Effects of simulation-based education on improving leadership skills in medical and nursing students: A systematic review

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Abstract

A systematic review was conducted to explore the effectiveness of simulation-based education to improve leadership skills in medical and nursing students. CINAHL and MEDLINE were searched from the first records until 12 November 2019. Free text terms and subject headings related to leadership skills, simulation, and undergraduate medical education were searched in the abstract and title. All types of original articles were included for intervention as simulation-based education, and outcomes as improvement in confidence, managing the patients, self-efficacy and leadership skills. Seventeen articles were shortlisted after initial screening, and six with aims to improve leadership skills were selected for analysis after inspecting the full text. Heterogeneity was found in interventions and data collection methods. Sessions were held in healthcare settings, and prior learning was used in only two studies. The lack of comparison or control group in studies limited the review to a narrative synthesis of evidence rather than a stronger quantitative meta-analysis. It was evident, even after the limited number of studies, that simulation-based leadership training could improve students' confidence to start their practice with the required skills.

Keywords: High-fidelity simulation training**,** leadership, simulations**, s**imulation training**,** students, medical**,** systematic review

1. Introduction

Although there are many definitions of leadership, the most agreed one states leadership as behaviours, personal qualities, styles, and tactics of a team leader, and impacts how the goals and objectives of the team will be met (1). This leads to the assumption that the beliefs and performance of a team and its members are manipulated by the leader of that team. By drawing on these concepts, elements of leadership can be identified as using authority, maintaining standards, planning, prioritising, and managing workload and resources (1). Today's complicated medical environment demands healthcare professionals to be competent in leadership skills along with comprehensive knowledge of their specific areas of specialization (2). The reason behind this requirement is that they have to bear challenges which not only involve clinical issues but also raise the financial costs of healthcare, which require strong interpersonal skills (2).

It has been previously asserted that a lack of leadership skills in healthcare providers can result in increased healthcare expenses. Interpersonal skills are an integral part of leadership skills; being incompetent in them causes difficulties in communication and intensive use of resources (3-10). This leads to the fact that practitioners must possess interpersonal skills and should work across improving components of leadership skills such as effectively collaborating, negotiate (5, 6, 11), communicating (8, 10, 12), building an organizational culture (3, 4, 8, 13) and advise inventive solutions (8, 9). In

other words, possessing leadership skills is inevitable for improved services in this demanding modern healthcare era (9).

The Accreditation Council for Graduate Medical Education (ACGME) has organized obligations for programs that comprise skills in quality improvement, system-based practice, and interpersonal communication (8). The CanMEDS Physician Competency Framework has determined seven roles for doctors: medical expert, collaborator, health advocate, communicator, manager, scholar, and professional (9). Medical professionals are now emphasizing leadership development in physician leaders since performance improvement, system-based practice, and practice management are essential for residency training in the US (11, 13) so they can acquire leadership skills and capabilities. When it comes to nursing, the American Nurse Association Leadership Institute has determined leadership qualities for improved patient outcomes when nurses have qualities such as inspirational, encouraging, and supportive (14).

Simulation-based education has been recommended in literature to facilitate any learning as it involves a wide range of activities and approaches which apply to expert or novice learners (13). This leads to incorporating simulation in the undergraduate medical and nursing curriculum as it provides a real experience to students with the benefit of not harming the

patients (14, 15). Simulation-based learning improves clinical skills and helps undergraduates to comprehend better as compared to case-based discussions (16). Issues like patient safety, a busy schedule of consultants/specialist doctors, limited availability of actual patients for training purposes, and other related factors have forced towards introducing the simulation laboratories and clinical skills practice centres for training medical students (17). Therefore, simulation is now a familiar tool in many countries and is becoming progressively dominant in medical, surgical, and nursing training (14, 18 – 21).

1.1. The rationale for the review

Limited research is found regarding non-technical skills training using simulation (22), especially in improving leadership skills at the undergraduate level, both for doctors and nurses. Moreover, training for medical and nursing students was analysed together to appraise the evidence of effectivity of simulation-based education. According to the literature, only one systematic review has been conducted on leadership skills related to undergraduate students. This review was by Barnes et al. (23), which aimed to investigate the perceived preparedness of medical students and junior doctors for their role as clinical leaders. Another review was planned by Darragh, Traynor & Joyce-McCoach (24), which is still ongoing and aims to explore the most effective interventions for developing leadership skills for nurses, and it does not include simulation-based education. The aims of these reviews did not intend to explore the effectiveness of using simulation-based education to improve leadership skills.

