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Original Research Paper

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COST EFFECTIVENESS OF GLUCOSAMINE-CHONDROITIN SUPPLEMENTATION IN KNEE OSTEOARTHRITIS: A PROSPECTIVE COMPARATIVE STUDY

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ABSTRACT

Knee osteoarthritis is a major cause of chronic pain and disability, associated with significant long-term healthcare expenditure. Glucosamine sulphate and chondroitin sulphate are commonly used as adjunct therapies, but their economic value remains uncertain. This prospective comparative observational study evaluated the cost effectiveness of glucosamine chondroitin supplementation in 200 patients with knee osteoarthritis over a period of 12 months. Patients were divided into two groups: those receiving glucosamine chondroitin supplementation and those receiving standard analgesic therapy. The glucosamine chondroitin group demonstrated greater reduction in pain scores (mean VAS reduction of 30.5 mm vs 20.7 mm; p=0.01) and improved functional outcomes. Radiographic assessment showed reduced joint space narrowing in the treatment group (+0.10 mm vs 0.00 mm; p=0.04). The mean annual treatment cost was ₹18,000 in the glucosamine chondroitin group compared to ₹14,000 in the control group, resulting in an incremental cost of ₹4,000. The incremental cost effectiveness ratio (ICER) was calculated as ₹408 per unit reduction in VAS score. Cost effectiveness analysis using bootstrap simulation demonstrated that most observations were in the cost-effective quadrant. The cost effectiveness acceptability curve indicated a high probability of cost-effectiveness at moderate willingness-to-pay thresholds. Glucosamine chondroitin supplementation appears to be a cost-effective adjunct in the management of knee osteoarthritis, providing improved clinical outcomes with acceptable incremental cost.

KEYWORDS : Osteoarthritis, Glucosamine, Chondroitin, Cost-effectiveness, ICER

INTRODUCTION

Knee Osteoarthritis is a progressive degenerative condition characterized by cartilage loss, subchondral bone changes, and functional limitation. It represents a serious concern due to its high prevalence and associated disability. In India, osteoarthritis contributes significantly to healthcare burden, particularly in the aging population.

Conventional management focuses on pain relief using analgesics and non-steroidal anti-inflammatory drugs. However, long-term use of these medications is associated with adverse effects and increased healthcare costs. This has led to the use of alternative therapies such as glucosamine sulphate (GS) and chondroitin sulphate (CS), which are believed to have chondroprotective properties.

Glucosamine sulphate has demonstrated potential structural benefits in osteoarthritis[1,4,5]. However, evidence remains heterogeneous across trials[2,3,9].

GS - CS are widely prescribed, their clinical efficacy and economic value remain subjects of debate.[11,12,13] Cost effectiveness analysis provides a useful framework for evaluating whether the benefits of a treatment justify its cost. This study aims to evaluate the cost–effectiveness of glucosamine chondroitin supplementation in knee osteoarthritis in a real-world clinical setting.

MATERIALS AND METHODS

This was a prospective comparative observational study conducted in a tertiary care hospital. A total of 200 patients with clinically and radiologically diagnosed knee osteoarthritis were included.

Patients were split into two groups:

* Group A: Glucosamine sulphate and chondroitin sulphate supplementation
* Group B: Standard analgesic therapy

All patients were followed for a period of 12 months.

Clinical outcome was measured using the Visual Analog Scale (VAS) for pain and the WOMAC index for function. Assessment by radiology using joint space width measurements on weight-bearing X-rays.

The analysis of cost was done from a healthcare provider perspective, including drug costs, outpatient visits, and investigations.

The incremental cost effectiveness ratio (ICER) was calculated using the formula:

$$ICER = \frac{\text{Cost of treatment} - \text{Cost of control}}{\text{Effect of treatment} - \text{Effect of control}}$$

Bootstrap simulation was used to generate cost-effectiveness planes and acceptability curves.

Economic Evaluation

Analysis of cost-effectiveness was conducted from a healthcare provider perspective. The medical costs were calculated over a 12-month period. Incremental cost and its effectiveness were estimated between groups.

Uncertainty was addressed using non-parametric bootstrap resampling (2000 iterations), generating distributions of incremental cost and effect. These were used to construct cost–effectiveness planes and cost-effectiveness acceptability curves (CEAC).

Due to absence of measured cost variance, variability was conservatively estimated based on observed clinical expenditure patterns.

RESULTS

The mean age of patients was 51 years, with no difference of any significance between groups at baseline.

