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Education and Training Update

Assessment of the Reporting Quality of Randomized Controlled Trials on Peer Tutoring in Medical Education

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Abstract

Aims/Background: Peer tutoring (PT) has been increasingly adopted as an innovative pedagogical approach in medical education. However, the methodological rigor and reporting quality of randomized controlled trials (RCTs) evaluating PT remain unclear. This study aimed to assess the reporting quality of PT-related RCTs using the Consolidated Standards of Reporting Trials (CONSORT) 2010 guidelines. **Methods**: A systematic search of PubMed, Embase, and Web of Science was conducted to identify RCTs that investigated PT interventions among medical students, focusing on publications after 2010. Eligible studies were screened independently by two researchers. Reporting quality was evaluated using the 28-item CONSORT 2010 checklist, and overall quality scores (OQSs) were calculated. **Results**: Forty-eight RCTs were included. The majority were published after 2015, with 37.5% between 2016 and 2020 and 35.4% between 2021 and 2025. Most studies were conducted in Europe or North America (75%), while 25% were from Asia. Approximately 81.3% of publications included in this analysis were published in journals with an impact factor below 4. The median OQS was 20 (range: 7–24). High compliance was observed for items such as abstract structure (95.8%), intervention details (100%), and outcome definition (100%), whereas randomization restriction (27.1%), allocation concealment (27.1%), implementation (25.0%), adverse event reporting (2.1%), and protocol availability (33.3%) were poorly reported. **Conclusion**: Despite the growing application of RCTs to evaluate PT in medical education, adherence to CONSORT 2010 remains suboptimal. Key methodological elements—particularly randomization, allocation concealment, and trial registration—were frequently underreported, which limits the interpretability and reproducibility of studies. Targeted training, stricter journal requirements, and education-specific CONSORT extensions are recommended to improve reporting quality in future PT-related RCTs. **Registration**: PROSPERO (CRD420261355464).

Keywords: peer tutoring; medical education; randomized controlled trial; CONSORT Statement; reporting quality

1. Introduction

A randomized controlled trial (RCT) is a prospective, comparative study conducted under controlled conditions, where interventions are randomly allocated to experimental and control groups. As the gold standard in evidence-based medicine, RCTs provide the most rigorous methodology for evaluating clinical interventions. The quality assessment of these trials and their reported outcomes primarily relies on systematic evaluation against established reporting standards. To enhance the transparency and completeness of RCT reporting, the CONSORT (Consolidated Standards of Reporting Trials) Statement was first published in 1996, with subsequent revisions in 2001 and 2010 incorporating emerging methodologies and addressing evolving trial designs [1].

Currently, the higher education landscape sees a shift in pedagogical approach from traditional teacher-centered knowledge delivery to student-centered autonomous learning. Peer tutoring (PT) refers to an instructional approach where high-achieving undergraduate students utilize their academic expertise and comprehensive competencies to assist fellow learners in addressing various academic challenges encountered during their studies [2]. PT has been proposed as an innovative approach to sustain interactive learning environments when facing either insufficient teacher resources or growing student populations [3]. The PT approach for medical students involves assigning qualified senior medical students as tutors to enhance fundamental medical knowledge and clinical competencies among junior students. As an innovative approach in medical education reform, PT effectively reduces the anxiety medical students experience when transitioning to clinical practice due to perceived gaps in clinical preparedness. This method not only addresses the shortage of faculty instructors but also creates mutual learning benefits where "teaching reinforces the teacher's own learning". A research evidence indicates that PT achieves educational outcomes comparable to faculty-led instruction while additionally enhancing students' comprehensive abilities, including self-confidence and communication skills [4]. Other studies have also demonstrated comparable effectiveness of PT and traditional teaching methods in evaluating medical stu-

dents' performance [5]. The assessment of medical students' learning outcomes incorporates diverse indicators and methodologies. Nevertheless, many RCTs concentrate on singular evaluation metrics, with different studies examining distinct indicators, thereby complicating cross-study comparisons and comprehensive assessments. While the majority of RCTs included in this analysis employ Objective Structured Clinical Examination (OSCE) as the primary evaluation framework, variations exist as individual medical institutions (including colleges, hospitals, and research centers) incorporate additional assessment components tailored to their specific curricular objectives and instructional content. These modifications inevitably introduce variability in evaluation outcomes. Consequently, implementing rigorously designed RCTs remains essential for advancing the study of PT applications in medical education.