Therefore, this systematic review aimed to determine:

What is the effectiveness of using simulation-based education to improve leadership skills in undergraduate medical and nursing students?

This research question was developed using the PICO framework: participants were undergraduates in any of the specialties of medicine or nursing students, and the intervention to be considered as simulation-based education in comparison to traditional teaching without simulation-based education. Outcomes to be measured as a result of the interventions were improved confidence in students to manage the patients, improved self-efficacy of leadership, and improvement in different skills of leadership like delegating, prioritizing, and collaborating.

2. Matherials and Methods

The systematic literature review was conducted using PRISMA guidelines (25) and standards from the Cochrane Handbook (26). A review protocol was prepared; however, it was not registered as this review was part of a PhD study.

2.1. Search strategy

The first and second authors independently searched two databases, CINAHL and MEDLINE, using the EBSCOhost platform from the first records until 12 November 2019. These two databases were selected as they contain a vast collection of references and articles from nursing and allied healthcare journals worldwide. A complete search strategy is illustrated in Fig. 1. A limit was applied for articles written only in English. Any conflict or disagreement about the selection of the article among the authors was resolved through discussion until a consensus was reached.

Search strategy for MEDLINE:	Search strategy for CINAHL:
1. undergraduate*	1. undergraduate*
2. learner*	2. learner*
3. student*	3. student*
4. medical education	4. medical education
5. students, Medical (MeSH Heading)	5. students, Medical (CINAHL Heading)
6. 1 OR 2 OR 3 OR 4 OR 5	6. 1 OR 2 OR 3 OR 4 OR 5
7. leader*	7. leader*
8. leadership	8. leadership
9. management skills	9. management skills
10. leadership (MeSH Heading)	10. leadership (CINCAHL Heading)
11. 7 OR 8 OR 9 OR 10	11. 7 OR 8 OR 9 OR 10
12. simulation	12. simulation
13. simulation-based education	13. simulation-based education
14. simulation training (MeSH Heading)	14. simulations (CINAHL Heading)
15. high-fidelity simulation training (MeSH Heading)	15. 12 OR 13 OR 14
16. 12 OR 13 OR 14 OR 15	16. 6 AND 11 AND 15
17. 6 AND 11 AND 16	

Fig.1. Detailed search strategy

2.2. Inclusion and exclusion criteria

Although randomized controlled trials (RCT) are the most reliable sources in a systematic review (27), as RCTs were not found in the initial scoping searches, all the study designs were included in this systematic review. Original studies in which simulation-based education interventions are introduced for medical undergraduate students and nursing students were included. All kinds of review studies or systematic reviews were excluded. Any studies assessing the intervention outside healthcare settings were also excluded.

2.3. Data extraction

Data for each study was extracted by creating standard data extraction forms based on the CRD's guidance for undertaking reviews in healthcare (27). This form included information regarding the author's name, year of publication, study title, type of publication, study design, type of population, sample size, aims of the study, instruments used for data collection, data about interventions, and outcomes from each study.

2.4. Data analysis

Full text of the papers which fulfilled the inclusion criteria was accessed, and data was extracted by one author SR. Narrative synthesis based on the guidelines from Cochrane (Ryan, 2019) was planned for analyzing the findings for this review. The synthesis was completed using four major steps: (1) Developing a theory of how the intervention works, why, and for whom; (2) Developing a preliminary synthesis of the findings of included studies; (3) Exploring relationships in the data within and between studies; (4) Assessing the robustness of the synthesis. Information gathered through data extraction tables along with an individual quality assessment of studies was used to fulfill the requirements of each of the above-mentioned domains.

2.5. Quality assessment

The methodological quality of the included studies was independently performed by two authors (SR and MT) using an appraisal instrument MMAT version 2018 by Hong et al. (2018). It is a mixed-method critical appraisal tool to assess the quality of studies included in systematic reviews,, including empirical studies based on observation, experimentation or simulation (28). This tool was selected as studies included in this review were of different types, i.e. quantitative, qualitative, mixed methods, and case study. The tool covered several questions enabling the judgement of the quality of each type of study. Every article was critically appraised using the two initial screening questions and then further questions to appraise the quality of the study.

