The effect of senile age on functional outcome and revision rate of unicompartmental knee arthroplasty: a systematic review and meta-analysis

handdong chen
BUCM: Beijing University of Chinese Medicine
ChangQuan Liu
China-Japan Friendship Hospital
JunCheng Ge
Peking University
Yue Zhang
BUCM: Beijing University of Chinese Medicine
QiDong Zhang
China-Japan Friendship Hospital
wanshou guo (wanshou_guo@163.com)
China-Japan Friendship Hospital

Research Article

Keywords: Unicompartmental knee arthroplasty, senile age, functional outcomes and revision, review and meta-analysis

Posted Date: July 5th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1772727/v1

Abstract

Background

Senile patients have received UKA less than younger patients, and senile age has been regarded as a relative contraindication to UKA. However, as surgical instruments and techniques have improved, the use of UKA in senile patients has also increased.The purpose of this study was to assess the effect of senile age on functional outcomes and cumulative revision rates in patients who underwent primary unicompartmental knee arthroplasty (UKA).

Methods

We performed a systematic search of PubMed, Embase, and the Cochrane Library to identify clinical studies involving the effect of stratified age on outcomes after UKA. The main measures were functional outcome scores including knee society scores (KSS) and Oxford knee scores (OKS) and revision rates. Data was collected by extraction form, and the relative literature was evaluated by using the methodological Index for Nonrandomized Studies (MINORS). Finally, pooled data was analyzed by the use of RevMan5.4 software.

Result

s A total of 8 studies were eligible and included in our study, and it provided a total of 57576 primary UKAs. Patients were divided into two cohort groups based on age classification: elderly age (60–75) and senile age (75–90). In the elderly and senile age groups, there were 37690 and 10942 primary UKAs, respectively. The data analysis showed a statistically significant difference in KSS (objective) and KSS (function) between the senile and elderly age groups ($P < 0.05$). On the other hand, the OKS decreased significantly in the senile age group ($P < 0.05$). In addition, the revision rate of UKA in the senile age group was similar or less than that in the elderly age group ($P > 0.05$).

Conclusion

Senile age is not a vital factor for revision in UKA, and functional outcomes in the senile population are acceptable compared to the younger age groups. Therefore, it is an effective and reliable procedure for relieving pain and improving function in senile patients, and we can infer that disease condition is more vital than age in confirming those who are going to do well postoperatively.

Background

Osteoarthritis of the knee is a cause of pain and loss of mobility in the elderly population with an increased life expectancy [1, 2]. In addition, the UKA plays an extremely important role in the treatment of isolated single compartment osteoarthritis [3, 4]. Compared with total knee arthroplasty (TKA), patients can achieve better functional outcomes, faster recovery, lower perioperative complications by only reconstructing the damaged compartment, most likely due to the preservation of bone stock and cruciate ligament, the reduced ti ssue and blood loss in the procedure [5–7].

However, the excellent efficacy depends on appropriate selection of patients, stable operation techniques, and rehabilitatio. Based on the improvement of surgical instruments and techniques, some of contraindications proposed by Kozinn and Scott in 1989 have gradually been diluted, and the use of UKA has increased rapidly. A growing number of studies have investigated the factors that influenced efficacy and safety in the short and long term, yielding a variety of perspectives on UKA [8, 9]. Furthermore, age was regarded as a factor in selecting candidates for UKA, with senile age being a relative contraindication. Interestingly, smaller numbers of octogenarians have undergone UKA than younger patients, and less studies have focused on its use in this population [10–12]. It is likely that surgeons believed that re-operating on senile patients was unnecessary and that TKA was the best option, or that the benefits of UKA were outweighed by its complication.

With the aging population, most senile patients have a variety of morbidities and weak physical systems, making them a unique challenge in orthopedic surgery [13]. The safety and efficacy of surgical procedures in the elderly have remained a focus. Therefore, the purpose of this meta-analysis was to explore the influence of senile age on patient functional outcome and revision rate after primary UKA. Our hypothesis was that there was no difference in functional outcomes and the revision rate after UKA in the senile compared with the elderly.

Methods

This systematic review and meta-analysis was performed by two independent reviewers (HD.C.and CQ.L.) according to the Prefered Reported Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.

