

Top-cited works about exercise for knee osteoarthritis: a bibliometric analysis from 2000 to 2021

Z.-H. YU¹, Z.-Y. HU¹, Z.-J. FAN², W.-G. GAO¹, H.-Z. ZHAO¹, X.-A. ZHANG¹, Y.-B. MA³

¹College of Kinesiology, Shenyang Sport University, Shenyang, China

²Rehabilitation Treatment Center, ³Musculoskeletal Rehabilitation Center, Beijing Rehabilitation Hospital, Capital Medical University, Beijing, China

Yu and Hu contributed equally to this work

Abstract. – OBJECTIVE: Previous trials demonstrated the effectiveness of exercise in improving pain and functional impairment in patients with knee osteoarthritis (KOA). However, a bibliometric analysis of top-cited papers on exercise treatment for KOA has not yet been conducted. The aim of the present study was to critically analyze the bibliometric characteristics of the most frequently cited articles on exercise treatment for KOA.

MATERIALS AND METHODS: Publications about exercise treatment for KOA from 2000 to 2021 were searched from the Web of Science database. Two authors independently collected 100 top-cited articles, and a consensus was reached to form the final list. The title, journal, author, year of publication, country and institution of origin, total citations, citations in 2021, main topics, research nature, and level of evidence were extracted, and the publication trends in exercise treatment for KOA were evaluated.

RESULTS: A total of 1,258 papers were retrieved from the database. According to the final list, clinical research accounted for 81% of the studies, but no statistical difference in the number of citations was found among the four types of articles ($p=0.194$). Seventy articles had a level of evidence of Ib, and no statistical differences in citations were found per level of evidence ($p=0.767$). Most of the top-cited articles were published between 2005-2014, and Dr Messier was the prominent writer in this field.

CONCLUSIONS: This bibliometric study is the first to identify the most cited papers in exercise treatment for KOA research. Traditional Chinese exercise, comorbidity, and exercise adherence may be the next popular research trends that will receive more attention in the future.

Key Words:

Exercise, Knee, Osteoarthritis, Bibliometric, Treatment.

Introduction

Osteoarthritis (OA) is the failure to repair joint damage caused by stress or abnormalities in any joint or periarticular tissue¹. Globally, more than 240 million people suffer from OA². The knee is the common joint affected, and more than 9.3 million adults (age ≥ 45 years) in the US suffer from knee osteoarthritis (KOA)³. KOA costs medical resources³ and increases the mortality rate of patients⁴. It is a major economic burden because it reduces the quality of life of patients^{5,6} and the direct cost of KOA to a patient's life is estimated to be \$129,600³. Numerous specialists and researchers have endeavored to give new insights into KOA^{7,8}. A large number of articles have been issued annually to identify the etiology, determine the risk factors, or explore the treatment methods. The treatments recommended by guidelines⁹⁻¹² include nonpharmacological therapies (exercise, education, and weight loss), anti-inflammatory agents, intra-articular injections, pharmacological therapy, and surgery. International evidence-based guidelines strongly recommend exercise, education, and weight loss as the core components of conservative KOA treatment¹². Many randomized controlled clinical trials have demonstrated the effectiveness of exercise in improving pain and functional impairment in patients with KOA¹³⁻¹⁵ and exercise is becoming increasingly popular in KOA treatment. These articles have made considerable progressions in exercise for KOA. But meanwhile, they make it difficult for investigators to gather critical information. Thus, to identify those high-impact articles on exercise for KOA is of much concern.

The advent of the Internet has dramatically changed the way academic journals are published

and the way readers access and read them¹⁶. The professional academic publication has grown exponentially in the last decade¹⁷. Bibliometrics is the process of extracting measurable data through the statistical analysis of published research studies and how the knowledge within a publication is used¹⁸. An important method in bibliometrics is citation analysis¹⁹. The number of citations reflects the influence of an article in its particular field, and articles with high citations may be the basis of research in the field²⁰. Analysis of top-cited studies helps understand the current achievement and guides researchers toward the direction of development of the field²¹.

Analysis of top-cited articles has been used in different fields, including cancer²², emotion²³, surgery²⁴, and erosive tooth wear²⁵. However, the number of top-cited articles on exercise therapy is small and there is no top-cited analysis of the exercise for KOA research. Intend to bridge this gap, we conducted a bibliometric analysis to identify and describe the top-cited articles about exercise for KOA and explore the reasons for their successful citation, which may help researchers in publishing and collaborating on their papers.

Materials and Methods

One-hundred top-cited published articles on exercise for KOA were identified on January 23, 2022, from the Web of Science (WOS) Core Collection. Our retrieval strategy was as follows: TI = (“knee osteoarthritides” OR “knee osteoarthritis” OR “osteoarthritis of knee” OR “osteoarthritis of the knee” OR “KOA”) and TI = (exercise OR train OR training OR physical activity OR physical activities OR strength OR endurance OR resistance OR stability OR “walk*” OR “Tai Chi” OR yoga OR “motor control” OR “core control” OR “stretch*” OR “run*” OR “muscle energy technique” OR “Pilates*” OR “McKenzie therapy” OR “Williams gymnastics” OR hydrotherapy OR “water sports” OR “kinesitherapy”). The literature search was limited to original and review articles. Conference papers, letters, editorials, comments, and books were excluded. The search was limited to the time span between 2000 and 2021 with no restrictions on language or funding support. Articles were included only if the primary intervention was exercise for treating KOA. Whereas those articles were excluded where primary intervention was not exercise or the condition treated was other than KOA.

Two of our authors (Zihan Y. and Zhengyu H.) completed the search independently, filtered the articles by title and abstract, and listed their top-100 initial literature. Comparison revealed a 4% discrepancy between the two authors' lists. A consensus was reached to form the final top-100 list through discussion with a third author (Yubao M).

The volume of citations, as an objective indicator, is not an absolute measure of the quality of the paper, but it reflects the impact of the paper in the scientific community. High-quality research will generate more citations than low-quality research²⁶. The articles were ranked on the basis of a total number of citations. For each study selected in the top-100 list, relevant data including title, journal, first and corresponding authors, publication year, country and institution of origin, total citations, citations in 2021, and main topics was tabulated.

These articles were classified into four categories: (1) clinical research, (2) review article, (3) observational study, and (4) basic research. The level of evidence of the articles was also classified according to the 2009 revised Oxford (UK) Center for Evidence-Based Medicine Levels of Evidence (Table I). We explored the correlation between year of publication and citations. The differences in the number of citations for different types and levels of evidence of articles were also explored. Journal information was obtained from the ISI Journal Citation Reports (2021) and journals with 3 or more articles within the top-100 list were included in the top-sources list. Authors with 2 or more publications in top-100 articles were selected as leading authors. By using statistics extracted *via* WOS search, studies were charted out on the basis of country and institution of origin. These quantitative indicators will provide a snippet on bibliometric trends, focus and shortcomings in exercise for KOA research and it will define the future goals (direction of funding) to improve the chances of development within the field.