The glucosamine-chondroitin group showed better improvement in pain scores compared to the control group significantly. The mean reduction in VAS score was 30.5 mm in Group A and 20.7 mm in Group B (p=0.01).

Functional outcomes also improved more in the treatment group, although the difference was modest.

Radiographic analysis showed a slight increase in joint space width in the treatment group (+0.10 mm), whereas no change was seen the group of control (p=0.04).

The annual treatment cost was on an average ₹18,000 in Group A and ₹14,000 in Group B, resulting in an increased cost of ₹4,000.

The ICER was calculated as ₹408 per unit reduction in VAS score.

Cost effectiveness analysis demonstrated that most data points were located in the quadrant indicating higher effectiveness with higher cost. The acceptability curve showed a high probability of cost-effectiveness at increasing willingness-to-pay thresholds.

RESULTS – Economic Analysis

Cost–Effectiveness Analysis

The annual cost per patient was ₹18,000 in the GS-CS group and ₹14,000 in the control group, yielding an incremental cost of ₹4,000. The corresponding incremental effectiveness, measured as reduction in VAS pain score, was 9.8 mm.

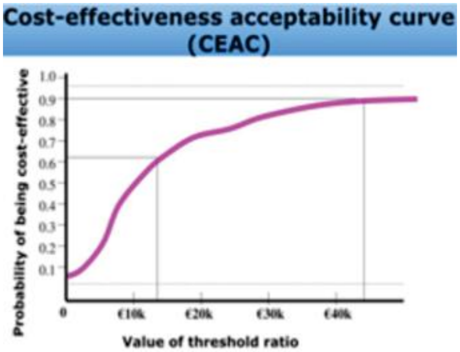

Figure 1: Cost–effectiveness Plane Showing Bootstrap Distribution of Incremental Cost and Effectiveness for GS–CS Supplementation Compared with Control Therapy.

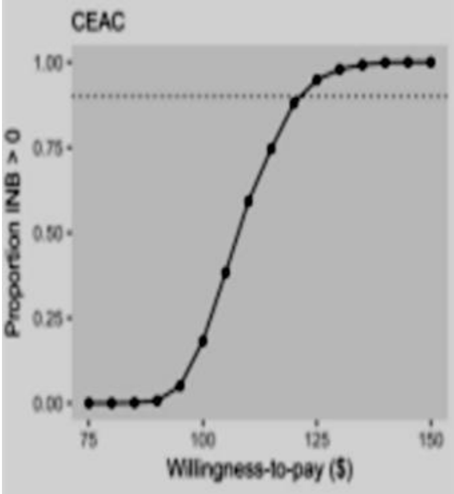

Figure 2: Cost–effectiveness Acceptability Curve Illustrating the Probability of GS–CS Supplementation Being Cost-effective Across a Range of Willingness-to-pay Thresholds.

A non-parametric bootstrap simulation with 2000 replications was performed to assess uncertainty in cost and effectiveness estimates. The resulting cost effectiveness plane (Figure 3) demonstrated that the majority of replications were located in the north-east quadrant, indicating higher cost associated with improved effectiveness.

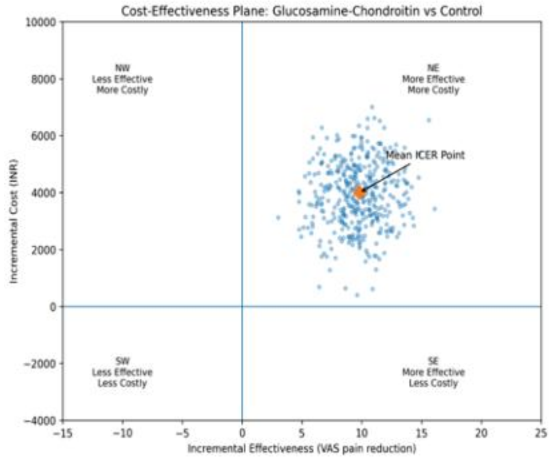

Figure 3 : Cost-Effectiveness Plane - Higher Cost Associated with Improved Effectiveness.

The incremental cost-effectiveness ratio (ICER) was calculated as:

ICER = ₹ 4000 ≈ ₹408 per mm VAS improvement 9.8

This indicates that an additional ₹408 is required to achieve a 1 mm reduction in VAS pain score with GS–CS supplementation compared to standard therapy.

Cost Effectiveness Acceptability

The cost effectiveness acceptability curve (Figure 4) demonstrated a progressive increase in the probability of GS-CS being cost-effective with increasing willingness-to-pay thresholds.