Search strategy and selection criteria

We searched relevant studies published by PubMed, Embase, and the Cochrane Library in January 10, 2022. The following search terms were used, including “Unicompartmental Knee Arthroplasty OR Unicondylar Knee Arthroplasty OR Partial Knee Arthroplasty OR Unicondylar Knee Replacement OR Partial Knee Replacement OR Unicompartmental Knee Replacement AND “age OR older OR the elderly.” There was no time interval established for the publication date.The searchable articles were initially screened based on title and abstract. After non-eligible studies were excluded, the full text of the remaining articles was evaluated for eligibility. Any disagreement between the reviewers was resolved by third investigator (QD.Z.).A flow chart of literatures search and selection is shown infig.1.

Eligibility criteria

Inclusion criteria were: (1) patients undergoing primary UKA, (2) age classification defined by WHO: middle age (44-60), elderly age (60-75), senile age (75-90); (3) initial outcomes included clinical and functional outcomes scores, revision rate, and implant survival rates; (4) study designs: prospective or retrospective cohort, randomized controlled trial.The exclusion were: outcomes were not reported according to age classification.

Data collection

Two reviewers (HD.C.and CQ.L.)independently extracted information from each eligible study, including first author, nation, publication year and journal, study design, number of UKA, length of follow-up, type of prosthesis, post-operative clinical and functional outcomes score (KSS, OKS), revision rate, and implant survival.

Methodological quality assessment

The quality of sutdy was evaluated using the MINORS.The checklist includes 12 items.Each item was scored from 0 to 2 points. The total score was 24 points for comparative studies. And a study with score of less than 12 points should not be included. The assessment was conducted by two reviewers (HD.C.and CQ.L.) and disagreement was resolved by discussion to reach consensus.

Statistical analysis

All analysis were performed with Rewiew Manager(Version 5.4). Dichotomous variables were presented as Risk ratio (RR) or odds ratio (OR), and continuous variables were shown as the mean differrence (MD), with 95% confidence intervals (95% CI). Heterogeneity between trials was evaluated using the I-square(I^2) test. The fixed effect model was preferred with low heterogeneity(I^2<50%). Otherwise, a random effect model was adopted. Sensitive analysis was conducted by excluding one study in each round and then evaluating the influence of any single study on the primary meta-analysis.

Results

Search results

Of the 1355 studies identified, 8 met the inclusion criteria and were included in our analysis. All eligible studies published between 2010 and 2021 were a prospective or retrospective design with a level of evidence . The mean MINORS scores was 18.13 (range,16 to 21), indicating that the studies were of good quality.

Patient characteristics

Table 1 showed the demographic characteristics of the patient. Eight studies provided a total of 57576 primary UKAs. According to the age classification from World Health Organization (WHO) in 2015, patients were divided into two groups: elderly age (60–75) and senile age (75–90). And there were 37690 and 10942 primary UKAs in the elderly age group and senile age group, respectively. All studies reported patient sex (25115 men and 31234 women) and a 5.05-years mean postoperative follow-up (range, 1.8–8.3). The Oxford phase 3 prosthesis was applied in five studies, whereas the ZUK was used in two.

Table 1
Characteristics of included studies

Author	Year	Journal	country	Study design	Level of evidence	Group	Patents	Number of UKA	M/F	Mean Follow-UP	Type of prosthesis
Cheng [14]	2020	BMC	China	RS		60 < 69 70–79 ≥80	195	60 79 70	90/119	21.8±11.2months	Oxford3
Goh [11]	2021	J Arthroplasty	Amerrica	PS		< 80 > 80	176	132 44	91/85	3.5years(2-5.2)	ZUK
Ingale [15]	2013	J Arthroplasty	UK	RS		< 60 60–69 70–79 ≥80	470	110 164 145 51	249/221	4.0±3.2years	Oxford3
Jeschke [16]	2016	JBJS	Germany	RS		< 55 55–64 65–74 ≥75	19719	4102 6662 6741 3441	7067/12652	5years	Not available
Liow [17]	2020	AOTS	Singapore	PS		< 75 ≥75	282	188 94	84/198	8.3 ± 3.0years	ZUK
Mohammad [10]	2021	KSSTA	UK	PS		< 55 55–64 65–74 ≥75	870	151 300 353 196	533/467	6.5±2.7years	Oxford3
Tadros [18]	2017	KSSTA	UK	PS		60–69 70–79 ≥80	395	188 149 58	215/180	4.3years(1.5–8.1)	Oxford3
W-Dahl [19]	2010	Acta Orthop	Sweden	RS		< 55 55–64 65–74 ≥75	34098	4577 11496 11033 6992	16786/17312	7years	Oxford3 Link-Uni Repicci