Statistical Analysis

Excel 2019 and SPSS version 26.0 (IBM Corp., Armonk, NY, USA) were used in the statistical analysis of the collected data. Shapiro-Wilk's test was applied to test the normality of the distribution of individual variables. Normally distributed data were presented as mean and standard deviation, and skewed data were presented as median and range. All *p*-values were two tailed, and $p \leq 0.05$ was considered statistically significant.

Table I. Shortened depiction of Oxford Centre for Evidence-Based Medicine 2011 Levels of Evidence.

Level		Rating criteria
I	Ia	Evidence obtained from a systematic review of relevant randomized controlled trials (including meta-analysis).
	Ib	Evidence obtained from at least one properly designed randomized, controlled trial.
II	IIa	Evidence obtained from at least one well-designed controlled trial without randomization.
	IIb	Evidence obtained from one well-designed, pseudo-experimental trial.
III		Evidence obtained from a well-designed, non-experimental descriptive trial.
IV		Evidence obtained from case reports, expert opinion, consensus conference.
II	Ib	Evidence obtained from at least one properly designed randomized, controlled trial.
	IIa	Evidence obtained from at least one well-designed controlled trial without randomization.
	IIb	Evidence obtained from one well-designed, pseudo-experimental trial.
III		Evidence obtained from a well-designed, non-experimental descriptive trial.
IV		Evidence obtained from case reports, expert opinion, consensus conference.

One-way ANOVA was used to test for differences in normally distributed data, and Kruskal-Wallis' test was used for skewed data. Spearman rank correlation was employed to test for correlations among nonparametric variables. This paper is a pooled study of previous works; therefore, an ethical review was not necessary.

Results

Most-Cited Articles, Types of Articles, and Level of Evidence

A total of 1,258 articles were retrieved from WOS and ranked according to their number of citations. The 100 top-cited articles are listed in **Supplementary Table I**. The number of articles cited ranged from 41 to 677. Among them, 11% were cited at least 200 times, and 5% were cited by more than 300 times. Although no language restriction was applied, all the included articles are published in English.

The 100 top-cited articles comprised 81 clinical research, 14 review articles, 2 observational research articles, and 3 basic research articles (Table

II). Differences in citations were explored among the different types of articles. The result showed no statistical differences in citations (Kruskal-Wallis test, $p=0.194$, clinical research: median=78 [42-677], review article: median=130 [41-337], observational study: median=96 [73-119], basic research: median=47 [45-80]; (Figure 1).

Differences in citations among different levels of evidence were also explored. Most of the articles had a level of evidence of Ib [n=70; median=78 (41-677)], followed by Ia (n=13; median=113 [41-272]), IIa [n=7, median= 91 (42-233)], III [n=5, median=81 [67-119)], and IV (n=2, median= 200); (Table III, Figure 2). However, no statistical differences in citations were found per level of evidence (Kruskal-Wallis test, $p=0.767$).

Journals in Which the Top 100 Articles Were Published

The 100 top-cited articles were published in 43 journals. The journals that published more than three articles are listed in Table IV with their impact factors, country, and category. Arthritis Care & Research (USA, n=14), Journal of Rheumatol-

Table II. Citations per type of article.

	Citations per type of article				
	Number	Range	Mean (\pm SD)	Median (Q25/Q75)	p^*
Clinical research (Gr1)	81	42/677	107.8 (\pm 97.7)	78 (54/115.5)	$p = 0.194$
Review article (Gr2)	14	41/337	141.9 (\pm 93.8)	130 (61/198)	
Observational Study (Gr3)	2	73/119	96 (\pm 32.5)	96	
Basic research (Gr4)	3	45/80	57.3 (\pm 19.7)	47	
Total	100	41/677	110.8 (\pm 95.5)	79.5 (54/118.8)	

*Kruskal-Wallis' test.

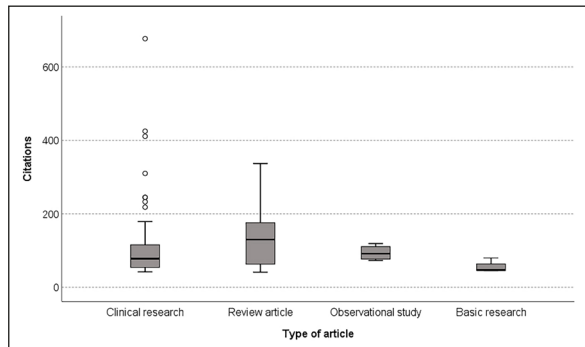


Figure 1. Citations according to the type of article.

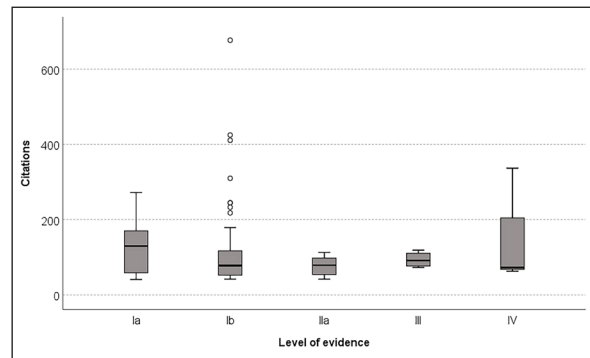


Figure 2. Citations according to the level of evidence.

ogy (Canada, n=7), Osteoarthritis and Cartilage (UK, n=7), and Physical Therapy (USA, n=7) were the most prominent journals and contributed 35% of the 100 top-cited articles. British Medical Journal (BMJ) from the UK had the highest impact factor (39.89). For the Journal Citation Reports (JCR) categories, in which these journals are indexed (they can be classified in more than one category), most of the journals belong to the Rheumatology, Orthopedics, and Rehabilitation category and were founded in the USA and UK in the last century.

Publication Year

Most of the articles were published between 2005-2014 (n=70). The articles published in 2003 had the highest average citations (average=604), and the articles published in 2000 accumulated the largest number of citations (total=1681), (Figure 3). The total citations increased as time went by ($r=-0.491, p<0.001$, Spearman’s correlation), (Figure 4). Based on the citations in 2021, the authors preferred to cite relatively new articles, and the correlation was statistically significant ($r=0.471, p<0.001$, Spearman’s correlation), (Figure 5).

