates. Access to this data may be an important consideration when deciding management options. For example, knee arthroplasties have reported postoperative infection and thrombotic event rates of 1% (Gajda et al. 2023) and a 1.3% (Keller et al. 2020), respectively. Knowing the postoperative risks helps the patient make more informed decisions and provides an opportunity for deeper patient-physician communication.

QUESTION 10: HOW LONG WILL MY PROSTHETIC KNEE LAST?

DISCERN Score: 44
JAMA Benchmark Criteria: 0
Flesch-Kincaid: 31.5

The ChatGPT response regarding the longevity of a prosthetic knee correctly explained that total knee implant longevity is multifactorial and varies by patient (Cohen et al. 2023). Additionally, current literature supports the chatbot statement that implants usually last in the range of 15–20 years (Hussain et al. 2016; Dalury 2016; Cohen et al. 2020; Berger et al. 2001; Dixon et al. 2005). The chatbot also recommended that patients communicate with their orthopedic surgeon regarding the lifespan of their knee implant, which is critical in building rapport and achieving patient-centered care (O'Reilly et al. 2022).

DISCUSSION

ChatGPT's integration into healthcare prompts an interesting exploration of its applicability in patient education, particularly in the context of KOA. Our study primarily aimed to assess the effectiveness of ChatGPT in providing reliable information for common patient questions regarding KOA. Of the ten questions, the average DISCERN score was 51. Three responses were considered good, six were fair, and one was poor (**Table 4**). However, they all lacked reliable citations. Furthermore, while ChatGPT may have potential in patient education, it should only be used as supplementary source of information. Adequate patient education should be performed by a board-certified orthopedic surgeon. This highlights the importance of a balanced approach in integrating AI into patient education.

Several studies incorporating ChatGPT in orthopedic contexts have drawn similar conclusions, which indicates that ChatGPT offers satisfactory preliminary information but requires clarification for improved decision making (Draschl et al. 2023). This approach suggests a cautious stance toward relying exclusively on AI-generated responses for medical advice. This study found that all responses received a JAMA Benchmark criteria score of zero due to a lack of citations in the chatbot responses. Similarly, Eng et al. found that ChatGPT's responses to common questions on rotator cuff repairs lacked reliable references, and they all received JAMA Benchmark criteria scores of zero. (Eng et al. 2024) Furthermore, other studies have found that ChatGPT lacks the ability to determine the reliability of the sources it utilizes to generate responses (Ayers et al. 2023). It also has the tendency to cite irrelevant articles, which have been termed "hallucinations" (Brega et al. 2015). In contrast, other investigations have highlighted inconsistencies in ChatGPT's accuracy for self-diagnosing orthopedic conditions, pointing to the variability and potential risks of depending solely on AI in medical contexts (Kuroiwa et al. 2023; Massey, Montgomery, and Zhang 2023).

Additionally, the average Flesch Kincaid grade level score was 29.33, indicating a college level grading level. The average American reads at an 8th grade level. Thus, many sources recommend that patient education resources do not surpass a 6th grade reading level (Cotugna, Vickery, and Carpenter-Haefele 2005; Weiss et al. 1994; Brega et al. 2015). This offers the ability to provide medical information that is both comprehensible and accurate in an inclusive manner. Given the chatbot's advanced language, it may be challenging for patients to understand and utilize the information it provides. Similarly, Fahy et al. found that the ChatGPT responses to patient questions about anterior cruciate ligament injuries were at least nine reading grade levels above the recommended 6th grade (Fahy et al. 2024). Interestingly, the responses were more complex with the more advanced 4.0 model (Fahy et al. 2024). However, this finding is not limited to ChatGPT. Sports medicine and sports orthopedics internet-based patient education resources are written at an advanced reading grade level. Doinn et al. found that these materials exceeded the recommended reading grade level by at least four grade levels (Ó Doinn et al. 2022). To improve the utility of patient education materials and future iterations of ChatGPT, the responses should be written at a lower reading grade level to optimize inclusivity for the general public.

Our findings affirm the multifaceted role of AI in healthcare. For specific conditions, like KOA, ChatGPT may be an effective tool to relay reliable information to patients. However, the level of reliability and need for additional clarification can significantly vary depending on the medical condition and context. This inconsistency underscores the importance of contextual evaluation when utilizing AI tools in healthcare, suggesting that AI may best function only as an adjunct to professional medical advice and consultation.