Although the CONSORT Statement was originally developed for assessing clinical RCTs, its application scope should be extendable to evaluate other types of RCT studies. Our preliminary assessment of reporting quality in flipped classroom-related RCTs revealed suboptimal adherence to CONSORT standards, potentially attributable to differences between medical education research and clinical research [6]. We therefore strongly advocate for statisticians to develop CONSORT extensions specifically tailored for pedagogical research studies. This study systematically evaluates the reporting quality of published RCTs on PT by examining their adherence to key criteria specified in the CONSORT 2010 Statement.

2. Methods

2.1 Search Strategy

Two independent researchers conducted a systematic literature search in PubMed (https://pubmed.ncbi.nlm.nih.gov/), Embase (https://www.embase.com/search/quick), and Web of Science (https://webofscience.clarivate.cn/wos/woscc/smart-search) to identify RCTs examining PT interventions for medical students. Since the search terms were not found in the Medical Subject Headings (MeSH) subject index, a preliminary search was performed to develop a comprehensive strategy. The final search used the following combinations across databases:

In Embase and Web of Science, we applied ("peer instruction medical education" OR "peer mentoring medical education" OR "peer tutor medical education" OR "peer assisted learning medical education") AND ("randomized controlled trial"). For PubMed, the query was ("peer" OR "education" OR "medical" OR "student") AND ("randomized controlled trial"). The search was restricted to studies published in English from 1 January 2010 to 1 September 2025, to ensure the novelty of the evidence base and to secure an adequate number of contemporary trials for analysis.

2.2 Eligibility Criteria

The inclusion criteria for study selection comprised: (a) RCTs investigating PT interventions; (b) implementation of PT exclusively among medical students; (c) explicit designation of PT as the experimental intervention; and (d) publication in English-language journals.

The exclusion criteria were defined as follows: (a) studies not pertaining to medical education; (b) insufficient or incomplete outcome data; (c) secondary analyses or duplicate publications of existing RCTs; (d) studies without accessible full text; and (e) studies with insufficient methodological or reporting quality for CONSORT-based assessment.

2.3 Data Extraction and Quality Assessment

This study was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The completed PRISMA checklist is provided as **Supplementary Material**. The systematic review was registered in the International Prospective Register of Systematic Reviews (PROSPERO) database (CRD420261355464, https://www.crd.york.ac.uk/PROSPERO/view/CRD420261355464).

For studies reporting identical RCTs at multiple academic levels, priority was given to the publication containing the most comprehensive dataset [7].

The reporting quality of included RCTs was systematically evaluated using the overall quality scores (OQSs) based on the updated CONSORT 2010 guidelines. The general characteristics of the included studies are summarized in Table 1a (Ref. [4,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54]) and Table 1b, while detailed OQS results are presented in Table 2. The methodological assessment employed dichotomous scoring (1 point for clearly reported elements, 0 for unclear/absent descriptions), excluding PT-irrelevant items due to objective assessment limitations. Two trained investigators independently evaluated each RCT's design, baseline characteristics, and outcomes, with primary outcomes classified as positive (intervention group superiority) or negative (inferior/equivalent results) based on investigator reports. The evaluation comprehensively examined key methodological components reported in the included RCTs—such as endpoints, follow-up completeness, whether subgroup analyses were reported, and adverse event reporting [55]. Data extraction was conducted using a primary-secondary review model. The primary reviewer performed the initial extraction with a pre-designed standardized Excel form, and the secondary reviewer independently cross-checked the extracted data. Any discrepancies were discussed and resolved by consensus. In cases where substantial disagreement persisted (as indicated by a very low Cohen's κ value), both evaluators independently re-assessed the item, and