Authors, Country, and Institution of Origin

Among the 100 top-cited articles, 14 authors had multiple first authorships, and 14 authors had multiple corresponding authorships, many of whom are both. For example, we found out that Dr Messier from Wake Forest University (USA) has four first authorships and four corresponding authorships. Table V lists the information of the top authors with more than one top cited article.

With regard to the authors’ affiliation, only the corresponding author was considered. The 100 authors belonged to 74 institutions from 18 different countries/regions, with a greater participation from the USA (n=31), followed by UK (n=10), China (n=9), Netherlands (n=8), and Denmark (n=8) (Figure 6). The USA led the research on exercise for KOA. Four institutions contributed more than two papers. The institution with the largest contribution was Wake Forest University (USA, n=6). Netherlands Institute for Health Services Research (Netherlands) appeared second with four papers, and Spenshult Hospital (Sweden) and Nottingham University Hospitals (UK) contributed three papers each. The major institutions are listed in Table VI.

Table III. Citations per type of article.

	Citations per type of article				p*
	Number	Range	Mean (± SD)	Median (Q25/Q75)	
Clinical research (Gr1)	81	42/677	107.8 (± 97.7)	78 (54/115.5)	p = 0.194
Review article (Gr2)	14	41/337	141.9 (± 93.8)	130 (61/198)	
Observational Study (Gr3)	2	73/119	96 (± 32.5)	96	
Basic research (Gr4)	3	45/80	57.3 (± 19.7)	47	
Total	100	41/677	110.8 (± 95.5)	79.5 (54/118.8)	

*Kruskal-Wallis’ test.

Table IV. Journals in which the 100 most-cited articles were published.

Journal	Number	IFs	Country	Category
Arthritis care & Research	14	5.178	USA	Rheumatology
Journal of rheumatology	7	5.346	Canada	Rheumatology
Osteoarthritis and cartilage	7	7.507	UK	Orthopedics
Physical therapy	7	3.14	USA	Orthopedics
Clinical rehabilitation	6	2.884	USA	Rehabilitation
Archives of physical medicine and rehabilitation	5	4.06	USA	Rheumatology
Rheumatology	4	7.046	UK	Rheumatology
BMC Musculoskeletal disorders	4	2.562	UK	Rheumatology
BMJ-British Medical Journal	3	93.333	UK	General & Internal

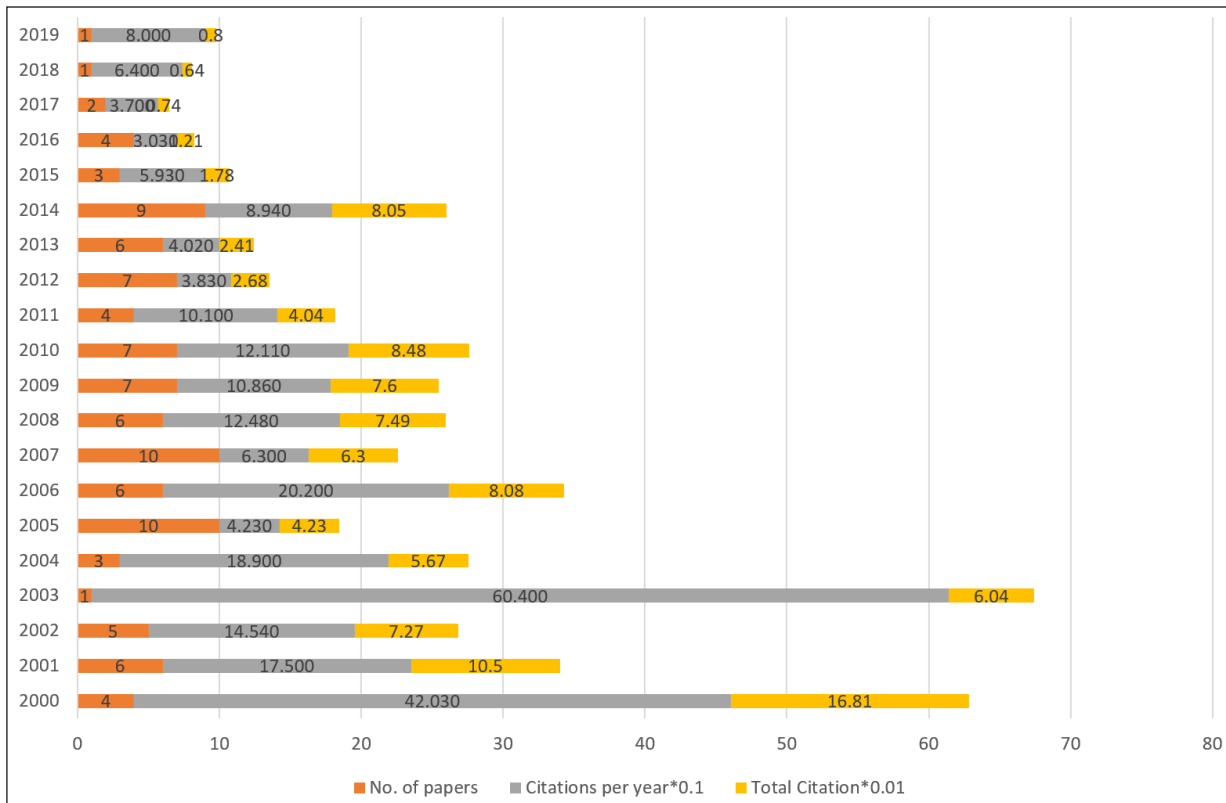


Figure 3. Annual number of publications, average citations and total citations.

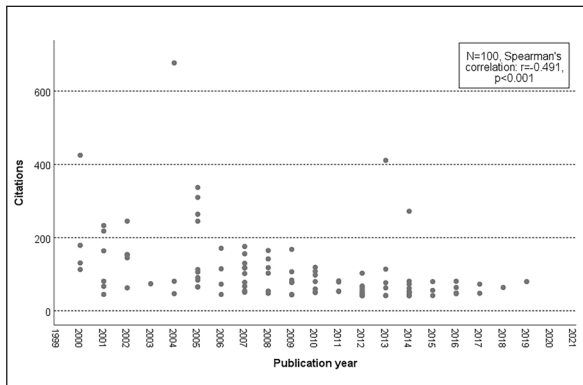


Figure 4. Overall citations since publication.