LIMITATIONS

While our study offers important insights, it is not without limitations. The selection of only ten questions for analysis in our study introduces the possibility of selection bias, as this small sample may not adequately represent the full

Table 4. Top 10 FAQs with their corresponding response accuracy scores

Number	Question	DISCERN Score	DISCERN Rating	JAMA Benchmark Criteria	Flesch-Kincaid Reading Ease Scores	Flesch-Kincaid Reading Grade Level
1	What causes osteoarthritis?	36	Poor	0	33.7	US Grade 13-16
2	Are there any treatments to repair knee cartilage damage due to osteoarthritis?	55	Good	0	32.1	US Grade 13-16
3	How is knee osteoarthritis treated?	58	Good	0	25.0	College Graduate
4	Do I need to stop doing my normal activities because of knee osteoarthritis?	50	Fair	0	42.4	US Grade 13-16
5	Why is losing weight recommended for knee osteoarthritis?	55	Good	0	32.1	US Grade 13-16
6	Is it safe to exercise with knee osteoarthritis?	51	Fair	0	34.6	US Grade 13-16
7	How do corticosteroid injections help with knee osteoarthritis?	51	Fair	0	6.8	College Graduate
8	When should I consider knee replacement surgery for knee osteoarthritis?	47	Fair	0	20.8	College Graduate
9	What are the risks of knee replacement surgeries?	47	Fair	0	34.3	US Grade 13-16
10	How long will my prosthetic knee last?	44	Fair	0	31.5	US Grade 13-16

spectrum of patient inquiries regarding KOA. This potentially limits the generalizability of our findings. Additionally, the questions were analyzed using scoring systems that involve subjective measurements. The authors attempted to decrease biases due to this methodology by having two authors score the responses individually. Furthermore, the chatbot failed to include reliable citations in the responses, which greatly impacted the authors' ability to utilize the JAMA Benchmark criteria. Due to the lack of citations, all responses received a score of zero. Lastly, there is variability in ChatGPT's responses based on question phrasing and program updates, which can lead to inconsistencies in the information produced. These limitations exemplify the need for cautious interpretation of our results and highlight areas for improvement in future research on AI applications in patient education.

CONCLUSION

ChatGPT-3.5 has the potential to be an informative tool for patients with questions about knee osteoarthritis. It was able to provide fair responses, however, some inquiries required clarification and all responses lacked reliable citations. Furthermore, the responses were written at a college grade reading level, which limits its utility. Therefore, proper patient education should be conducted by orthopedic surgeons. This study highlights the need for patient education resources that are accessible, accurate, and comprehensible.

REFERENCES

Afzali, Tamana, Mia V. Fangel, Anne S. Vestergaard, Michael S. Rathleff, Lars H. Ehlers, and Martin B. Jensen. 2018. "Cost-Effectiveness of Treatments for Non-Osteoarthritic Knee Pain Conditions: A Systematic Review." *PLOS ONE* 13 (12): e0209240. https://doi.org/10.1371/journal.pone.0209240.

Alshammari, Ahmed O., Nasser A. Altamimi, Faisal F. Alshammari, Ohud A. Altamimi, Abdullah M. Aljarboa, Abdullah S. Alshebli, Jamal A. Almarshadi, et al. 2023. "Awareness About Total Knee Arthroplasty Among Hail Population." *Cureus*, January. https://doi.org/10.7759/cureus.33260.

Arden, Nigel K., Thomas A. Perry, Raveendhara R. Bannuru, Olivier Bruyère, Cyrus Cooper, Ida K. Haugen, Marc C. Hochberg, Timothy E. McAlindon, Ali Mobasheri, and Jean-Yves Reginster. 2021. "Non-Surgical Management of Knee Osteoarthritis: Comparison of ESCEO and OARSI 2019 Guidelines." *Nature Reviews Rheumatology* 17 (1): 59–66. https://doi.org/10.1038/s41584-020-00523-9.

Arroll, Bruce, and Felicity Goodyear-Smith. 2004. "Corticosteroid Injections for Osteoarthritis of the Knee: Meta-Analysis." *BMJ* 328 (7444): 869. https://doi.org/10.1136/bmj.38039.573970.7C.

Aweid, Osama, Zakir Haider, Abdel Saed, and Yegappan Kalairajah. 2018. "Treatment Modalities for Hip and Knee Osteoarthritis: A Systematic Review of Safety." *Journal of Orthopaedic Surgery* 26 (3): 230949901880866. https://doi.org/10.1177/2309499018808669.

Ayers, John W., Adam Poliak, Mark Dredze, Eric C. Leas, Zechariah Zhu, Jessica B. Kelley, Dennis J. Faix, et al. 2023. "Comparing Physician and Artificial Intelligence Chatbot Responses to Patient Questions Posted to a Public Social Media Forum." *JAMA Internal Medicine* 183 (6): 589. https://doi.org/10.1001/jamainternmed.2023.1838.

Bannuru, R.R., M.C. Osani, E.E. Vaysbrot, N.K. Arden, K. Bennell, S.M.A. Bierma-Zeinstra, V.B. Kraus, et al. 2019. "OARSI Guidelines for the Non-Surgical Management of Knee, Hip, and Polyarticular Osteoarthritis." *Osteoarthritis and Cartilage* 27 (11): 1578–89. https://doi.org/10.1016/j.joca.2019.06.011.