Functional outcomes

Data from 3 of the 8 studies were pooled in the meta-analysis to assess functional outcomes using the KSS and OKS after UKA. Our findings revealed that the KSS(objective) was significantly lower in the senile age group than in the elderly age group, with no between-study heterogeneity (MD -2.60, 95% CI -4.08 to -1.11, $P < 0.05$). Details are shown in Fig. 2a. There was no publication bias indicated by the funnel plot in this analysis. And as shown in Fig. 2b, KSS (function) also was significantly decreased in the senile group (MD -15.71, 95% CI -19.93 to -11.49, $P < 0.05$). Furthermore, the OKS was used in three other studies to assessed the functional outcomes and pain. Pooled data showed that OKS in the senile group was significantly lower than that of the elderly group, with higher between-study heterogeneity. Further sensitivity analysis performed between two groups (2 studies) showed there was not a statistically significant difference, with no between-study heterogeneity ((MD -1.70, 95% CI -2.59 to -0.81, $P < 0.05$). The Fig. 2c shows the details.

revision and implant survival rates

As depicted in Fig. 3, the pooled data on revision rate showed a mean reduction in the senile age group than in the elderly age group, with higher between-study heterogeneity. The funnel plot showed that there was publication bias in this analysis. Furthermore, a sensitivity analysis comparing the revision rate between two groups (5 studies) showed no statistically significant differences, with no significant between-study heterogeneity (OR 0.96, 95% CI, 0.52 to 1.79, $P > 05$). Our findings discovered that aseptic loosening, progression of arthritis, and bearing dislocation were the most common factors for revision. Details are shown in Table 2.Three studies reported an mean implant survival rate of 95.9% at 5 years in the senile age group, while one study reported an implant survival rate of 92.8% at 8 years of follow-up.

Table 2
reason for revision of included in 5 studies

Reason for revision	Elderly age patients (n = 1482)	Senile age patients (n = 507)
Bearing dislocation	7 (0.005)	3 (0.006)
Aseptic implant loosening	12 (0.008)	4 (0.008)
Progression of arthritis	17 (0.010)	3 (0.006)
iinfection	4 (0.003)	1 (0.002)
No cause pain	8 (0.005)	3 (0.006)
Periprosthetic fracture	3 (0.002)	1 (0.002)

Discussion

According to the findings presented here, the postoperative functional outcomes were significantly lower for the senile age group compared with the elderly age group. Furthermore, the revision rate of UKA in the senile was similar or less than those of the elderly patients. Thus, the findings of this study supported that the UKA was an excellent choice for the senile patients who meet the criteria of isolated single compartment osteoarthritis, as it possesses both high levels of safety and efficacy.

The literatures demonstrated that UKA had a growing number of advantages compared to TKA in the treatment of unicompartmental osteoarthritis, including faster recovery, shorter hospital stay, better satisfaction and fewer perioperative complications [20, 21].With the increasing elderly population and longer life expectancy, the majority of eldrely patients, particularly those who were senile, suffered from chronic medical diseases and had a weaked physique, such as heart disease and respiratory disease, among others [22].As a result, it was particularly vital to alleviate pain and dysfunction in patients with osteoarthritis through a minimally invasive procedure.

The KSS and OKS were reliable indexes for assessing knee function recovery after arthroplasty, and a sdudy concluded that age was a significant predictor of the function at follow-up [23]. As shown in Figs. 2, the KSS functional outcome in advanced patients (> 75years) was lower than in younger patients after UKA. On the other hand, the OKS, which indicated that scores were adversely correlated with functional outcomes, was lower in the senile patients compared the elderly. It was contradictory with our previous outcomes. There was a possibility that the OKS included a total of 12 items, 5 of which focused on knee pain. And the senile patients had a greater capacity for enduring pain. Alternately, they were sensitive to easing the pain after procedure because they had been through a lot of it [24].Overall, the decline in functional results were associated with older age, the existence of possible comorbidities and the decrease in behavior and physiology.