3. Results

Search results from both databases were combined using Mendeley reference management software. Research in MEDLINE yielded 40 results, and 37 studies were found from CINAHL, which totalled 77. After removing the duplicates, 41 records were considered for further screening, among which 17 articles were selected for full screening. Six articles were finalized for the data analysis phase after the screening process. All included articles were original journal articles and were published during the years 2010-2018. A narrative synthesis was planned and conducted for data analysis as meta-analysis was not possible because methodological and statistical heterogeneity was found among the studies. PRISMA flow diagram in Fig.2 shows the flow chart detailing the number of studies at each stage of the review.
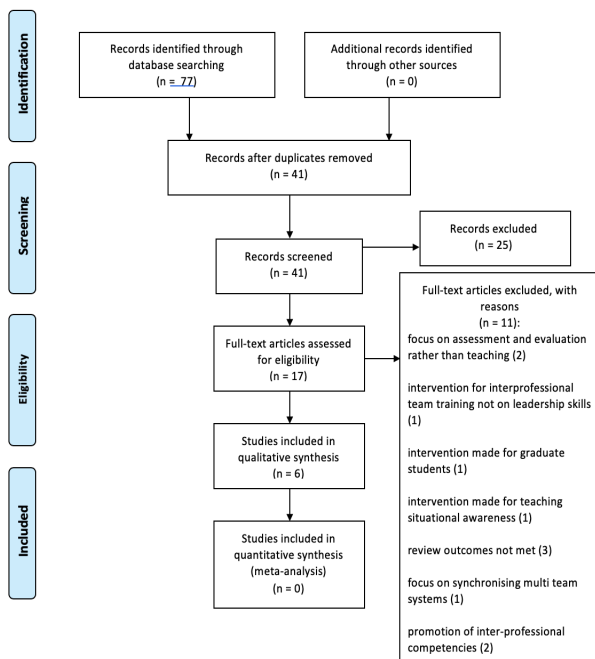
Fig. 2. Flow chart detailing the number of studies at each stage of the review

3.1. Study characteristics

Out of six studies, two were conducted in America (29, 30), and the remaining were in Sweden (31), Georgia (32), Norway (33)

and Canada (34). Four studies involved nursing students as participants which were in their final year or towards their final exams (29, 30, 32, 34). Two studies involved medical students in their 4th, 5th, or 6th year as participants (31, 33). Table I and Table II show the pre-set tables used for data extraction from studies. Table–I shows the main characteristics of the studies, and Table II shows the interventions and outcomes of each study. During the quality assessment using the instrument MMAT version 2018 by Hong et al. (28), two of the studies (29, 34) among six were rated low quality based on more numbers of "Can't Tell" or "No" responses and the rest were rated high quality. A detailed quality assessment of each article is shown in the supplementary file (Supplementary file)

Quantitative (30-33), qualitative (34), and mixed methods (29) were used for data collection. Heterogeneity was found within the data collection methods and interventions. Simulated sessions were usually held for a day with rotations of groups, and some of the interventions were aided with prior learning in didactic sessions (29) or e-learning modules (30) to provide orientation on the simulation-based session (29,30). The main aim of all the studies was to introduce simulation-based education for improving leadership skills which included delegation, prioritization, collaboration, and teamwork. These aims and measured outcomes of studies are related to the aim of this review, i.e., to determine the effectiveness of simulation-based education for training leadership skills.

Sessions were developed using simulated patients and scenarios or high-fidelity manikins in healthcare settings. Students attended the sessions in groups of two to six. All the interventions except one (29) had a debriefing session after the simulation activity. Different scenarios were developed for the same session ranging from acute care and emergency care, where students had to rotate in groups to practice in each scenario until all the groups had participated.

3.2. Measured outcomes in the studies
Improved self-efficacy

It was reported in all studies that learners better understood the importance of leadership skills after attending the simulated sessions. In a study by Simones et al. (30), learners strongly supported the significance of hands-on practice for an improved understanding of working in teams and making decisions as a leader. In a study by Meurling et al. (31), medical students participated in three training sessions on patient management with alternating roles as observers and active participants. It was noticed that learners performed better in the role of active participants (leaders) than the observers (followers); however, their mental strain was also high in the role of leader. Leadership self-efficacy, which means confidence in own ability to lead successfully, was improved from a mean score of 5.15 (SD 0.12) to 5.42 (SD 0.12) at the end of the session. Having been trained as both leader and follower made students realize the behaviours required in a leadership role.