Berger, Richard A., John H. Lyon, Joshua J. Jacobs, Regina M. Barden, Eric M. Berkson, Mitchell B. Sheinkop, Aaron G. Rosenberg, and Jorge O. Galante. 2001. "Problems With Cementless Total Knee Arthroplasty at 11 Years Followup." *Clinical Orthopaedics and Related Research* 392 (November): 196–207. https://doi.org/10.1097/00003086-200111000-00024.

Block, Joel A., and Dmitriy Cherny. 2021. "Management of Knee Osteoarthritis." *Medical Clinics of North America* 105 (2): 367–85. https://doi.org/10.1016/j.mcna.2020.10.005.

Bosomworth, Neil J. 2009. "Exercise and Knee Osteoarthritis: Benefit or Hazard?" *Canadian Family Physician Medecin de Famille Canadien* 55 (9): 871–78.

Brega, Angela G., Megan A. G. Freedman, William G. LeBlanc, Juliana Barnard, Natabhona M. Mabachi, Maribel Cifuentes, Karen Albright, Barry D. Weiss, Cindy Brach, and David R. West. 2015. "Using the Health Literacy Universal Precautions Toolkit to Improve the Quality of Patient Materials." *Journal of Health Communication* 20 (sup2): 69–76. https://doi.org/10.1080/10810730.2015.1081997.

Brophy, Robert H., and Yale A. Fillingham. 2022. "AAOS Clinical Practice Guideline Summary: Management of Osteoarthritis of the Knee (Nonarthroplasty), Third Edition." *Journal of the American Academy of Orthopaedic Surgeons* 30 (9): e721-29. https://doi.org/10.5435/JAAOS-D-21-01233.

Campbell, Kirk A., Bryan M. Saltzman, Randy Mascarenhas, M. Michael Khair, Nikhil N. Verma, Bernard R. Bach, and Brian J. Cole. 2015. "Does Intra-Articular Platelet-Rich Plasma Injection Provide Clinically Superior Outcomes Compared With Other Therapies in the Treatment of Knee Osteoarthritis? A Systematic Review of Overlapping Meta-Analyses." *Arthroscopy: The Journal of Arthroscopic & Related Surgery* 31 (11): 2213–21. https://doi.org/10.1016/j.arthro.2015.03.041.

Charnock, D., S. Shepperd, G. Needham, and R. Gann. 1999. "DISCERN: An Instrument for Judging the Quality of Written Consumer Health Information on Treatment Choices." *Journal of Epidemiology & Community Health* 53 (2): 105–11. https://doi.org/10.1136/jech.53.2.105.

"ChatGPT." n.d. Accessed December 20, 2023. https://chat.openai.com/chat.

Cohen, Daniel, Arieh Greenberg, Anton Maliarov, David Seligman, and David Backstein. 2023. "Long-Term Outcomes of the Nexgen© Posterior Stabilized Knee: Minimum 15 Year Follow-Safe and Effective." *European Journal of Orthopaedic Surgery & Traumatology: Orthopedie Traumatologie* 33 (7): 2943–49. https://doi.org/10.1007/s00590-023-03514-0.

Cohen, Daniel, Dina Kogan, Amir Rubin, Ari Zimran, and Ehud Lebel. 2020. "Longevity of Total Hip Arthroplasty Implants in Patients with Gaucher Disease." *HIP International* 30 (2): 147–51. https://doi.org/10.1177/1120700019834919.

Collins, N. J., H. F. Hart, and K. A. G. Mills. 2019. "Osteoarthritis Year in Review 2018: Rehabilitation and Outcomes." *Osteoarthritis and Cartilage* 27 (3): 378–91. https://doi.org/10.1016/j.joca.2018.11.010.

Coskun, Burhan, Gokhan Ocakoglu, Melih Yetemen, and Onur Kaygisiz. 2023. "Can ChatGPT, an Artificial Intelligence Language Model, Provide Accurate and High-Quality Patient Information on Prostate Cancer?" *Urology* 180 (October): 35–58. https://doi.org/10.1016/j.urology.2023.05.040.

Cotugna, Nancy, Connie E. Vickery, and Kara M. Carpenter-Haefele. 2005. "EVALUATION OF LITERACY LEVEL OF PATIENT EDUCATION PAGES IN HEALTH-RELATED JOURNALS." *Journal of Community Health* 30 (3): 213–19. https://doi.org/10.1007/s10900-004-1959-x.

Dalury, D. F. 2016. "Cementless Total Knee Arthroplasty: Current Concepts Review." *The Bone & Joint Journal* 98-B (7): 867–73. https://doi.org/10.1302/0301-620X.98B7.37367.