Revision, which is defined as the removal or exchange of at least one implant component in the knee for any reason, was often regarded as a endpoint of UKA survival [25]. Apart from functional outcomes, our analysis indicate that the revision rate of UKA in senile patients was comparable or less than those of younger patients. Age should not be considered a direct determinant in the revision or the decision to do TKA or UKA, but there was a potential effect on morbidity and mortality in the older group.

A growing body of research indicated that the most common reasons for UKA revision were bearing dislocation, aseptic loosening, and contralateral arthritis progression, all of which were related to implant design, surgeon experience, and hospital volume [26, 27]. And, some studies also found that the risk of perioperative death in TKA increased with age and history of cardiovascular disease [28, 29]. In our study, senile patients who underwent UKA showed excellent clinical results and lower revision rate during follow-up. In the meantime, it was obvious that the life expectancy of the senile patients was relatively short, and the implants were less likely to be exceeded.

The following were the limitations of this analysis. Firstly, several studies tended to utilize > 80 years as the cut-off for senile age. This could lead to the omission of data on those patients. In addition, despite the fact that included studies were published in influential journals, there were differences in demographics and operation techniques between countries and regions.Thirdly, there was no mention of medial or lateral UKA in the study and report on implant types like mobile and fixed bearing. Fixed bearings had more polyethyene wear compared with mobile bearings, according to the literature. Furthermore, despite the fact that functional outcomes, revision rate and survival rate all were reported, the length of follow-up varied between studies. In our annlysis,one study had repoted the shortest follow-up of 1.8 years, while another was followed for 8.3 years. Finally, there were potential confounders, including BMI, activity leveal,sex and comorbidities.

Conclusions

Our findings were that senile age is not a crucial factor for revision in UKA, and has less effect on functional outcomes. Therefore, it is an effective and reliable precedure to relieve pain and improve functional outcomes in the elderly. At the same time, it is a reasonable option for the elderly (> 80 years) that has less relative morbidity and mortality, so long as they meet the criteria of UKA. Thus, we can infer that disease condition is more vital than age in confirming those who are going to do well postoperatively.

Abbreviations

CI: Confidence intervals; KSS: Knee society score; MD: Mean differrence; MINORS: Methodological Index for Nonrandomized Studies ; OKS: Oxford knee score; OR : Odds ratio ; PRISMA : Prefered Reported Items for Systematic Reviews and Meta-Analyses; RR : Risk ratio ; TKA: Total knee arthroplasty; UKA: Unicompartmental knee arthroplasty

Declarations

Acknowledgments

The authors have no acknowledgements to make

Authors’ contributions

All authors have contributed to the review and meta-analysis. HD.C and WS.G had the idea for the study. HD.C, CQ.L, and JC. G selected studies for inclusion and abstracted data. HD.C and YZ did the statistical analysis. YZ interpreted the data. HD.C, WS.G and QD.Z wrote and revised the manuscript. All authors approved the final draft.

Funding

This study was supported by National Science Foundation of China(grant numbers 82072494, 81972130)

The funder was involved in the revision of the article.

Availability of data and materials

All data generated or analysed generated during this study are included in this published article.