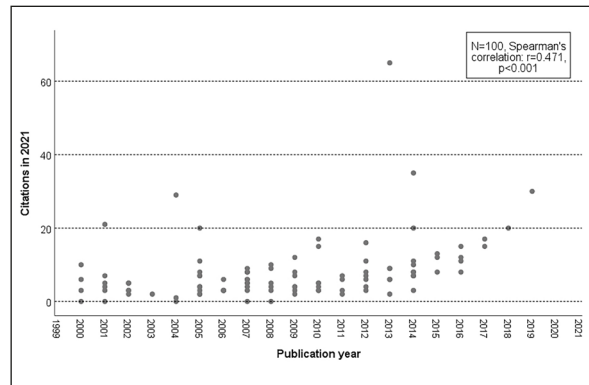


Figure 5. Citations in 2021.

Table V. Authors with more than one of top cited articles.

First author	Number	Corresponding author	Number
Messier SP	4	Messier SP	4
Pisters MF	3	Pisters MF	3
Abbott JH	2	Abbott JH	2
Bennell KL	2	Bennell KL	2
Deyle GD	2	Deyle GD	2
Fitzgerald GK	2	Fitzgerald GK	2
Focht BC	2	Focht BC	2
Henriksen M	2	Henriksen M	2
Jan MH	2	Jan MH	2
Lin DH	2	Lin DH	2
Roddy E	2	Roddy E	2
Thorstensson CA	2	Thorstensson CA	2
Wang CC	2	Wang CC	2
Wang TJ	2	Wang TJ	2

Discussion

Hip OA and KOA are one of the leading causes of global disability. With the increase in the world’s aging and obese populations, the pressure on the health care system of various countries will continue to increase. Among the 291 diseases studied by the GBD 2010 study²⁷, hip OA and KOA ranked as the 11th largest contributor to global disability in 2010. International evidence-based guidelines recommend exercise as the core of conservative treatment for KOA¹². The present bibliometric study analyzed the highly cited literatures on KOA exercise therapy published in the past two decades. A total of 1,258

eligible articles were retrieved, the articles were screened to obtain the top 100 cited articles, and bibliometric indicators (title, journal, first and corresponding authors, year of publication, country and institution of origin, total citations, citations in 2021, research nature, and level of evidence) were extracted.

The number of citations of an article is related to the impact of the article over time but not to the quality of the article²⁸. Even the most cited papers were not cited when they were first published²⁸. As time passes and old knowledge is replaced by new knowledge, these so-called “classics” also lose their luster and decrease in citations, and the citations of new articles increase ($r= 0.471$,

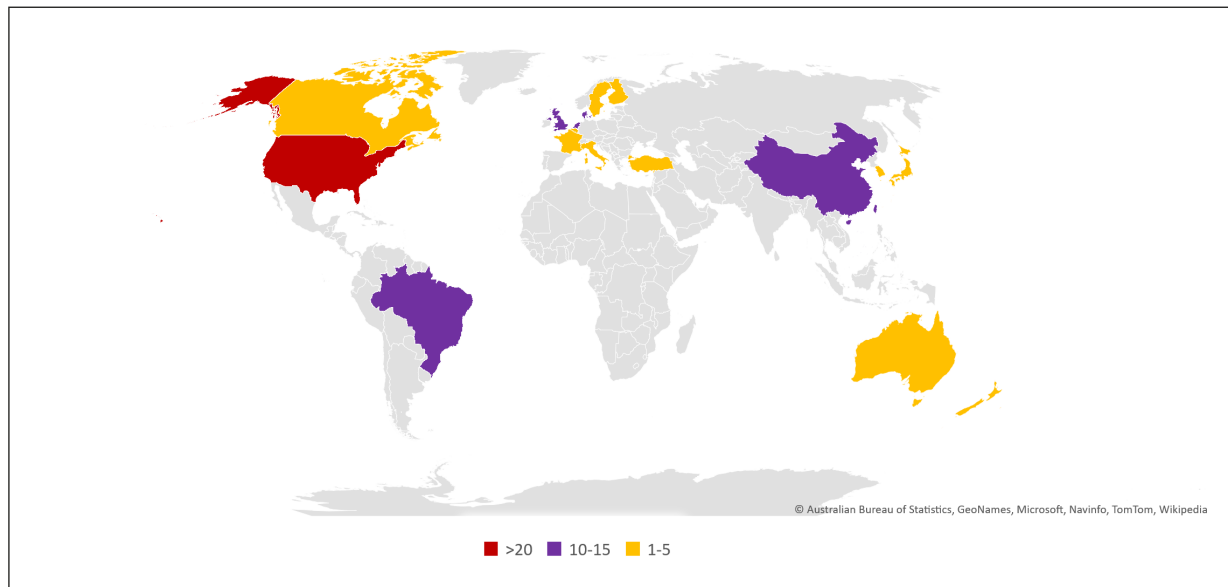


Figure 6. World map of total country output.

Table VI. Institutions with more than two of the top 100 cited articles.

Institution	Number
Wake Forest University (USA)	6
Netherlands Institute for Health Services Research (Netherlands)	4
Spenshult Hospital (Sweden)	3
Nottingham University Hospitals (UK)	3

$p < 0.001$, Spearman's correlation), (Figure 4). Similar to other papers^{30,33}, the total citations increase over time ($r = -0.491$, $p < 0.001$, Spearman's correlation), (Figure 5). Notably, the knowledge in this field is updated every day, and the number of new articles is also increasing rapidly. As a result, some of the newly published articles in the table should also attract our attention as they may become highly cited articles in the future. Similar to other areas of research²⁹⁻³¹, the main country of origin of the 100 top-cited articles is the USA, which may be related to the population and strong research funding. KOA has a high incidence in the United States, and more than 9.3 million adults (age ≥ 45 years) in the USA suffer from KOA³². However, the populations of different countries vary widely and may cause some bias.

The majority of articles were published in journals from the UK and the USA. The articles published in American journals are more inclined to cite local journals, and articles published in British journals are more inclined to cite articles from British journals. The reason is that in the field of KOA, journals from the two countries rank high, and high-level articles are expected to appear in these journals to improve their influence. In turn, the publication of excellent articles helps journals to maintain a leading position in this field. *Arthritis Care & Research (USA)*, *Journal of Rheumatology (Canada)*, *Osteoarthritis and Cartilage (UK)*, and *Physical Therapy (USA)* are four professional journals that focus on OA, and they contributed 35% of the top 100 articles.

Similar to other articles, universities are the main contributors in the study of exercise treatment for KOA with 65 articles published. Prestigious hospitals and rehabilitation centers also contributed 35 articles owing to the universality of KOA in clinical practice. Wake Forest University from the USA contributed six top-cited articles.