Di, Yalong, Changxu Han, Liang Zhao, and Yizhong Ren. 2018. "Is Local Platelet-Rich Plasma Injection Clinically Superior to Hyaluronic Acid for Treatment of Knee Osteoarthritis? A Systematic Review of Randomized Controlled Trials." *Arthritis Research & Therapy* 20 (1): 128. https://doi.org/10.1186/s13075-018-1621-0.

Dixon, Michael C., Richard R. Brown, Dominik Parsch, and Richard D. Scott. 2005. "MODULAR FIXED-BEARING TOTAL KNEE ARTHROPLASTY WITH RETENTION OF THE POSTERIOR CRUCIATE LIGAMENT." *The Journal of Bone and Joint Surgery-American Volume* 87 (3): 598–603. https://doi.org/10.2106/00004623-200503000-00018.

Donovan, R. L., T. A. Edwards, A. Judge, A. W. Blom, S. K. Kunutsor, and M. R. Whitehouse. 2022. "Effects of Recurrent Intra-Articular Corticosteroid Injections for Osteoarthritis at 3 Months and beyond: A Systematic Review and Meta-Analysis in Comparison to Other Injectables." *Osteoarthritis and Cartilage* 30 (12): 1658–69. https://doi.org/10.1016/j.joca.2022.07.011.

Draschl, Alexander, Georg Hauer, Stefan F. Fischerauer, Angelika Kogler, Lukas Leitner, Dimosthenis Andreou, Andreas Leithner, and Patrick Sadoghi. 2023. "Are ChatGPT's Free-Text Responses on Periprosthetic Joint Infections of the Hip and Knee Reliable and Useful?" *Journal of Clinical Medicine* 12 (20): 6655. https://doi.org/10.3390/jcm12206655.

Duivenvoorden, Tijs, Reinoud W. Brouwer, Tom M. van Raaij, Arianne P. Verhagen, Jan A.N. Verhaar, and Sita M.A. Bierma-Zeinstra. 2015. "Braces and Orthoses for Treating Osteoarthritis of the Knee." *Cochrane Database of Systematic Reviews*. https://doi.org/10.1002/14651858.CD004020.pub3.

Ekhtiari, Seper, Anthony Bozzo, Kim Madden, Mitchell J. Winemaker, Anthony Adili, and Thomas J. Wood. 2021. "Unicompartmental Knee Arthroplasty: Survivorship and Risk Factors for Revision." *Journal of Bone and Joint Surgery* 103 (23): 2170–76. https://doi.org/10.2106/JBJS.21.00346.

Eng, Emma, Colton M. Mowers, Divesh Sachdev, Payton Yerke-Hansen, Garrett R. Jackson, Derrick M. Knapik, and Vani J. Sabesan. 2024. "Despite an Advanced Readability for the General Population, ChatGPT-3.5 Can Effectively Supplement Patient-Related Information Provided by the Treating Surgeon Regarding Common Questions About Rotator Cuff Repair." *Arthroscopy: The Journal of Arthroscopic & Related Surgery*, May. https://doi.org/10.1016/j.arthro.2024.05.009.

Fahy, Stephen, Stephan Oehme, Danko Milinkovic, Tobias Jung, and Benjamin Bartek. 2024. "Assessment of Quality and Readability of Information Provided by ChatGPT in Relation to Anterior Cruciate Ligament Injury." *Journal of Personalized Medicine* 14 (1): 104. https://doi.org/10.3390/jpm14010104.

Felson, D. T. 2023. "Evidence Suggests That Intraarticular Corticosteroids Are Effective (Short Term) and Safe (Long Term)." *Osteoarthritis and Cartilage* 31 (2): 140–41. https://doi.org/10.1016/j.joca.2022.10.010.

Flesch, Rudolph. 1948. "A New Readability Yardstick." *Journal of Applied Psychology* 32 (3): 221–33. https://doi.org/10.1037/h0057532.

Fraval, Andrew, Yew Ming Chong, David Holcdorf, Virginia Plunkett, and Phong Tran. 2012. "Internet Use by Orthopaedic Outpatients - Current Trends and Practices." *The Australasian Medical Journal* 5 (12): 633–38. https://doi.org/10.4066/AMJ.2012.1530.

Fuggle, N. R., C. Cooper, R. O. C. Oreffo, A. J. Price, J. F. Kaux, E. Maheu, M. Cutolo, et al. 2020. "Alternative and Complementary Therapies in Osteoarthritis and Cartilage Repair." *Aging Clinical and Experimental Research* 32 (4): 547–60. https://doi.org/10.1007/s40520-020-01515-1.