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Competing interests

The authors declare that there are no conflict of interest

References

1. Kumar H, Pal CP, Sharma YK, Kumar S, Uppal A. Epidemiology of knee osteoarthritis using Kellgren and Lawrence scale in Indian population. J Clin Orthop Trauma. 2020;11(Suppl 1):125–9.
2. Wallace IJ, Worthington S, Felson DT, et al. Knee osteoarthritis has doubled in prevalence since the mid-20th century. Proc Natl Acad Sci U S A. 2017;114(35):9332–6.
3. Hansen EN, Ong KL, Lau E, Kurtz SM, Lonner JH. Unicondylar Knee Arthroplasty in the U.S. Patient Population: Prevalence and Epidemiology. Am J Orthop (Belle Mead NJ). 2018;47(12):10.
4. Streit MR, Streit J, Walker T, et al. Minimally invasive Oxford medial unicompartmental knee arthroplasty in young patients. Knee Surg Sports Traumatol Arthrosc. 2017;25(3):660–8.
5. van der List JP, Chawla H, Zuiderbaan HA, Pearle AD. The Role of Preoperative Patient Characteristics on Outcomes of Unicompartmental Knee Arthroplasty: A Meta-Analysis Critique. J Arthroplasty. 2016;31(11):2617–27.
6. Kavanagh MD, Abola MV, Tanenbaum JE, Knapik DM, Fitzgerald SJ, Wera GD. Unicompartmental Knee Arthroplasty in Octogenarians versus Younger Patients: A Comparison of 30-Day Outcomes. J Knee Surg. 2022;35(4):401–8.
7. Kleeblad LJ, van der List JP, Zuiderbaan HA, Pearle AD. Larger range of motion and increased return to activity, but higher revision rates following unicompartmental versus total knee arthroplasty in patients under 65: a systematic review. Knee Surg Sports Traumatol Arthrosc. 2018;26(6):1811–22.
8. Liddle ADCORR, Insights®. No Differences in Outcomes Scores or Survivorship of Unicompartmental Knee Arthroplasty Between Patients Younger or Older than 55 Years of Age at Minimum 10-year Followup. Clin Orthop Relat Res. 2019;477(6):1447–9.

9. Battenberg AK, Netravali NA, Lonner JH. A novel handheld robotic-assisted system for unicompartmental knee arthroplasty: surgical technique and early survivorship. J Robot Surg. 2020;14(1):55–60.
10. Mohammad HR, Mellon S, Judge A, Dodd C, Murray D. The effect of age on the outcomes of cementless mobile bearing unicompartmental knee replacements. Knee Surg Sports Traumatol Arthrosc. 2022;30(3):928–38.
11. Goh GS, Corvi JJ, Grace TR, Eralp I, Small I, Lonner JH. Octogenarians Undergoing Medial Unicompartmental Knee Arthroplasty Have Similar Patient-Reported Outcomes as Their YoungerCounterparts. J Arthroplasty. 2021;36(11):3656–61.
12. Kennedy JA, Matharu GS, Hamilton TW, Mellon SJ, Murray DW. Age and Outcomes of Medial Meniscal-Bearing Unicompartmental Knee Arthroplasty. J Arthroplasty. 2018;33(10):3153–9.
13. Ghomrawi HM, Eggman AA, Pearle AD. Effect of age on cost-effectiveness of unicompartmental knee arthroplasty compared with total knee arthroplasty in the U.S. J Bone Joint Surg Am. 2015;97(5):396–402.
14. Cheng J, Feng M, Cao G, Li Z, An S, Lu S. Patient outcomes in Anteromedial osteoarthritis patients over 80 years old undergoing Oxford Unicompartmental knee Arthroplasty in China. BMC Musculoskelet Disord. 2020;21(1):446. Published 2020 Jul 8.
15. Ingale PA, Hadden WA. A review of mobile bearing unicompartmental knee in patients aged 80 years or older and comparison with younger groups. J Arthroplasty. 2013;28(2):262–7.e2.
16. Jeschke E, Gehrke T, Günster C, et al. Five-Year Survival of 20,946 Unicondylar Knee Replacements and Patient Risk Factors for Failure: An Analysis of German Insurance Data. J Bone Joint Surg Am. 2016;98(20):1691–8.
17. Liow MHL, Goh GS, Pang HN, et al. Should patients aged 75 years or older undergo medial unicompartmental knee arthroplasty? A propensity score-matched study. Arch Orthop Trauma Surg. 2020;140(7):949–56.
18. Tadros BJ, Dabis J, Twyman R. Short-term outcome of unicompartmental knee arthroplasty in the octogenarian population. Knee Surg Sports Traumatol Arthrosc. 2018;26(5):1571–6.
19. W-Dahl A, Robertsson O, Lidgren L, Miller L, Davidson D, Graves S. Unicompartmental knee arthroplasty in patients aged less than 65. Acta Orthop. 2010;81(1):90–4.
20. Gruskay J, Richardson S, Schairer W, et al. Incidence and safety profile of outpatient unicompartmental knee arthroplasty. Knee. 2019;26(3):708–13.
21. Hansen EN, Ong KL, Lau E, Kurtz SM, Lonner JH. Unicondylar Knee Arthroplasty Has Fewer Complications but Higher Revision Rates Than Total Knee Arthroplasty in a Study of Large United States Databases. J Arthroplasty. 2019;34(8):1617–25.
22. Arias-de la Torre J, Smith K, Dregan A, et al. Impact of comorbidity on the short- and medium-term risk of revision in total hip and knee arthroplasty. BMC Musculoskelet Disord. 2020;21(1):447. Published 2020 Jul 9.
23. Scuderi GR, Sikorskii A, Bourne RB, Lonner JH, Benjamin JB, Noble PC. The Knee Society Short Form Reduces Respondent Burden in the Assessment of Patient-reported Outcomes. Clin Orthop Relat Res. 2016;474(1):134–42.
24. Vasso M, Corona K, Gomberg B, Marullo M. European Knee Associates Small Implants focus group. Obesity increases the risk of conversion to total knee arthroplasty after unicompartimental knee arthroplasty: a meta-analysis [published online ahead of print, 2021 Oct 31]. Knee Surg Sports Traumatol Arthrosc. 2021;10.1007/s00167-021-06780-9.
25. Lacko M, Schreierová D. Comparison of survival rate and risk of revision for mobile-bearing and fixed-bearing total knee replacements. Eklem Hastalik Cerrahisi. 2019;30(2):70–8.
26. Kazarian GS, Barrack TN, Okafor L, Barrack RL, Nunley RM, Lawrie CM. High Prevalence of Radiographic Outliers and Revisions with Unicompartmental Knee Arthroplasty. J Bone Joint Surg Am. 2020;102(13):1151–9.
27. Kim KT, Lee S, Kim JH, Hong SW, Jung WS, Shin WS. The Survivorship and Clinical Results of Minimally Invasive Unicompartmental Knee Arthroplasty at 10-Year Follow-up. Clin Orthop Surg. 2015;7(2):199–206.
28. Smilowitz NR, Gupta N, Ramakrishna H, Guo Y, Berger JS, Bangalore S. Perioperative Major Adverse Cardiovascular and Cerebrovascular Events Associated With Noncardiac Surgery. JAMA Cardiol. 2017;2(2):181–7.
29. Hansen PW, Gislason GH, Jørgensen ME, et al. Influence of age on perioperative major adverse cardiovascular events and mortality risks in elective non-cardiac surgery. Eur J Intern Med. 2016;35:55–9.