Table 1. Main characteristics of the studies included for the review

Author/ Year	Study Title	Publication Type	Study Design	Population & Sample Size	Aims
Simones, et al (2010)	Collaborative simulation project to teach scope of practice	Journal Article	Quantitative	New graduate nurses and licensed practice nurses, expected to start nursing practice from 3 different schools (population size not mentioned)	Develop a simulation project to enable nursing students to practice and apply principles relate to delegation, supervision, scope of practice, leadership and culturally competent care
Kaplan, et al (2010)	Use of multiple patient simulators to enhance prioritizing and delegating skills for senior nursing students	Journal Article	Quantitative	97 Nursing students aged 20-29 in final year	A simulation-based learning experience was developed to increase student confidence and enhance student ability to safely and effectively prioritize, delegate and implement care for patients
Jakobsen, et al (2018)	Examining participant perceptions of an interprofessional simulation-based trauma team training for medical and nursing students	Journal Article	Quantitative	101 medical, 44 nursing students and 16 facilitators	To describe the adaptation of an interprofessional simulation course in an undergraduate setting and to report participants' experiences with the course and students' learning outcomes
Nowell (2016)	Delegate, collaborate, or consult? A capstone simulation for senior nursing students	Journal Article	Qualitative	Fourth-year nursing students (population size not mentioned)	Simulation created to develop and sustain the prioritization, organization and delegation skills of fourth year nursing students
Meurling, et al (2012)	Leaders' and followers' individual experiences during the early phase of simulation-based team training: an exploratory study	Journal Article	Quantitative	54 medical students in their 4th or 6th year	Explore individual experiences and behaviours of leaders and followers during early phase of simulation-based team training
Martin, et al (2016)	Integration of leadership competencies in a community health simulation	Journal Article	Case Study/Mixed Methods	Nursing students (population size not mentioned)	To use simulation as a compelling learning strategy and teach disaster preparedness and application of leadership and management knowledge in nursing students

Table 2. Details of Interventions and Outcomes

Author/year	Length of Simulated Session	Type of Simulator	Debriefing	Speciality	Evaluation of Intervention	Outcomes
Simones et al (2010)	Online learning before simulation, 50 minutes of simulation, 30 minutes of debriefing	Real actors and manikins	Structured debriefing with guided reflective questions about delegation, prioritization, collaboration and management skills	Acute care	Evaluation Rubric	Improved confidence about having leadership capabilities of delegating and prioritizing. Frequent simulation-based exercises suggested to be integrated earlier in student's educational experiences
Kaplan et al (2010)	30-minute briefing, role assignment, 20 minutes simulation, 1-hour group debriefing	Medium-fidelity manikins	Structured debriefing conducted to provide feedback on confidence level, rationale for prioritization and developing strategies for effective delegation	Different medical cases	Online anonymous survey	69% (n = 67) reported increased understanding of prioritizing and delegating care. 78% (n = 76) reported confidence in ability to work as a team. 55% (n = 52) were more confident prioritizing and delegating care
Jakobsen	15-20 minutes simulation, 40-45 minutes debriefing, 3 interactive lectures and 1 evaluation session of 30 mins each	High-fidelity manikins	Structured debriefing session including the use of video recording of the team performance for reflection focusing on communication, leadership and intra and interprofessional collaboration	Emergency medicine	Post-intervention study From students: Questionnaire with open-ended free text questions and Likert Scale with 25 items From facilitators: 12 item Likert scale	More understanding of leadership role. significantly high scores in questions regarding leadership. Facilitators responded that students' skills in leadership and communication improved. Nursing students struggled less than medical students
Nowell (2016)	30 mins briefing, 1-hour clinical immersion, 1-hour debriefing	moulaged patient simulators	Structured debriefing where students reflected objectives, strength and weaknesses of sessions. Guided discussion around delegation, collaboration, and consultation. Students encouraged to talk about the reasoning and critical thinking used in problem solving and decision	Multiple surgical and medical patients	Open-ended questions	Students were able to provide patient-centred care, display advance thinking skills to organize and prioritize patient care and demonstrate emerging leadership skills in response to rapidly changing client health situations. Collaboration