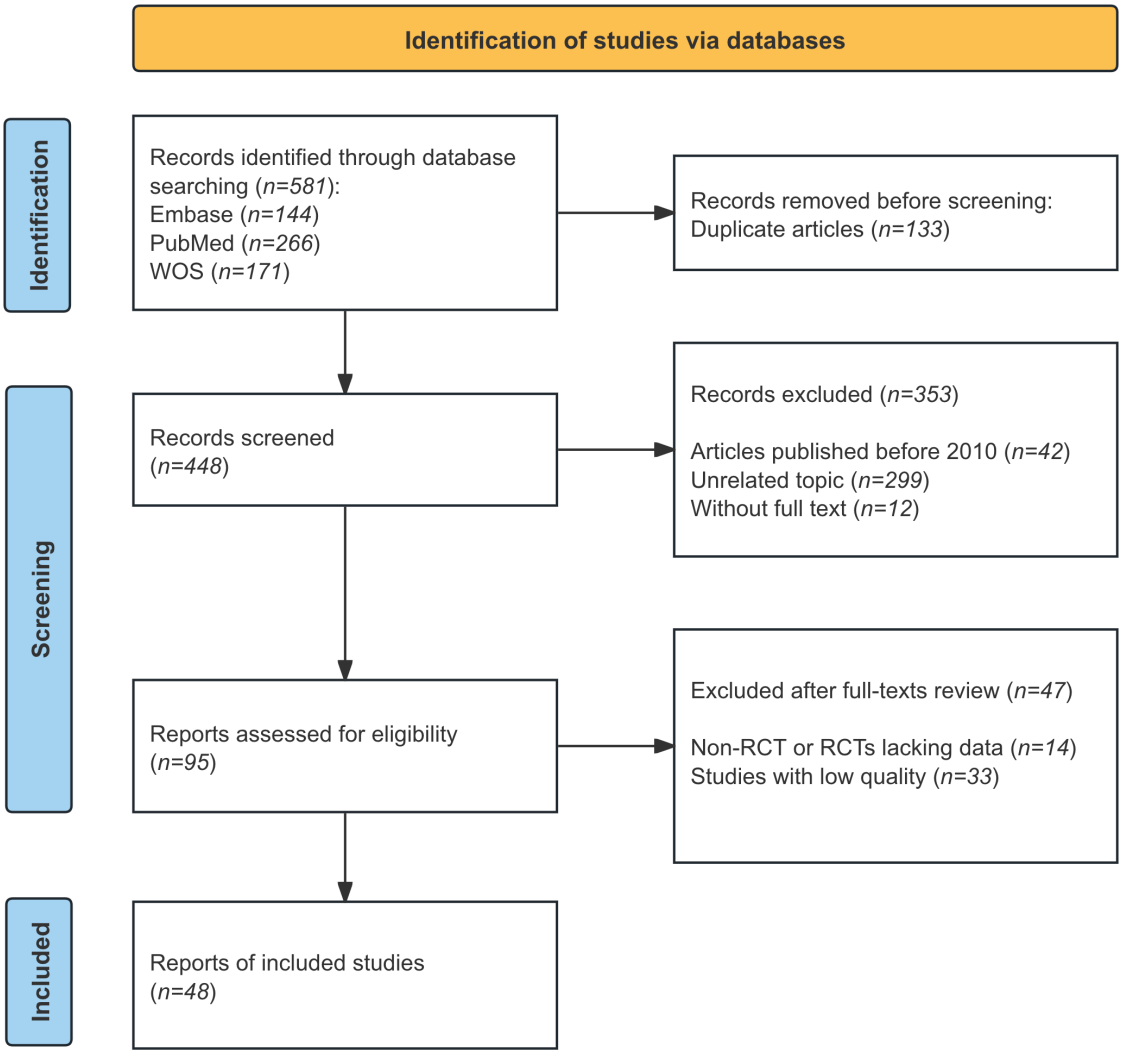

Fig. 1. Flow diagram illustrating the identification and selection of included RCTs. Created using Microsoft Word (version 2021, Microsoft Corporation, Redmond, WA, USA). RCTs, randomized controlled trials; WoS, Web of Science.

final decisions were reached through consultation with a senior methodological advisor to ensure consistency and minimize subjective bias. To quantify inter-rater reliability and minimize subjectivity, Cohen's κ coefficient was calculated for each CONSORT item. For each CONSORT item, the proportion of studies with adequate reporting was calculated.

3. Results

3.1 Study Selection

The systematic search strategy implemented in PubMed, Embase and Web of Science databases yielded an initial pool of 581 potentially relevant publications through advanced search techniques. Following a rigorous screening process involving title, abstract, and full-text review, 533 articles were excluded according to predefined criteria: 133 duplicate publications, 42 articles published before 2010, 299 studies with irrelevant topic, 12 records without full text, 33 studies of low quality, and 14 non-RCTs. This meticulous selection process resulted in the final inclusion of 48 methodologically sound RCTs meeting all eligibility requirements [4,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54].

Fig. 1 provides a schematic overview of the study selection process for included RCTs.