Figures

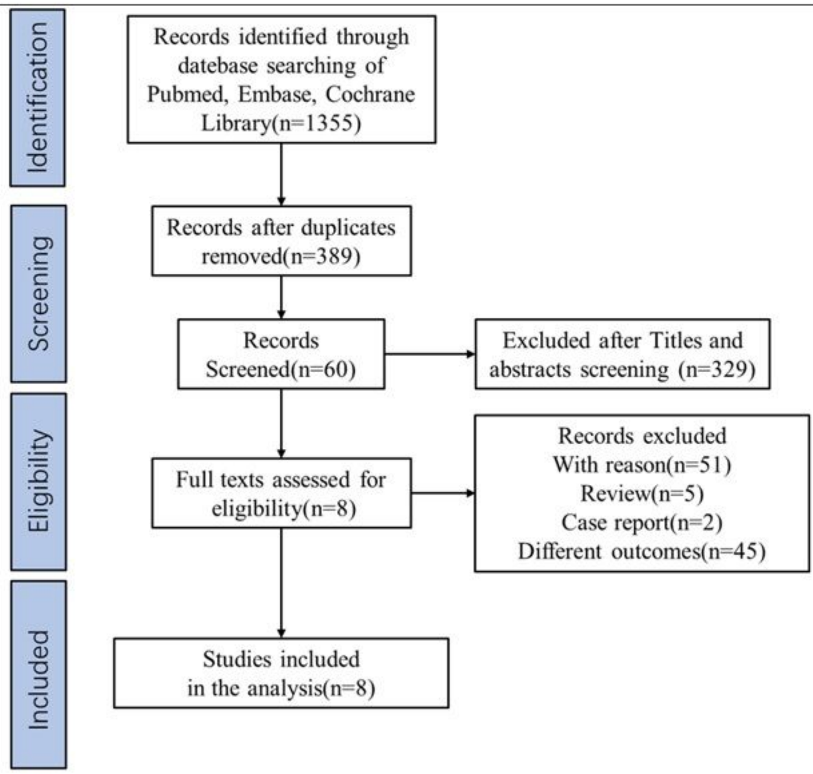

Fig.1 Flowchart of the study

Figure 1

See image above for figure legend.