			making			skills were developed throughout the simulation. Feedback supports need of continuous simulation session
Meurling et al (2012)	4 hours simulation of 9 scenarios using basic medical problems	3 Medium fidelity patient simulators	After each scenario, structured debriefing including an emotional 'blow-out', feedback on medical management and clinical performance, active participants' experience and observers' views of individual teamwork behaviours and feed back to active participants. Trainers' concluding remarks and recommendations	Recreated emergency ward	Video analysis and observation	Participants' self-efficacy and clinical performance improved, cross-training in the roles of leader and follower increased the understanding of the difficulties specific to each role and enhanced learning about each role
Martin et al (2016)	Briefing during didactic sessions.	Simulated scenario close to real-life Bombing situation	Debriefing discussion focused on prioritisation of patient and assessment of scenario	Acute Emergency	Post-intervention observation	Competencies in both community health nursing and nursing leadership were explored which provided rich learning experience. Learners were able to connect the knowledge and its application to practice

Improved confidence in managing the patients

It was also reported that learners were more confident in caring for multiple patients after attending the simulated sessions. In a study by Martin et al. (31), where nursing students were trained to develop leadership skills using a simulated scenario of a bombing emergency, learners experienced managing more patients than in a normal hospital emergency ward. This training helped them improve their capability of managing and prioritizing patients. In another study (34), in which nursing students participated in a capstone simulation and responded to open-ended questions their critical thinking abilities were improved. Learners also felt that they were able to incorporate their simulation experiences to provide patient-centred care and apply advanced thinking skills to organize and prioritize patient care.

Improvement in leadership skills

Overall, the studies focused on training the undergraduates

in several leadership skills, which included managing, delegation, collaboration, prioritization, supervision, teamwork, and communication. Although different studies focused on different sets of skills, the major focus was to improve the skills of leading and managing the patients. Improved leadership skills in learners after attending the simulation-based practice sessions was a common finding.

In one of the studies (32), students strongly reported that simulation exercise increased their understanding of prioritizing and delegating care (68%), they were more confident in prioritizing and delegating care (55%). They were more confident in their ability to work as a team (78%). However, some of the learners also felt inadequate after attending the simulation sessions as they perceived that it pointed out their deficiencies or areas of improvement. Moreover, simulation-based exercises were made part of the curriculum as the objectives of the study were successfully met.

In one study (30), combined simulation-based learning was provided for three nursing schools to improve leadership skills of delegation, supervision, prioritization of care, teamwork, and communication. Online learning modules were delivered for pre-learning so that all the learners possess the same level of knowledge at the time of simulation exercises. Students were also assessed during the sessions using the pre-set evaluation rubrics on the above-mentioned skills. Students strongly supported simulation-based learning and had a realization that they did not possess the experience of working in teams and also noted the scope of improvement in leadership skills with further practice. However, evaluation through rubrics concluded that students were good at delegation and communication skills which matched the students' perception given during debriefing sessions. Faculty of all three nursing schools concluded that further simulated sessions should be planned to improve learners' educational experiences.

Moreover, a post-intervention study was conducted on one-day training using high-fidelity simulation for medical and nursing students to assess the effectiveness of this intervention for training students on leadership skills along with stress management, teamwork, and communication skills (33). 101 medical and 44 nursing students responded to a questionnaire with open-ended questions, while 98 medical and 67 nursing students responded to a 25-item Likert scale about the intervention. Sixteen facilitators out of 20 also took part in responding to the questionnaires. Facilitators generally agreed that students' skills in leadership and communication improved during the day of the simulation. The authors concluded that using a simulation-based course focusing on education leadership, communication, and teamwork skills will yield positive outcomes.

4. Discussion

This systematic review summarizes the findings of six studies on the effects of simulation-based education to improve leadership skills in undergraduate nursing and medical students. Of these six studies, all reported improved leadership skills in learners after attending simulated sessions. Although the review included studies from different countries and diverse interventions, results supported the fact that simulation-based education provides an opportunity for a powerful learning experience as it creates a learning environment where mistakes are not harmful to patients (35).