Gajda, Mateusz, Paulina Gajda, Agnieszka Pac, Barbara Gryglewska, Marcin Wojnarski, Anna Różańska, Inga Lipińska-Tobiasz, and Jadwiga Wójkowska-Mach. 2023. "Post-Discharge Occurrence of Surgical Site Infections after Hip or Knee Arthroplasty Surgery in Poland, a Population-Based Study." *Scientific Reports* 13 (1): 15940. https://doi.org/10.1038/s41598-023-43111-z.

Gersing, A. S., B. J. Schwaiger, M. C. Nevitt, J. Zarnowski, G. B. Joseph, G. Feuerriegel, P. M. Jungmann, et al. 2019. "Weight Loss Regimen in Obese and Overweight Individuals Is Associated with Reduced Cartilage Degeneration: 96-Month Data from the Osteoarthritis Initiative." *Osteoarthritis and Cartilage* 27 (6): 863–70. https://doi.org/10.1016/j.joca.2019.01.018.

Giorgino, Riccardo, Domenico Albano, Stefano Fusco, Giuseppe M. Peretti, Laura Mangiavini, and Carmelo Messina. 2023. "Knee Osteoarthritis: Epidemiology, Pathogenesis, and Mesenchymal Stem Cells: What Else Is New? An Update." *International Journal of Molecular Sciences*. https://doi.org/10.3390/ijms24076405.

Godziuk, Kristine, Carla M. Prado, Lauren Beaupre, C. Allyson Jones, Jason R. Werle, and Mary Forhan. 2021. "A Critical Review of Weight Loss Recommendations before Total Knee Arthroplasty." *Joint Bone Spine* 88 (2): 105114. https://doi.org/10.1016/j.jbspin.2020.105114.

Goh, Siew-Li, Monica S. M. Persson, Joanne Stocks, Yunfei Hou, Nicky J. Welton, Jianhao Lin, Michelle C. Hall, Michael Doherty, and Weiya Zhang. 2019. "Relative Efficacy of Different Exercises for Pain, Function, Performance and Quality of Life in Knee and Hip Osteoarthritis: Systematic Review and Network Meta-Analysis." *Sports Medicine (Auckland, N.Z.)* 49 (5): 743–61. https://doi.org/10.1007/s40279-019-01082-0.

Gravel, Jocelyn, Madeleine D'Amours-Gravel, and Esli Osmanlliu. 2023. "Learning to Fake It: Limited Responses and Fabricated References Provided by ChatGPT for Medical Questions." *Mayo Clinic Proceedings: Digital Health* 1 (3): 226–34. https://doi.org/10.1016/j.mcpdig.2023.05.004.

Griffin, Timothy M., and Farshid Guilak. 2005. "The Role of Mechanical Loading in the Onset and Progression of Osteoarthritis." *Exercise and Sport Sciences Reviews* 33 (4): 195–200. https://doi.org/10.1097/00003677-200510000-00008.

Herbold, Steffen, Annette Hautli-Janisz, Ute Heuer, Zlata Kikteva, and Alexander Trautsch. 2023. "A Large-Scale Comparison of Human-Written versus ChatGPT-Generated Essays." *Scientific Reports* 13 (1): 18617. https://doi.org/10.1038/s41598-023-45644-9.

Hsu, H., and R. M. Siwiec. 2023. "Knee Osteoarthritis." Treasure Island (FL). 2023. https://www.ncbi.nlm.nih.gov/books/NBK507884/.

Hussain, S. M., D. W. Neilly, S. Baliga, S. Patil, and R. M. D. Meek. 2016. "Knee Osteoarthritis: A Review of Management Options." *Scottish Medical Journal* 61 (1): 7–16. https://doi.org/10.1177/0036933015619588.

Jasper, L. L., C. A. Jones, J. Mollins, S. L. Pohar, and L. A. Beaupre. 2016. "Risk Factors for Revision of Total Knee Arthroplasty: A Scoping Review." *BMC Musculoskeletal Disorders* 17 (1): 182. https://doi.org/10.1186/s12891-016-1025-8.

Jindasakchai, P., C. Angthong, P. Panyarachun, P. Rajbhandari, and N. Rungrattanawilai. 2023. "Therapeutic Significance of Insoles in Patients with Knee Osteoarthritis." *European Review for Medical and Pharmacological Sciences* 27 (11): 5023–30. https://doi.org/10.26355/eurrev_202306_32619.

Johnson, Douglas, Rachel Goodman, J. Patrinely, Cosby Stone, Eli Zimmerman, Rebecca Donald, Sam Chang, et al. 2023. "Assessing the Accuracy and Reliability of AI-Generated Medical Responses: An Evaluation of the Chat-GPT Model." *Research Square*. https://doi.org/10.21203/rs.3.rs-2566942/v1.