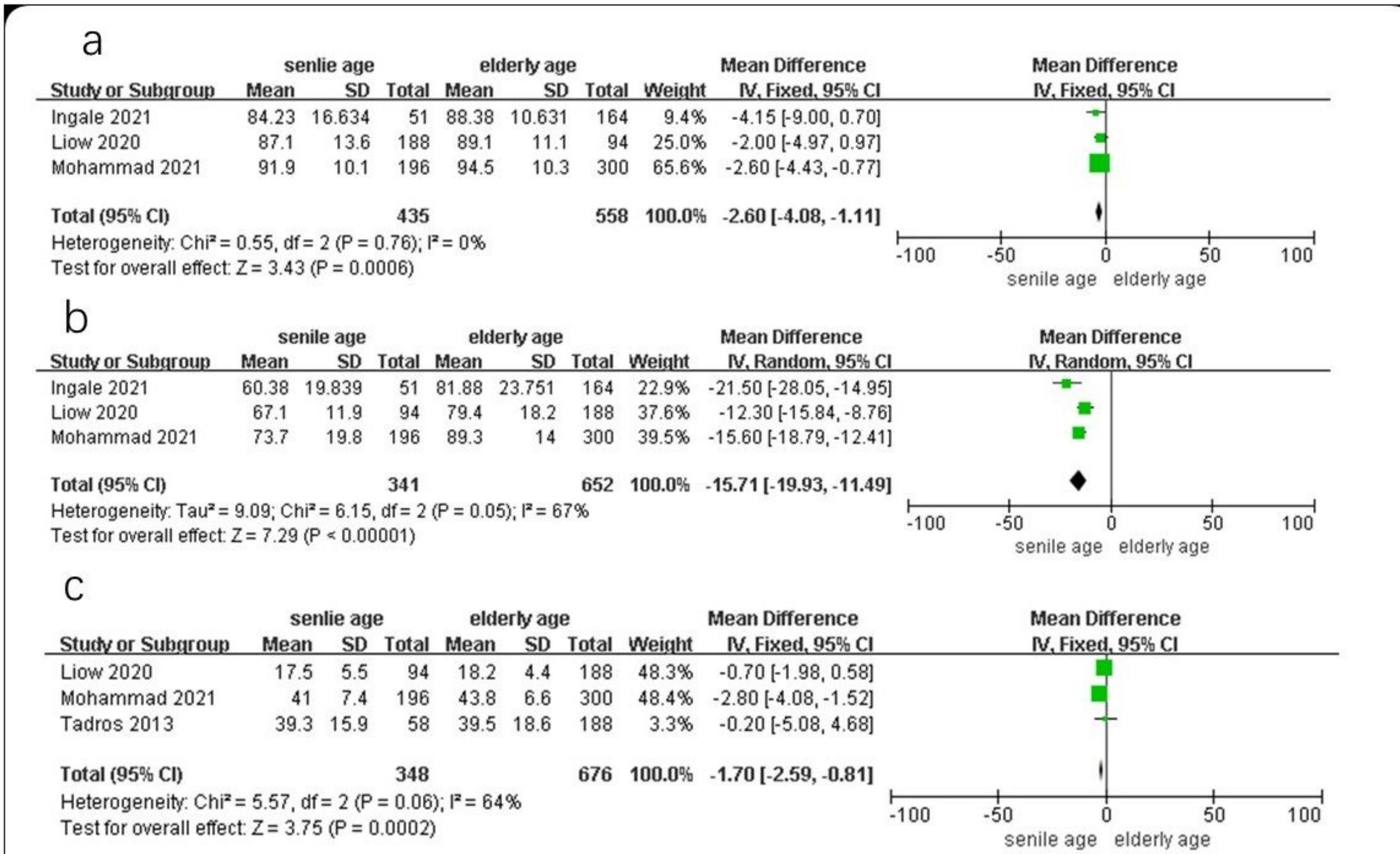

Fig.2 Forest plot analysis of the functional outcomes between the senile age and elderly age group: KSS (Objective)(a), KSS (Function)(b), OKS(c).