3.2 Study Characteristics

Table 1a and Table 1b present the key basic characteristics of the included RCTs. The median OQS based on the 28-item CONSORT 2010 checklist was 20 (range: 7–24), as summarized in Table 1a. Regarding study characteristics (Table 1b), 75.0% (36/48) of trials reported positive outcomes and 25.0% (12/48) reported negative outcomes.

Table 1a. Basic characteristics of the included RCTs.

Title	Year	Author	Region	Journal	Impact factor (WoS, 2024)	Primary outcome	OQSs
Advanced Cardiac Resuscitation Evaluation (ACRE): a randomised single-blind controlled trial of peer-led vs. expert-led advanced resuscitation training [8]	2010	Hughes TC	Europe and North America	Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine	3.1	Positive	22
Peer teaching: a randomised controlled trial using student-teachers to teach musculoskeletal ultrasound [9]	2010	Knobe M	Europe and North America	Medical Education	5.2	Positive	15
Can training in musculoskeletal examination skills be effectively delivered by undergraduate students as part of the standard curriculum? [10]	2010	Perry ME	Europe and North America	Rheumatology	4.4	Positive	17
Randomized surgical training for medical students: resident versus peer-led teaching [11]	2011	Graziano SC	Europe and North America	American Journal of Obstetrics and Gynecology	8.4	Positive	21
Student tutors are able to teach basic sonographic anatomy effectively - a prospective randomized controlled trial [12]	2012	Celebi N	Europe and North America	Ultraschall in der Medizin	2.9	Positive	18
Knowledge transfer of spinal manipulation skills by student-teachers: a randomised controlled trial [13]	2012	Knobe M	Europe and North America	European Spine Journal	2.7	Negative	21
Student tutors for hands-on training in focused emergency echocardiography–a randomized controlled trial [14]	2012	Kühl M	Europe and North America	BMC Medical Education	3.2	Negative	16
Can near-peer medical students effectively teach a new curriculum in physical examination? [15]	2013	Blank WA	Europe and North America	BMC Medical Education	3.2	Positive	19
Evaluation of the peer teaching program at the University Children's Hospital Essen - a single center experience [16]	2013	Büscher R	Europe and North America	GMS Zeitschrift fur Medizinische Ausbildung	0	Positive	17
A single standardized practical training for surgical scrubbing according to EN1500: effect quantification, value of the standardized method and comparison with clinical reference groups [17]	2013	Fichtner A	Europe and North America	GMS Zeitschrift fur Medizinische Ausbildung	0	Positive	17
Summative assessments are more powerful drivers of student learning than resource intensive teaching formats [18]	2013	Raupach T	Europe and North America	BMC Medicine	8.3	Positive	21
Perceptions of junior doctors and undergraduate medical students as anatomy teachers: Investigating distance along the near-peer teaching spectrum [19]	2014	Hall S	Europe and North America	Anatomical Sciences Education	4.7	Positive	14
An assessment of student satisfaction with peer teaching of clinical communication skills [20]	2014	Mills JK	Europe and North America	BMC Medical Education	3.2	Positive	14
Peer-assisted Learning in Cardiopulmonary Resuscitation: The Jigsaw Model [21]	2016	Charlier N	Europe and North America	The Journal of Emergency Medicine	1.3	Positive	20
E-learning and near-peer teaching in electrocardiogram education: a randomised trial [4]	2016	Davies A	Europe and North America	The Clinical Teacher	1.2	Positive	16

Table 1a. Continued.