Julin, Jaakko, Esa Jämsen, Timo Puolakka, Yrjö T. Konttinen, and Teemu Moilanen. 2010. "Younger Age Increases the Risk of Early Prosthesis Failure Following Primary Total Knee Replacement for Osteoarthritis." *Acta Orthopaedica* 81 (4): 413–19. https://doi.org/10.3109/17453674.2010.501747.

Jüni, Peter, Roman Hari, Anne W.S. Rutjes, Roland Fischer, Maria G. Silletta, Stephan Reichenbach, and Bruno R. da Costa. 2015. "Intra-Articular Corticosteroid for Knee Osteoarthritis." *Cochrane Database of Systematic Reviews*. https://doi.org/10.1002/14651858.CD005328.pub3.

Katz, Jeffrey N., Kaetlyn R. Arant, and Richard F. Loeser. 2021. "Diagnosis and Treatment of Hip and Knee Osteoarthritis: A Review." *JAMA* 325 (6): 568–78. https://doi.org/10.1001/jama.2020.22171.

Keller, Karsten, Lukas Hobohm, Stefano Barco, Irene Schmidtmann, Thomas Münzel, Martin Engelhardt, Lukas Eckhard, Stavros V. Konstantinides, and Philipp Drees. 2020. "Venous Thromboembolism in Patients Hospitalized for Knee Joint Replacement Surgery." *Scientific Reports* 10 (1): 22440. https://doi.org/10.1038/s41598-020-79490-w.

Kincaid, J. P., R. P. Fishburne Jr., R. L. Rogers, R. L. Rogers, and B. S. Chissom. 1975. "Derivation Of New Readability Formulas (Automated Readability Index, Fog Count And Flesch Reading Ease Formula) For Navy Enlisted Personnel." Institute for Simulation and Training. https://doi.org/10.21236/ADA006655.

Kompel, Andrew J., Frank W. Roemer, Akira M. Murakami, Luis E. Diaz, Michel D. Crema, and Ali Guermazi. 2019. "Intra-Articular Corticosteroid Injections in the Hip and Knee: Perhaps Not as Safe as We Thought?" *Radiology* 293 (3): 656–63. https://doi.org/10.1148/radiol.2019190341.

Kraus, Virginia B., Kyle Sprow, Kenneth E. Powell, David Buchner, Bonny Bloodgood, Katrina Piercy, Stephanie M. George, William E. Kraus, and 2018 PHYSICAL ACTIVITY GUIDELINES ADVISORY COMMITTEE*. 2019. "Effects of Physical Activity in Knee and Hip Osteoarthritis: A Systematic Umbrella Review." *Medicine and Science in Sports and Exercise* 51 (6): 1324–39. https://doi.org/10.1249/MSS.0000000000001944.

Kulkarni, Kunal, Timothy Karssiens, Vijay Kumar, and Hemant Pandit. 2016. "Obesity and Osteoarthritis." *Maturitas* 89 (July): 22–28. https://doi.org/10.1016/j.maturitas.2016.04.006.

Kuroiwa, Tomoyuki, Aida Sarcon, Takuya Ibara, Eriku Yamada, Akiko Yamamoto, Kazuya Tsukamoto, and Koji Fujita. 2023. "The Potential of ChatGPT as a Self-Diagnostic Tool in Common Orthopedic Diseases: Exploratory Study." *Journal of Medical Internet Research* 25 (September): e47621. https://doi.org/10.2196/47621.

Laperche, Jacob, Richard Feinn, Karen Myrick, and Mohamad J. Halawi. 2022. "Obesity and Total Joint Arthroplasty: Does Weight Loss in the Preoperative Period Improve Perioperative Outcomes?" *Arthroplasty* 4 (1): 47. https://doi.org/10.1186/s42836-022-00149-0.

Lespasio, Michelle J., Nicolas S. Piuzzi, M. Elaine Husni, George F. Muschler, Aj Guarino, and Michael A. Mont. 2017. "Knee Osteoarthritis: A Primer." *The Permanente Journal* 21:16–183. https://doi.org/10.7812/TPP/16-183.

Lim, Wei Boon, and Oday Al-Dadah. 2022. "Conservative Treatment of Knee Osteoarthritis: A Review of the Literature." *World Journal of Orthopedics* 13 (3): 212–29. https://doi.org/10.5312/wjo.v13.i3.212.

Martel-Pelletier, Johanne, Emmanuel Maheu, Jean-Pierre Pelletier, Ludmila Alekseeva, Ouafa Mkinsi, Jaime Branco, Pierre Monod, Frédéric Planta, Jean-Yves Reginster, and François Rannou. 2019. "A New Decision Tree for Diagnosis of Osteoarthritis in Primary Care: International Consensus of Experts." *Aging Clinical and Experimental Research* 31 (1): 19–30. https://doi.org/10.1007/s40520-018-1077-8.