Figure 2

See image above for figure legend.

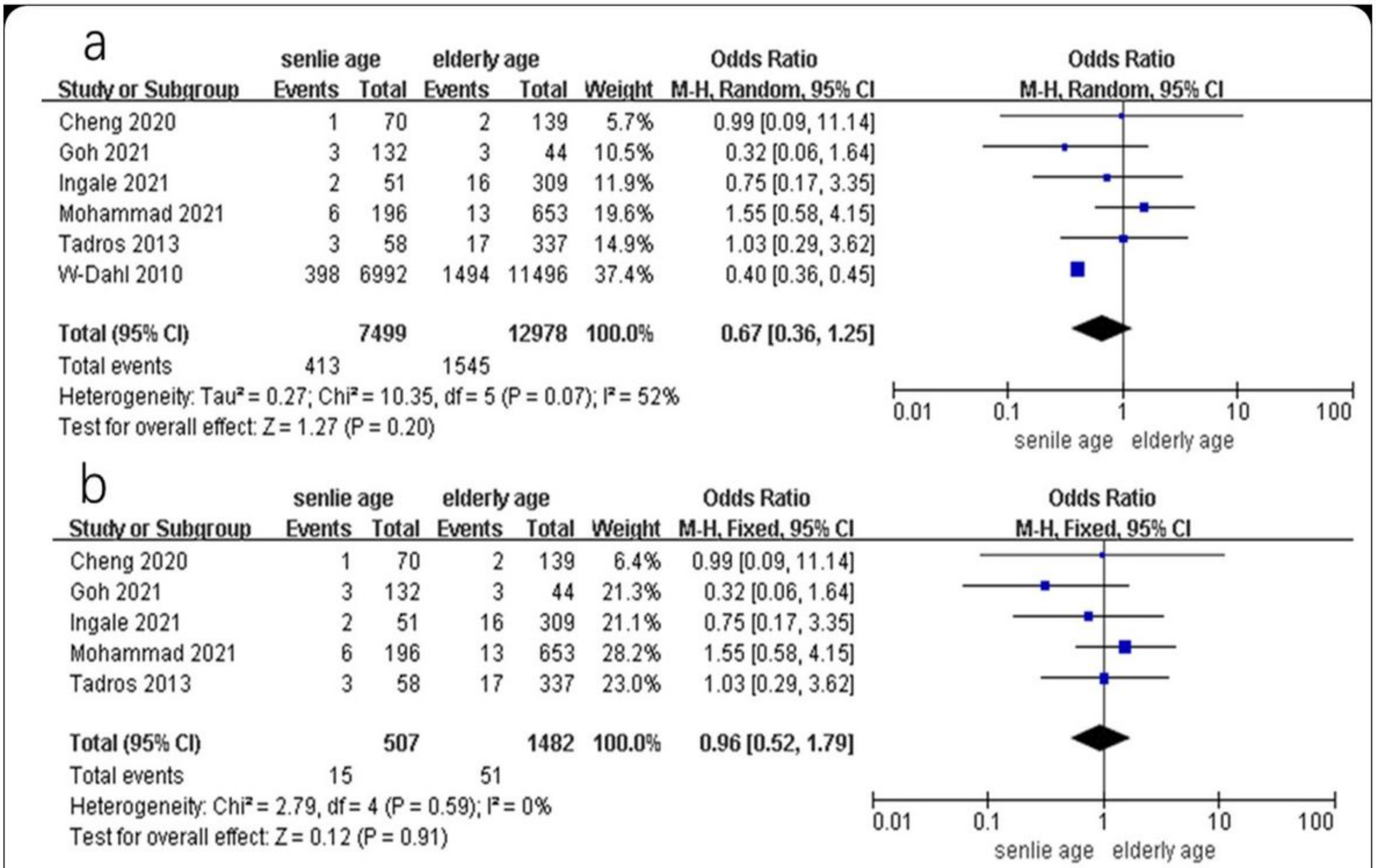

Fig.3 Forest plot analysis of the revision rate in the senile age and elderly age group

Figure 3

See image above for figure legend.