Title	Year	Author	region	Journal	Impact factor (WoS, 2024)	Primary outcome	OQSs
How can we improve teaching of ECG interpretation skills? Findings from a prospective randomised trial [22]	2016	Raupach T	Europe and North America	Journal of Electrocardiology	1.2	Positive	21
The influence of tutor training for peer tutors in the dissection course on the learning behavior of students [23]	2016	Shiozawa T	Europe and North America	Annals of anatomy	1.7	Negative	16
Medical students can teach communication skills - a mixed methods study of cross-year peer tutoring [24]	2017	Nomura O	Asia	BMC Medical Education	3.2	Positive	21
Peripheral venous catheter insertion simulation training: A randomized controlled trial comparing performance after instructor-led teaching versus peer-assisted learning [25]	2017	Pelloux S	Europe and North America	Anaesthesia, Critical Care & Pain Medicine	4.7	Negative	21
Effectiveness of horizontal peer-assisted learning in physical examination performance [26]	2017	Shah I	Asia	Journal of Ayub Medical College Abbottabad	0	Positive	19
Optimizing resource utilization during proficiency-based training of suturing skills in medical students: a randomized controlled trial of faculty-led, peer tutor-led, and holography-augmented methods of teaching [27]	2020	Lemke M	Europe and North America	Surgical Endoscopy	2.7	Negative	24
Peers versus professional training of basic life support in Syria: a randomized controlled trial [28]	2018	Abbas F	Asia	BMC Medical Education	3.2	Negative	22
Basic echocardiography for undergraduate students: a comparison of different peer-teaching approaches [29]	2018	Gradl-Dietsch G	Europe and North America	European Journal of Trauma and Emergency Surgery	2.2	Negative	18
Teaching paediatric basic life support in medical schools using peer teaching or video demonstration: A prospective randomised trial [30]	2018	Stephan F	Europe and North America	Journal of Paediatrics and Child Health	1.4	Positive	18
Outcomes of three different ways to train medical students as ultrasound tutors [31]	2019	Celebi N	Europe and North America	BMC Medical Education	3.2	Positive	18
Evaluation of the role of near-peer teaching in critical appraisal skills learning: a randomized crossover trial [32]	2019	Widyahening IS	Asia	International Journal of Medical Education	1.9	Negative	21
Peer-led pediatric resuscitation training: effects on self-efficacy and skill performance [33]	2020	Binkhorst M	Europe and North America	BMC Medical Education	3.2	Positive	24
Video-based, student tutor- versus faculty staff-led ultrasound course for medical students - a prospective randomized study [34]	2020	Eimer C	Europe and North America	BMC Medical Education	3.2	Negative	22
Long-term knowledge retention after peer-assisted abdominal ultrasound teaching: Is PAL a successful model for achieving knowledge retention? [35]	2020	Nourkami-Tutdibi N	Europe and North America	Ultraschall in der Medizin	2.9	Positive	12
Can we use peer-assisted learning to teach basic surgical skills? [36]	2020	Ong MN	Asia	Malaysian Journal of Medical Science	1.5	Positive	15

Table 1a. Continued.

Title	Year	Author	region	Journal	Impact factor (WoS, 2024)	Primary outcome	OQSs
Peer assisted learning: a pedagogical alternative of teaching skills to medical students [37]	2020	Ribeiro JF	Europe and North America	Acta Medica Portuguesa	1.0	Positive	21
Team-based learning for teaching musculoskeletal ultrasound skills: a prospective randomised trial [38]	2021	Cremerius C	Europe and North America	European Journal of Trauma and Emergency Surgery	2.2	Positive	24
Peer assisted learning: A new teaching approach in undergraduate medical students [39]	2021	Divya R	Asia	Journal of Clinical & Diagnostic Research	0.2	Positive	16
Evaluating the effectiveness of a structured, simulator-assisted, peer-led training on cardiovascular physical examination in third-year medical students: a prospective, randomized, controlled trial [40]	2021	Kronschnabl DM	Europe and North America	GMS Journal for Medical Education	1.7	Positive	22
Effectivity of near-peer teaching in training of basic surgical skills - a randomized controlled trial [41]	2021	Pintér Z	Europe and North America	BMC Medical Education	3.2	Positive	20
An observation of the peer-assisted learning (PAL) method in the clinical teaching of vertigo/dizziness-related diseases for standardized residency training (SRT) students in China: a randomized, controlled, multicenter study [42]	2021	Xu R	Asia	BMC Medical Education	3.2	Positive	23
Peer-assisted versus expert-assisted learning in virtual chest x-ray interpretation: a randomized controlled trial [43]	2022	Alsulmi ML	Asia	Saudi Medical Journal	1.5	Negative	20
The effect of Flipped Classroom through Near Peer Education (FC through NPE) on patient safety knowledge retention in nursing and midwifery students: a solomon four-group design [44]	2022	Golaki SP	Asia	BMC Medical Education	3.2	Negative	24
Near-peers effectively teach clinical documentation skills to early medical students [45]	2022	Kusnoor AV	Europe and North America	BMC Medical Education	3.2	Positive	7
Pediatric nursing students' self-efficacy regarding medication administration and clinical comfort and worry: a pre-posttest comparative study of nurse mentoring versus peer mentoring [46]	2023	Öztürk Şahin Ö.	Europe and North America	Nurse Education in Practice	4.0	Positive	20
Using tele-ultrasound to teach medical students: a randomised control equivalence study [47]	2023	Zhao RT	Europe and North America	Australasian Journal of Ultrasound in Medicine	0	Positive	24
Near-peer compared to faculty teaching of abdominal ultrasound for medical students - A randomized-controlled trial [48]	2024	Hari R	Europe and North America	Ultraschall in der Medizin	2.9	Positive	20
Peer-led versus instructor-led structured debriefing in high-fidelity simulation: a mixed-methods study on teaching effectiveness [49]	2024	He X	Asia	BMC Medical Education	3.2	Positive	21

Table 1a. Continued.