Considerable heterogeneity was found among the conceptual frameworks, population size, teaching methods, contents of sessions, assessment methods, learning objectives, and measured outcomes. More studies examined undergraduate nursing students compared to medical students, however, outcomes of improved understanding of learners' role as leaders and improved leadership skills were met in almost all of the studies. Two of the studies reported that simulation-based interventions were aided by modules or teaching before the simulation-based training (29,30), which

gave learners an understanding and know-how of what they would be doing in the sessions. This implies that when the simulation is combined with traditional or didactic methods of training leadership skills, desirable results can be achieved because learners get an opportunity to apply their classroom knowledge without fear of errors. Moreover, the potential benefits of repetition can be attained which in a single session are difficult to achieve (22). It has been already asserted in the literature that sustained effects were achieved when technical skills training using simulation was repeated (22, 36, 37). Advancing these reasons, it was strongly suggested in all studies that simulation-based teachings should be continued or implemented in the undergraduate curriculum so that undergraduates completely understand their roles as leaders before entering the practice.

Informing one of the intended outcomes of the review, two out of six studies (29, 34) concluded that nursing students were confident that their self-efficacy and to manage the patients improved after simulated sessions. This relates to the assertion by Ross, Tarun & Johnson (38) that practitioners not equipped with leadership skills may face difficulties during practice, which would impact patient safety and also create unhealthy working environments. The intended outcome of improving leadership skills using simulation-based education was achieved in almost all the studies, and learners showed enthusiasm and satisfaction after attending the sessions.

Generally, studies conducted to assess the effects of simulation-based education used open-ended questions or feedback questionnaires from the learners rather than using a controlled group. An assessment rubric was also used, which provided the opportunity to teach and assess the students at the same time. The use of questionnaires and rubrics provided a clear description of their use and was in line with good practice (39). Furthermore, it was found in this review that most of the literature evaluates the impact of interventions on a narrow set of measures, for example, learners' satisfaction scores and their self-assessment about knowledge gained from the intervention. Evidence from fields other than medicine has signposted that leadership development programs have a positive impact not only on an individual but on organizational performance as well (40, 41). However, the rareness of studies using pilot programs on this theme makes the evidence weaker. Pilot programs or studies using control groups are required to provide stronger evidence for the most effective interventions that can help train leadership skills at maximum capacity (42). Although learners' satisfaction and feedback are important, a dearth of research exploring the effectiveness of simulation-based education in undergraduates was found. Moreover, fewer studies were found to explore the mechanisms by which leadership skills can be taught to medical undergraduates to foster learning and change (42). Although two studies used standardized patients and manikins (30, 34), the effectiveness of low-fidelity simulation for leadership skills training was not explored. It can be suggested that this aspect be explored as

using low-fidelity simulation can be especially beneficial for improving healthcare outcomes in developing and under-developed countries (43).

The review has some limitations mostly because of the type of studies included in the review. As in initial research, sufficient randomized controlled trials were not found related to the field of interest, all types of studies were included in the review and that is why evaluating the interventions without having controlled variables by researchers was challenging (42). All of the studies suffering from the lack of comparison or control group lead towards a weak alternative of measuring outcomes using questionnaires or open-ended questionnaires. This leads to the implication that potential bias in the included studies could not be ruled out. Overall, this review was limited to a narrative synthesis of evidence rather than a stronger quantitative meta-analysis. Also, the review only included medical and nursing students. Expanding it to other health professions using simulation to improve leadership skills would have increased the number of relevant studies found for review. For further research, using diverse methods such as randomized controlled trials and case-control studies is suggested, to improve the scientific quality of evidence present in this field.

The findings of this review indicate that using simulation-based medical education is feasible for training leadership skills in undergraduate students. The number of studies included in the review was limited, and none of the studies achieved high scores in the quality assessment, which implies that more research is required in this area to determine the best practices. Furthermore, it was evident, even after limited studies that leadership training improves the confidence of students, and improvements in students' skills can be translated into benefits for their future medical practice. Moreover, this synthesis of the literature suggests important gaps in programs which offer integrating leadership skills training with clinical skills training and limited use of high-fidelity simulation.

Conflict of interest

Funding

Acknowledgments

Authors' contributions
Concept: S.R., Design: S.R., Data Collection or Processing: S.R., M.T. Analysis or Interpretation: S.R., Literature Search: S.R., M.T., Writing: S.R., M.T.

Ethical Statement
This study does not required ethics committee approval.

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