Unlike the previous bibliometric reports³³, the 100 top-cited articles on KOA and exercise consisted of works with high level of evidence; 87% of them belong to Ia and Ib, which may be related

to the inclusion criteria. This finding suggests that researchers have a strong interest in exploring the therapeutic effects of exercise treatment for KOA, and these articles are highly instructive in clinical practice.

The two most productive authors in this study are Messier from Wake Forest University and Pisters from NIVEL. Messier, with four first authorships and four corresponding authorships, is a respected and highly productive sports medicine specialist who has achieved great success in the field of OA and exercise research. He has participated in 104 published articles on OA, physical exercise, and obesity, which is a tremendous contribution to the field of OA. His article "Exercise and dietary weight loss in overweight and obese older adults with knee osteoarthritis - The arthritis, diet, and activity promotion trial" (2004)¹⁴ was published in *Arthritis & Rheumatism* and has been cited 677 times. It is an 18-month randomized, single-blind clinical trial. The results show that moderate weight loss combined with moderate exercise, compared with single intervention, can better improve the function, pain, and action ability of elderly overweight patients with KOA. The two authors, as first and/or corresponding author, published 10 highly cited articles with a total of 1,913 citations, which account for 17% of the total citations. This finding highlights the fact that few authors can make remarkable contributions to a specific research field³⁴.

The most cited articles in the top 100 list in 2021 were analyzed to identify some topics worthy of our current research attention and guide future research directions. Multiple exercises, which integrate warm-up exercise, aerobic exercise, lower limb resistance exercise, and cool-down exercise, is the most popular among KOA exercise therapy^{14,35-37}. More than a quarter of the top cited articles conducted intervention experiments with multiple exercises. This finding suggests that multiple exercises are the hotspot of exercise therapy for KOA.

Traditional Chinese exercises, such as Tai Chi³⁸⁻⁴³ and Baduanjin⁴⁴⁻⁴⁶, which are popular among Chinese folk, seem to be attracting increasing research attention. Tai Chi is a traditional Chinese mind-body exercise that enhances balance, strength, flexibility, and self-efficacy and reduces pain, depression, and anxiety⁴⁷. Baduanjin has a great emphasis on mind-body integration; slow body movements along with musculoskeletal stretching should be coordinated with deep breathing, physical relaxation, and mental concentration, leading to a deep state of medita-

tive therapy⁴⁸. Compared with Tai Chi, Baduanjin is easier to learn, because it only comprises eight movements. It can be independently practised at home or in the workplace and seems to have more room to research now. In addition, many other traditional Chinese skills, such as Wuqinxi, Liuzijue, and Yijinjing, are worth studying. Currently, the popularity of traditional Chinese exercise is low in countries other than China, and it can be a potential research direction to extend it to the world and observe its therapeutic effects on different races. This intervention requires systematic guidance from professional teachers.

In clinical practice, physicians often exclude exercise therapy from treatment prescriptions because of comorbidity⁴⁹. Therapists may be concerned about exacerbating comorbidity symptoms because of exercise. Even if exercise is scheduled, it will be at such a reduced intensity that it will not be effective in achieving the therapeutic benefits of exercise⁵⁰. Unfortunately, most patients with KOA have multiple comorbidities, such as cardiovascular diseases, type 2 diabetes mellitus, chronic obstructive pulmonary disease (COPD), obesity, and depression^{51,52}. Comorbidities may limit exercise tolerance to some extent; for example, comorbid heart failure or COPD may limit exercise capacity and even lead to exercise-induced adverse effects⁵³. Thus, exploring how to use exercise to treat KOA with different comorbidities safely and efficiently is a promising strategy considering the complexity of comorbidities.

These results⁵⁴⁻⁵⁶ show that exercise adherence is very important for the treatment of KOA by exercise therapy. Exercise intervention needs more patience owing to the long course of KOA. As exercise adherence will decline over time, the treatment effect of exercise therapy will deteriorate⁵⁵. Nicolson⁵⁷ proposed that graded exercise should be carried out for patients with KOA to improve exercise adherence. Messier⁵⁸ introduced how to improve the adherence of subjects, which is the key to the success of the experiment and treatment. Future research should focus on how to stimulate patients with KOA to maintain an exercise behavior for a long time⁵⁵.

The treatment of KOA is complex, and the therapeutic effect of exercise alone may not be ideal. Therefore, multidisciplinary cooperation is needed to improve its treatment effect. Some authors proposed the use of other treatments, such as ultrasound⁵⁹, acupuncture^{60,61}, low-level laser^{62,63}, and intra-articular drug injections⁶⁴⁻⁶⁷, in combination with exercise for KOA. In clinical practice, many therapeutic methods, such as Chi-

nese herbal treatment⁶⁸, can be combined with exercise therapy to explore their therapeutic effect.

Limitations

This citation analysis has some limitations. First of all, data retrieval was limited to WOS. Some common databases, such as Google and Scopus, are not included in WOS; therefore, this study may lack citations. The reliance on filtering for articles and reviews in WOS can be justified by findings from a recent study⁶⁹ that showed that WOS is more accurate than alternatives such as Scopus. Second, as time goes on, especially with the rapid development of science and technology, some citation classics may not be as important or may even be eliminated. Therefore, we should take an objective attitude towards these articles. The articles in the top 100 list were published before 2019. Therefore, they cannot reflect the latest research results. Third, we searched the database according to title. Hence, some articles without the target keyword in the title might have been omitted. Finally, only the first author and corresponding author were considered in the analyses of authors and countries. The main reason for this selection was to make the results more intuitive, because they usually contribute the most to the article, but some bias may occur.

Conclusions

Citation analysis remains one of the best tools to quantify the impact of an article. This bibliometric study is the first to identify the most cited papers on exercise treatment for KOA research. Traditional Chinese exercise, comorbidity, and adherence may be the next popular research trends that will receive more attention in the future.

Conflict of Interest

The Authors declare that they have no conflict of interests.

Acknowledgements

We would like to thank Zhongtian Yu for her critical comments on the manuscript.

Funding

This research was funded by the 2020-2022 Special Science and Technology Development Project of Beijing Rehabilitation Hospital, Capital Medical University [grant numbers #2020-066].

Authors' Contribution

Conceptualization, Zihan Yu, Zhengyu Hu.; writing original draft preparation, Zihan Yu; data analysis, Weiguang Gao, Zhijiao Fan and Haozhi Zhao; writing review and editing, Xinan Zhang and Yubao Ma; in charge of the fund programme, Yubao Ma. All authors have read and agreed to the published version of the manuscript.

ORCID ID

Zihan Yu: 0000-0002-9985-7244; Zhengyu Hu: 0000-0003-1481-1886; Zhijiao Fan: 0000-0002-5006-4796; Weiguang Gao: 0000-0001-9321-4291; Yubao Ma: 0000-0002-9164-6100.