Martin, Cody L., and James A. Browne. 2019. "Intra-Articular Corticosteroid Injections for Symptomatic Knee Osteoarthritis: What the Orthopaedic Provider Needs to Know." *Journal of the American Academy of Orthopaedic Surgeons* 27 (17): e758-66. https://doi.org/10.5435/JAAOS-D-18-00106.

Massey, Patrick A., Carver Montgomery, and Andrew S. Zhang. 2023. "Comparison of ChatGPT–3.5, ChatGPT-4, and Orthopaedic Resident Performance on Orthopaedic Assessment Examinations." *Journal of the American Academy of Orthopaedic Surgeons* 31 (23): 1173–79. https://doi.org/10.5435/JAAOS-D-23-00396.

Masud, Saad, Brendan Sheehan, Alexis Rousseau-Saine, Allison Tucker, Emilie Sandman, Ivan Wong, Jarret Woodmass, et al. 2021. "Arthroscopy Association of Canada Position Statement on Exercise for Knee Osteoarthritis: A Systematic Review of Guidelines." *Orthopaedic Journal of Sports Medicine* 9 (6): 23259671211016900. https://doi.org/10.1177/23259671211016900.

Meheux, Carlos J., Patrick C. McCulloch, David M. Lintner, Kevin E. Varner, and Joshua D. Harris. 2016. "Efficacy of Intra-Articular Platelet-Rich Plasma Injections in Knee Osteoarthritis: A Systematic Review." *Arthroscopy: The Journal of Arthroscopic & Related Surgery* 32 (3): 495–505. https://doi.org/10.1016/j.arthro.2015.08.005.

Messier, Stephen P., Richard F. Loeser, Michelle N. Mitchell, Gianfranco Valle, Timothy P. Morgan, W. Jack Rejeski, and Walter H. Ettinger. 2000. "Exercise and Weight Loss in Obese Older Adults with Knee Osteoarthritis: A Preliminary Study." *Journal of the American Geriatrics Society* 48 (9): 1062–72. https://doi.org/10.1111/j.1532-5415.2000.tb04781.x.

Messier, Stephen P., Shannon L. Mihalko, Daniel P. Beavers, Barbara J. Nicklas, Paul DeVita, J. Jeffery Carr, David J. Hunter, et al. 2021. "Effect of High-Intensity Strength Training on Knee Pain and Knee Joint Compressive Forces Among Adults With Knee Osteoarthritis." *JAMA* 325 (7): 646. https://doi.org/10.1001/jama.2021.0411.

Messier, Stephen P., Allison E. Resnik, Daniel P. Beavers, Shannon L. Mihalko, Gary D. Miller, Barbara J. Nicklas, Paul deVita, et al. 2018. "Intentional Weight Loss in Overweight and Obese Patients With Knee Osteoarthritis: Is More Better?" *Arthritis Care & Research* 70 (11): 1569–75. https://doi.org/10.1002/acr.23608.

Miller, Gary D., Barbara J. Nicklas, Cralen Davis, Richard F. Loeser, Leon Lenchik, and Stephen P. Messier. 2006. "Intensive Weight Loss Program Improves Physical Function in Older Obese Adults with Knee Osteoarthritis." *Obesity* 14 (7): 1219–30. https://doi.org/10.1038/oby.2006.139.

Najm, Aurélie, Alessia Alunno, James M. Gwinnutt, Catherine Weill, and Francis Berenbaum. 2021. "Efficacy of Intra-Articular Corticosteroid Injections in Knee Osteoarthritis: A Systematic Review and Meta-Analysis of Randomized Controlled Trials." *Joint Bone Spine* 88 (4): 105198. https://doi.org/10.1016/j.jbspin.2021.105198.

Nielsen, Flemming K., Niels Egund, Anette Jørgensen, and Anne Grethe Jurik. 2017. "Risk Factors for Joint Replacement in Knee Osteoarthritis; a 15-Year Follow-up Study." *BMC Musculoskeletal Disorders* 18 (1): 510. https://doi.org/10.1186/s12891-017-1871-z.

Ó Doinn, Tiarnán, James M. Broderick, Rebecca Clarke, and Niall Hogan. 2022. "Readability of Patient Educational Materials in Sports Medicine." *Orthopaedic Journal of Sports Medicine* 10 (5): 232596712210923. https://doi.org/10.1177/23259671221092356.

O'Reilly, Olivia C., Alan G. Shamrock, Marcy Rosenbaum, Charles R. Clark, and Brendan M. Patterson. 2022. "Physician-Patient Communication in the Orthopedic Clinic: Surgeon-Identified Challenges." *The Iowa Orthopaedic Journal* 42 (1): 275–81.

Parvizi, Javad, Arlen D. Hanssen, and Mark J. Spangehl. 2004. "Total Knee Arthroplasty Following Proximal Tibial Osteotomy." *The Journal of Bone & Joint Surgery* 86 (3): 474–79. https://doi.org/10.2106/00004623-200403000-00003.