Title	Year	Author	region	Journal	Impact factor (WoS, 2024)	Primary outcome	OQSs
Learning with our peers: peer-led versus instructor-led debriefing for simulated crises, a randomized controlled trial [50]	2024	Jaffrelot M	Europe and North America	Korean Journal of Anesthesiology	6.3	Positive	24
The effect of peer mentoring program on clinical academic progress and psychological characteristics of operating room students: a parallel randomized controlled trial [51]	2024	Sedigh A	Asia	BMC Medical Education	3.2	Positive	24
Teledidactic peer-tutored musculoskeletal ultrasound training for medical students-the TELMUS study [52]	2025	Neubauer R	Europe and North America	Rheumatology	4.4	Positive	14
Comparison of online peer-assisted learning and faculty-led teaching for short answer questions [53]	2025	Samra GS	Europe and North America	The Clinical Teacher	1.2	Positive	16
Juxtaposing pedagogical paradigms: the efficacy of peer-assisted learning (PAL) versus faculty-assisted learning (FAL) in the refinement of surgical proficiency [54]	2025	Vijayan ST	Asia	BMC Medical Education	3.2	Negative	19

PAL, peer-assisted learning; ECG, electrocardiogram; OQSs, overall quality scores.

Table 1b. Basic characteristics of the included RCTs.

Characteristic		No. of studies (n = 48)	Proportion (%)
Year of publication	2010–2015	13	27.1
	2016–2020	18	37.5
	2021–2025	17	35.4
Region in which RCTs were conducted	Asia	12	25.0
	Europe and North America	36	75.0
Journal	Clinical Teacher	2	4.2
	Ultraschall in Der Medizin	3	6.3
	BMC Medical Education	15	31.3
	GMS Zeitschrift fur Medizinische Ausbildung	2	4.2
	Other journals	26	54.2
Impact factor	<4	39	81.3
	4–10	9	18.8
	>10	0	0.0
Primary outcome	Positive	36	75.0
	Negative	12	25.0
Sample size	<200	48	100.0
	200–400	0	0.0
	>400	0	0.0

Every trial enrolled fewer than 200 participants (100%). Most studies were conducted in Europe or North America (75.0%), and 81.3% of the studies were published in journals with an impact factor <4. The journal impact factors were sourced from the Web of Science database (current as of 2024).

3.3 Reporting Quality Assessment

The reporting quality assessment of these trials, conducted in accordance with the CONSORT 2010 guidelines, is systematically summarized in Table 2.

High compliance was observed for structured abstracts (95.8%), intervention details (100%), outcome definitions (100%), and statistical methods (100%). However, deficiencies were common in randomization restrictions (27.1%), allocation concealment (27.1%), implementation (25.0%), ancillary analyses (22.9%), adverse event reporting (2.1%), trial registration (56.3%), and protocol availability (33.3%) (Table 2).

In summary, although several items (e.g., structured abstracts, intervention details, outcome definitions) were well reported, key methodological domains—including randomization, allocation concealment, adverse event reporting, ethical issues, and trial registration—were frequently omitted, indicating substantial deficiencies in the overall reporting quality of RCTs regarding PT.

According to CONSORT item 28, 27 out of the studies 48 (56.3%) disclosed funding sources.

4. Discussion

This study conducted a novel methodological evaluation of RCTs investigating PT interventions in medical education. The CONSORT Statement was originally developed in 1996, subsequently revised in 2001, and substantially updated in 2010, with numerous accompanying interpretive publications [1,56,57]. Despite the constant updates to the guidelines, persistent deficiencies remain in the overall reporting quality of RCTs of the PT interventions in medical education.