Availability of Data and Materials

The data supporting this study's findings are available from the corresponding author, Y.B.M., upon reasonable request.

Ethics Approval

Not applicable.

References

- 1) Sharma L. Osteoarthritis of the knee. *N Engl J Med* 2021; 384: 51-59.
- 2) Global Burden of Disease Study 2013 Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet* 2015; 386: 743-800.
- 3) Losina E, Paltiel AD, Weinstein AM, Yelin E, Hunter DJ, Chen SP, Klara K, Suter LG, Solomon DH, Burbine SA, Walensky RP, Katz JN. Lifetime medical costs of knee osteoarthritis management in the United States: impact of extending indications for total knee arthroplasty. *Arthritis Care Res (Hoboken)* 2015; 67: 203-215.
- 4) Hawker GA. Osteoarthritis is a serious disease. *Clin Exp Rheumatol* 2019; 37: 3-6.
- 5) Mapel DW, Shainline M, Paez K, Gunter M. Hospital, pharmacy, and outpatient costs for osteoarthritis and chronic back pain. *J Rheumatol* 2004; 31: 573-583.
- 6) Panyarachun P, Angthong C, Jindasakchai P, Rajbhandari P, Rungrattanawilai N. Abnormal foot pressure in older adults with knee osteoarthritis: a systematic review. *Eur Rev Med Pharmacol Sci* 2022; 26: 6236-6241.
- 7) Anzillotti G, Conte P, Di Matteo B, Bertolino EM, Marcacci M, Kon E. Injection of biologic agents for treating severe knee osteoarthritis: is there a chance for a good outcome? A systematic review of clinical evidence. *Eur Rev Med Pharmacol Sci* 2022; 26: 5447-5459.
- 8) Cao TN, Huynh KN, Tran HT, Nguyen MD. Association between asymptomatic hyperuricemia and knee osteoarthritis in older outpatients. *Eur Rev Med Pharmacol Sci* 2022; 26: 6600-6607.
- 9) Richmond J, Hunter D, Irrgang J, Jones MH, Snyder-Mackler L, Van Durme D, Rubin C, Matzkin EG, Marx RG, Levy BA, Watters WC, 3rd, Goldberg MJ, Keith M, Haralson RH, 3rd, Turkelson CM, Wies JL, Anderson S, Boyer K, Sluka P, St Andre J, McGowan R. American Academy of Orthopaedic Surgeons clinical practice guideline on the treatment of osteoarthritis (OA) of the knee. *J Bone Joint Surg Am* 2010; 92: 990-993.
- 10) Richmond J, Hunter D, Irrgang J, Jones MH, Levy B, Marx R, Snyder-Mackler L, Watters WC, 3rd, Haralson RH, 3rd, Turkelson CM, Wies JL, Boyer KM, Anderson S, St Andre J, Sluka P, McGowan R. Treatment of osteoarthritis of the knee (nonarthroplasty). *J Am Acad Orthop Surg* 2009; 17: 591-600.
- 11) Hochberg MC, Altman RD, April KT, Benkhalti M, Guyatt G, McGowan J, Towheed T, Welch V, Wells G, Tugwell P. American College of Rheumatology 2012 recommendations for the use of nonpharmacologic and pharmacologic therapies in osteoarthritis of the hand, hip, and knee. *Arthritis Care Res (Hoboken)* 2012; 64: 465-474.
- 12) Bannuru RR, Osani M, Vaysbrot E, Arden N, Bennell K, Bierma-Zeinstra S, Kraus V, Lohmander LS, Abbott J, Bhandari M. OARSJ guidelines for the non-surgical management of knee, hip, and polyarticular osteoarthritis. *Osteoarthritis Cartilage* 2019; 27: 1578-1589.
- 13) Thomas KS, Muir KR, Doherty M, Jones AC, O'Reilly SC, Bassey EJ. Home based exercise programme for knee pain and knee osteoarthritis: randomised controlled trial. *Bmj* 2002; 325: 752.
- 14) Messier SP, Loeser RF, Miller GD, Morgan TM, Rejeski WJ, Sevick MA, Ettinger WH, Jr., Pahor M, Williamson JD. Exercise and dietary weight loss in overweight and obese older adults with knee osteoarthritis: the Arthritis, Diet, and Activity Promotion Trial. *Arthritis Rheum* 2004; 50: 1501-1510.
- 15) Deyle GD, Allison SC, Matekel RL, Ryder MG, Stang JM, Gohdes DD, Hutton JP, Henderson NE, Garber MB. Physical therapy treatment effectiveness for osteoarthritis of the knee: a randomized comparison of supervised clinical exercise and manual therapy procedures versus a home exercise program. *Phys Ther* 2005; 85: 1301-1317.
- 16) Björk BC. Open access to scientific articles: a review of benefits and challenges. *Intern Emerg Med* 2017; 12: 247-253.
- 17) Björk BC. A study of innovative features in scholarly open access journals. *J Med Internet Res* 2011; 13: e115.
- 18) Agarwal A, Durairajanayagam D, Tatagari S, Esteves SC, Harlev A, Henkel R, Roychoudhury S, Homa S, Puchalt NG, Ramasamy R, Majzoub A, Ly KD, Tvrdá E, Assidi M, Kesari K, Sharma R, Banihani S, Ko E, Abu-Elmagd M, Gosálvez J, Bashiri A. Bibliometrics: tracking research impact by selecting the appropriate metrics. *Asian J Androl* 2016; 18: 296-309.
- 19) Feijoo JF, Limeres J, Fernández-Varela M, Ramos I, Diz P. The 100 most cited articles in dentistry. *Clin Oral Investig* 2014; 18: 699-706.