Petrigna, Luca, Federico Roggio, Bruno Trovato, Marta Zanghì, Claudia Guglielmino, and Giuseppe Musumeci. 2022. "How Physical Activity Affects Knee Cartilage and a Standard Intervention Procedure for an Exercise Program: A Systematic Review." *Healthcare (Basel, Switzerland)* 10 (10): 10. https://doi.org/10.3390/healthcare10101821.

Raynauld, Jean-Pierre, Chris Buckland-Wright, Rupert Ward, Denis Choquette, Boulos Haraoui, Johanne Martel-Pelletier, Imad Uthman, et al. 2003. "Safety and Efficacy of Long-Term Intraarticular Steroid Injections in Osteoarthritis of the Knee: A Randomized, Double-Blind, Placebo-Controlled Trial." *Arthritis & Rheumatism* 48 (2): 370–77. https://doi.org/10.1002/art.10777.

Schmitt, Jochen, Toni Lange, Klaus-Peter Günther, Christian Kopkow, Elisabeth Rataj, Christian Apfelbacher, Martin Aringer, et al. 2017. "Indication Criteria for Total Knee Arthroplasty in Patients with Osteoarthritis – A Multi-Perspective Consensus Study." *Zeitschrift Für Orthopädie Und Unfallchirurgie* 155 (05): 539–48. https://doi.org/10.1055/s-0043-115120.

Sharma, Leena. 2021. "Osteoarthritis of the Knee." *The New England Journal of Medicine* 384 (1): 51–59. https://doi.org/10.1056/NEJMcp1903768.

Tahir, Muhammad, Muhammad Usman, Fazal Muhammad, Shams ur Rehman, Imran Khan, Muhammad Idrees, Muhammad Irfan, and Adam Glowacz. 2020. "Evaluation of Quality and Readability of Online Health Information on High Blood Pressure Using DISCERN and Flesch-Kincaid Tools." *Applied Sciences* 10 (9): 3214. https://doi.org/10.3390/app10093214.

Tanaka, R., J. Ozawa, N. Kito, and H. Moriyama. 2013. "Efficacy of Strengthening or Aerobic Exercise on Pain Relief in People with Knee Osteoarthritis: A Systematic Review and Meta-Analysis of Randomized Controlled Trials." *Clinical Rehabilitation* 27 (12): 1059–71. https://doi.org/10.1177/0269215513488898.

Tiffreau, V., D. Mulleman, E. Coudeyre, M.M. Lefevre-Colau, M. Revel, and F. Rannou. 2007. "The Value of Individual or Collective Group Exercise Programs for Knee or Hip Osteoarthritis. Elaboration of French Clinical Practice Guidelines." *Annales de Réadaptation et de Médecine Physique* 50 (9): 741–46. https://doi.org/10.1016/j.annrmp.2007.10.001.

Wallace, Ian J., Steven Worthington, David T. Felson, Robert D. Jurmain, Kimberly T. Wren, Heli Maijanen, Robert J. Woods, and Daniel E. Lieberman. 2017. "Knee Osteoarthritis Has Doubled in Prevalence since the Mid-20th Century." *Proceedings of the National Academy of Sciences of the United States of America* 114 (35): 9332–36. https://doi.org/10.1073/pnas.1703856114.

Weiss, Barry D., Jay S. Blanchard, Daniel L. McGee, Gregory Hart, Barbara Warren, Michael Burgoon, and Kenneth J. Smith. 1994. "Illiteracy among Medicaid Recipients and Its Relationship to Health Care Costs." *Journal of Health Care for the Poor and Underserved* 5 (2): 99–111. https://doi.org/10.1353/hpu.2010.0272.

Young, James J., Julie Rønne Pedersen, and Alessio Bricca. 2023. "Exercise Therapy for Knee and Hip Osteoarthritis: Is There An Ideal Prescription?" *Current Treatment Options in Rheumatology* 9 (3): 82–98. https://doi.org/10.1007/s40674-023-00205-z.

Zeng, C. Y., Z. R. Zhang, Z. M. Tang, and F. Z. Hua. 2021. "Benefits and Mechanisms of Exercise Training for Knee Osteoarthritis." *Frontiers in Physiology*, no. 12 (December). https://doi.org/10.3389/fphys.2021.794062.

Zhang, W., R. W. Moskowitz, G. Nuki, S. Abramson, R. D. Altman, N. Arden, S. Bierma-Zeinstra, et al. 2008. "OARSI Recommendations for the Management of Hip and Knee Osteoarthritis, Part II: OARSI Evidence-Based, Expert Consensus Guidelines." *Osteoarthritis and Cartilage* 16 (2): 137–62. https://doi.org/10.1016/j.joca.2007.12.013.