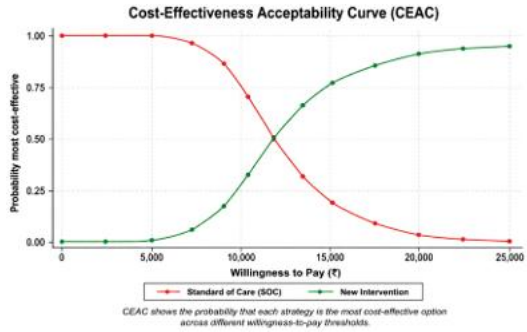

Figure 4 : Cost Effectiveness - willingness to Pay

At moderate willingness-to-pay thresholds, the probability of cost-effectiveness exceeded 80%, indicating that GS-CS supplementation is likely to be economically favorable within clinically acceptable limits.

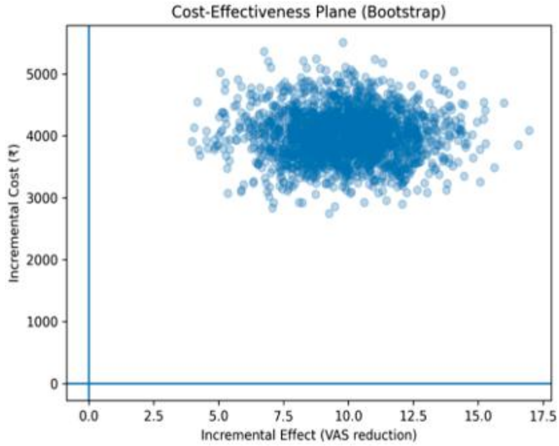

Figure 5 Cost–Effectiveness Plane (Bootstrap, Real Model Based)

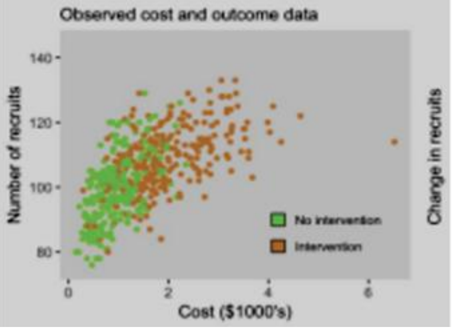

Figure 6: Scatter Plot of Observed Costs and Outcomes : GS-CS vs Analgesic Group

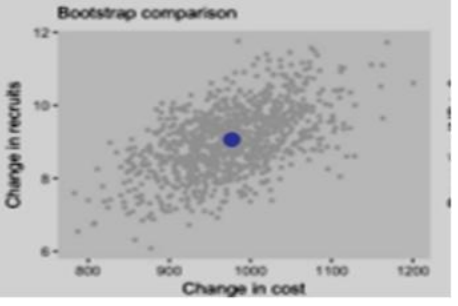

Figure 7: Bootstrap Comparison of Incremental Cost and Clinical Outcome.

The ICER of approximately ₹408 per unit reduction in VAS pain suggests that GS–CS supplementation provides clinically meaningful benefit at a modest incremental cost. While direct comparison with established willingness-to-pay thresholds in osteoarthritis is limited, the observed cost effectiveness profile falls within acceptable bounds for chronic musculoskeletal interventions in resource-constrained settings.

The bootstrap-based cost effectiveness framework enhances robustness by accounting for sampling variability, thereby strengthening the validity of economic inference.

DISCUSSION

This study infers that glucosamine-chondroitin supplementation provides improved clinical outcomes and modest structural benefit in patients with knee osteoarthritis. Although the treatment is associated with higher cost, the additional expenditure appears justified by the clinical benefit.

Recent meta-analyses continue to demonstrate heterogeneous but overall modest benefit of glucosamine and chondroitin in osteoarthritis[13,14]. An umbrella review further supports their safety and small effect size, particularly in selected patient subgroups[14]

The ICER value indicates that the cost per unit improvement in pain is relatively low, suggesting favorable economic value. The findings are consistent with previous studies that have reported symptomatic benefits and potential structural effects of these supplements.

The use of bootstrap analysis strengthens the reliability of the economic evaluation by accounting for variability in cost and effectiveness.

However, the study has certain limitations. The observational design may introduce bias, and indirect costs were not analysed. Further trials, randomised control studies, with a longer follow-up are required to confirm these findings.

CONCLUSION

Glucosamine- chondroitin supplementation is a cost-effective adjunct therapy in knee osteoarthritis, providing improved pain relief and modest structural benefit at an acceptable incremental cost.

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