- 20) Yoon SJ, Yoon DY, Ja Lim K, Moon JY, Hong SJ, Baek S, Yun EJ. The 100 top-cited articles focused on magnetic resonance: a bibliometric analysis. *Acta Radiol* 2019; 60: 710-715.
- 21) Zhang Y, Quan L, Du L. The 100 top-cited studies in cancer immunotherapy. *Artif Cells Nanomed Biotechnol* 2019; 47: 2282-2292.
- 22) Shi S, Gao Y, Liu M, Bu Y, Wu J, Tian J, Zhang J. Top 100 most-cited articles on exosomes in the field of cancer: a bibliometric analysis and evidence mapping. *Clin Exp Med* 2021; 21: 181-194.
- 23) Du L, Luo S, Liu G, Wang H, Zheng L, Zhang Y. The 100 Top-Cited Studies About Pain and Depression. *Front Psychol* 2019; 10: 3072.
- 24) He L, Fang H, Wang X, Wang Y, Ge H, Li C, Chen C, Wan Y, He H. The 100 most-cited articles in urological surgery: A bibliometric analysis. *Int J Surg* 2020; 75: 74-79.
- 25) Rocha AO, Santos PS, Machado BA, Bolan M, Cardoso M, Martins-Junior PA, Santana CM. The Top 100 Most-Cited Papers in Erosive Tooth Wear: A Bibliometric Analysis. *Caries Res* 2022; 56: 29-35.
- 26) Bornmann L, Daniel HD. What do citation counts measure? A review of studies on citing behavior. *J DOC* 2008; 64: 45-80.
- 27) Cross M, Smith E, Hoy D, Nolte S, Ackerman I, Fransen M, Bridgett L, Williams S, Guillemin F, Hill CL, Laslett LL, Jones G, Cicuttini F, Osborne R, Vos T, Buchbinder R, Woolf A, March L. The global burden of hip and knee osteoarthritis: estimates from the global burden of disease 2010 study. *Ann Rheum Dis* 2014; 73: 1323-1330.
- 28) Ahmad SS, Evangelopoulos DS, Abbasian M, Röder C, Kohl S. The hundred most-cited publications in orthopaedic knee research. *J Bone Joint Surg Am* 2014; 96: e190.
- 29) Tang N, Zhang W, George DM, Wei C, Su Y, Huang T. The Top 100 Most-Cited Articles on Arthroscopy: Most Popular Topic Is Rotator Cuff Rather Than Cartilage in the Last 5 Years. *Arthroscopy* 2021; 37: 1779-1797.e1771.
- 30) Peng M-S, Chen C-C, Wang J, Zheng Y-L, Guo J-B, Song G, Wang X-Q. The top 100 most-cited papers in long non-coding RNAs: a bibliometric study. *Cancer Biol Ther* 2021; 22: 40-54.
- 31) Chan SHW, Yu CK, Li AWO. Impact of mindfulness-based cognitive therapy on counseling self-efficacy: A randomized controlled crossover trial. *Patient Educ Couns* 2021; 104: 360-368.
- 32) Kapural L, Deering JP. A technological overview of cooled radiofrequency ablation and its effectiveness in the management of chronic knee pain. *Pain Manag* 2020; 10: 133-140.
- 33) Schargus M, Kromer R, Druchkiv V, Frings A. The top 100 papers in dry eye – A bibliometric analysis. *Ocul Surf* 2018; 16: 180-190.
- 34) Taylor S, Landry CA, Paluszek MM, Asmundson GJG. Reactions to COVID-19: Differential predictors of distress, avoidance, and disregard for social distancing. *J Affect Disord* 2020; 277: 94-98.
- 35) Minns Lowe CJ, Barker KL, Dewey M, Sackley CM. Effectiveness of physiotherapy exercise after knee arthroplasty for osteoarthritis: systematic review and meta-analysis of randomised controlled trials. *Bmj* 2007; 335: 812.
- 36) Pisters MF, Veenhof C, van Meeteren NL, Ostelo RW, de Bakker DH, Schellevis FG, Dekker J. Long-term effectiveness of exercise therapy in patients with osteoarthritis of the hip or knee: a systematic review. *Arthritis Rheum* 2007; 57: 1245-1253.
- 37) van Baar ME, Dekker J, Oostendorp RA, Bijl D, Voorn TB, Bijlsma JW. Effectiveness of exercise in patients with osteoarthritis of hip or knee: nine months' follow up. *Ann Rheum Dis* 2001; 60: 1123-1130.
- 38) Zampogna B, Papalia R, Papalia GF, Campi S, Vasta S, Vorini F, Fossati C, Torre G, Denaro V. The role of physical activity as conservative treatment for hip and knee osteoarthritis in older people: a systematic review and meta-analysis. *J Clin Med* 2020; 9: 1167.
- 39) Ye J, Cai S, Zhong W, Cai S, Zheng Q. Effects of tai chi for patients with knee osteoarthritis: a systematic review. *J Phys Ther Sci* 2014; 26: 1133-1137.
- 40) Wang C, Schmid CH, Iversen MD, Harvey WF, Fielding RA, Driban JB, Price LL, Wong JB, Reid KF, Rones R, McAlindon T. Comparative Effectiveness of Tai Chi Versus Physical Therapy for Knee Osteoarthritis: A Randomized Trial. *Ann Intern Med* 2016; 165: 77-86.
- 41) Wang C, Schmid CH, Hibberd PL, Kalish R, Roubenoff R, Rones R, McAlindon T. Tai Chi is effective in treating knee osteoarthritis: a randomized controlled trial. *Arthritis Rheum* 2009; 61: 1545-1553.
- 42) Lee HJ, Park HJ, Chae Y, Kim SY, Kim SN, Kim ST, Kim JH, Yin CS, Lee H. Tai Chi Qigong for the quality of life of patients with knee osteoarthritis: a pilot, randomized, waiting list controlled trial. *Clin Rehabil* 2009; 23: 504-511.
- 43) Brismée J-M, Paige RL, Chyu M-C, Boatright JD, Hagar JM, McCaleb JA, Quintela MM, Feng D, Xu KT, Shen C-L. Group and home-based tai chi in elderly subjects with knee osteoarthritis: a randomized controlled trial. *Clin Rehabil* 2007; 21: 99-111.
- 44) Zeng Z-p, Liu Y-b, Fang J, Liu Y, Luo J, Yang M. Effects of Baduanjin exercise for knee osteoarthritis: a systematic review and meta-analysis. *Complement Ther Med* 2020; 48: 102279.
- 45) Ye J, Zheng Q, Zou L, Yu Q, Veronese N, Grabovac I, Stefanac S, Tzeng H-M, Yu JJ. Mindful exercise (Baduanjin) as an adjuvant treatment for older adults (60 years old and over) of knee osteoarthritis: a randomized controlled trial. *Evid Based Complement Alternat Med* 2020; 2020:9869161.
- 46) Ye J, Simpson MW, Liu Y, Lin W, Zhong W, Cai S, Zou L. The effects of baduanjin qigong on postural stability, proprioception, and symptoms of patients with knee osteoarthritis: a randomized controlled trial. *Front Med (Lausanne)* 2020; 6: 307.
- 47) Wang C, Collet JP, Lau J. The effect of Tai Chi on health outcomes in patients with chronic conditions:

- a systematic review. *Arch Intern Med* 2004; 164: 493-501.
- 48) Zou L, Pan Z, Yeung A, Talwar S, Wang C, Liu Y, Shu Y, Chen X, Thomas GA. A review study on the beneficial effects of Baduanjin. *J Altern Complement Med* 2018; 24: 324-335.
 - 49) Boyd CM, Vollenweider D, Puhan MA. Informing evidence-based decision-making for patients with comorbidity: availability of necessary information in clinical trials for chronic diseases. *PLoS One* 2012; 8: e41601.
 - 50) Holden MA, Nicholls EE, Young J, Hay EM, Foster NE. Role of exercise for knee pain: what do older adults in the community think? *Arthritis Care Res (Hoboken)* 2012; 64: 1554-1564.
 - 51) Reeuwijk KG, de Rooij M, van Dijk GM, Veenhof C, Steultjens MP, Dekker J. Osteoarthritis of the hip or knee: which coexisting disorders are disabling? *Clin Rheumatol* 2010; 29: 739-747.
 - 52) Li M, Nie Y, Zeng Y, Wu Y, Liu Y, Wu L, Shen B. The trajectories of depression symptoms and comorbidity in knee osteoarthritis subjects. *Clin Rheumatol* 2022; 41: 235-243.
 - 53) de Rooij M, van der Leeden M, Cheung J, van der Esch M, Häkkinen A, Haverkamp D, Roorda LD, Twisk J, Vollebregt J, Lems WF. Efficacy of tailored exercise therapy on physical functioning in patients with knee osteoarthritis and comorbidity: a randomized controlled trial. *Arthritis Care Res (Hoboken)* 2017; 69: 807-816.
 - 54) Van Gool CH, Penninx BW, Kempen GI, Rejeski WJ, Miller GD, Van Eijk JTM, Pahor M, Messier SP. Effects of exercise adherence on physical function among overweight older adults with knee osteoarthritis. *Arthritis Rheum* 2005; 53: 24-32.
 - 55) Pisters MF, Veenhof C, Schellevis FG, Twisk JW, Dekker J, De Bakker DH. Exercise adherence improving long-term patient outcome in patients with osteoarthritis of the hip and/or knee. *Arthritis Care Res (Hoboken)* 2010; 62: 1087-1094.
 - 56) Campbell R, Evans M, Tucker M, Quilty B, Dieppe P, Donovan JL. Why don't patients do their exercises? Understanding non-compliance with physiotherapy in patients with osteoarthritis of the knee. *J Epidemiol Community Health* 2001; 55: 132-138.
 - 57) Nicolson PJ, Bennell KL, Dobson FL, Van Ginckel A, Holden MA, Hinman RS. Interventions to increase adherence to therapeutic exercise in older adults with low back pain and/or hip/knee osteoarthritis: a systematic review and meta-analysis. *Br J Sports Med* 2017; 51: 791-799.
 - 58) Messier SP, Mihalko SL, Legault C, Miller GD, Nicklas BJ, DeVita P, Beavers DP, Hunter DJ, Lyles MF, Eckstein F. Effects of intensive diet and exercise on knee joint loads, inflammation, and clinical outcomes among overweight and obese adults with knee osteoarthritis: the IDEA randomized clinical trial. *Jama* 2013; 310: 1263-1273.
 - 59) Huang M-H, Lin Y-S, Lee C-L, Yang R-C. Use of ultrasound to increase effectiveness of isokinetic exercise for knee osteoarthritis. *Arch Phys Med Rehabil* 2005; 86: 1545-1551.
 - 60) Williamson L, Wyatt M, Yein K, Melton J. Severe knee osteoarthritis: a randomized controlled trial of acupuncture, physiotherapy (supervised exercise) and standard management for patients awaiting knee replacement. *Rheumatology* 2007; 46: 1445-1449.
 - 61) Foster NE, Thomas E, Barlas P, Hill JC, Young J, Mason E, Hay EM. Acupuncture as an adjunct to exercise based physiotherapy for osteoarthritis of the knee: randomised controlled trial. *BMJ* 2007; 335: 436.
 - 62) Assis L, Milares LP, Almeida T, Tim C, Magri A, Fernandes KR, Medalha C, Renno AM. Aerobic exercise training and low-level laser therapy modulate inflammatory response and degenerative process in an experimental model of knee osteoarthritis in rats. *Osteoarthritis Cartilage* 2016; 24: 169-177.
 - 63) Alfredo PP, Bjordal JM, Dreyer SH, Meneses SRF, Zaguetti G, Ovanessian V, Fukuda TY, Junior WS, Martins RABL, Casarotto RA. Efficacy of low level laser therapy associated with exercises in knee osteoarthritis: a randomized double-blind study. *Clin Rehabil* 2012; 26: 523-533.
 - 64) Petersen SG, Beyer N, Hansen M, Holm L, Aagaard P, Mackey AL, Kjaer M. Nonsteroidal anti-inflammatory drug or glucosamine reduced pain and improved muscle strength with resistance training in a randomized controlled trial of knee osteoarthritis patients. *Arch Phys Med Rehabil* 2011; 92: 1185-1193.
 - 65) Messier S, Mihalko S, Loeser R, Legault C, Jolla J, Pfruender J, Prosser B, Adrian A, Williamson J. Glucosamine/chondroitin combined with exercise for the treatment of knee osteoarthritis: a preliminary study. *Osteoarthritis Cartilage* 2007; 15: 1256-1266.
 - 66) Henriksen M, Christensen R, Klokke L, Bartholdy C, Bandak E, Ellegaard K, Boesen MP, Riis RGC, Bartels EM, Bliddal H. Evaluation of the benefit of corticosteroid injection before exercise therapy in patients with osteoarthritis of the knee: a randomized clinical trial. *JAMA Intern Med* 2015; 175: 923-930.
 - 67) Doi T, Akai M, Fujino K, Iwaya T, Kurosawa H, Hayashi K, Marui E. Effect of home exercise of quadriceps on knee osteoarthritis compared with nonsteroidal antiinflammatory drugs: a randomized controlled trial. *Am J Phys Med Rehabil* 2008; 87: 258-269.
 - 68) Zhang W, Wang S, Zhang R, Zhang Y, Li X, Lin Y, Wei X. Evidence of Chinese herbal medicine Duhuo Jisheng decoction for knee osteoarthritis: a systematic review of randomised clinical trials. *BMJ Open* 2016; 6: e008973.
 - 69) Mishra AK, Jain MK, Dash SK. Ambient Air Quality and Indexing with Reference to Suspended Particulate Matter and Gaseous Pollutants Around a Cement Plant in OCL India Limited, Rajgangpur, Odisha, India. *Current Science* 2019; 116: 1905.