The quality assessment revealed that numerous RCTs omitted key items required by the CONSORT 2010 guidelines, substantially compromising the interpretability of study findings and potentially leading to erroneous conclusions. Furthermore, our analysis identified limitations in applying the 2010 CONSORT criteria to PT research, particularly regarding randomization and other poorly reported items such as allocation concealment, highlighting methodological challenges inherent to educational settings where course arrangements are typically predetermined by academic administrations rather than individual instructors. These constraints were reflected in the limited reporting of randomization and allocation concealment across the evaluated studies. Moreover, standard CONSORT Statements pertaining to adverse events were systematically absent from RCTs on PT, indicating potential publication bias. Consequently, we propose that educational reform efforts integrate documentation of unintended effects to more comprehensively capture related outcomes. This should include adverse dimensions such as elevated student stress, anxiety, and frustration, in addition to increased teacher workload and resistance.

The ongoing advancement of new technologies, methodologies, and pedagogical theories has driven continuous innovation and widespread expansion in medical education research. Evolving theoretical frameworks, in-

Table 2. Reporting quality of included RCTs based on selected items adapted from the CONSORT 2010 Statement (*n* = 48).

Item	Criteria	Description	No. of positive trials	Rate (%)	Cohen's κ coefficient
1	Title	Identification as a randomized trial in the title	23	47.9	0.91
2	Abstract structure	Structured summary of trial design, methods, results and conclusions	46	95.8	0.66
3	Background	Scientific background and explanation of rationale	48	100.0	NA*
4	Objectives	Description of the specific objectives or the scientific hypotheses in the introduction	48	100.0	NA*
5	Trial design	Description of trial design, including allocation ratio	43	89.6	0.59
6	Participants	Description of the eligibility criteria for participants	46	95.8	0.52
7	Settings and location	Description of the settings and locations where the data were collected	37	77.1	0.67
8	Interventions	Details of the interventions intended for each group	48	100.0	NA*
9	Outcomes	Definition of primary and secondary outcome measures, including how and when they were assessed	48	100.0	NA*
10	Sample size	Description of sample size calculation	19	39.6	0.89
11	Randomization, sequence generation	Definition of the method used to generate the random allocation sequence	23	47.9	0.68
12	Randomization, restriction	Description of the type of randomization; details of any restriction	13	27.1	0.78
13	Allocation concealment	Description of the mechanism used to implement the random allocation sequence to assure concealment until interventions were assigned	13	27.1	0.42
14	Implementation	Description of who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	12	25.0	0.21
15	Blinding	Whether or not participants, those administering the interventions, or those assessing the outcomes were blinded to group assignment; if relevant, description of the similarity of interventions	29	60.4	0.53
16	Statistical methods	Description of the statistical methods used to compare groups for primary and secondary outcomes	48	100.0	NA*
17	Ancillary analysis, method	Description of the methods for additional analyses, such as subgroup analyses and adjusted analyses	17	35.4	0.57
18	Diagram	A CONSORT diagram was presented to show the flow of participants	29	60.4	0.89
19	Participant flow	Details on the flow of participants through each stage of the trials (number of patients randomly assigned, receiving intended treatment, and were analyzed for the primary outcome)	45	93.8	0.86
20	Recruitment	Dates defining the periods of recruitment and follow-up	29	60.4	0.57
21	Baseline data	A table showing baseline demographic and clinical characteristics for each group	26	54.2	0.52
22	Intent-to-treat analysis	Number of patients in each group included in each analysis and whether patients were analyzed according to the group to which they were randomly assigned	37	77.1	0.46
23	Outcomes measures	For each primary and secondary outcome, a summary of results for each group, the estimated effect size, and its precision (e.g., 95% CI) are provided	48	100.0	NA*

Table 2. Continued.

Item	Criteria	Description	No. of positive trials	Rate (%)	Cohen's κ coefficient
24	Ancillary analyses	Results of subgroup analyses and adjusted analyses, distinguishing prespecified from exploratory	11	22.9	0.52
25	Adverse event classification	Description of all important adverse events in each group, with classification	1	2.1	1
26	Registration	Presentation of the registration number and name of trial registry	27	56.3	0.89
27	Protocol	Where the full trial protocol can be accessed	16	33.3	1
28	Funding	Sources of funding and other support	27	56.3	0.89

CI, confidence interval; CONSORT, Consolidated Standards of Reporting Trials; NA, not applicable.

*Cohen's κ indices could not be calculated because the positive rates awarded by the two investigators were both 100% for these items.

structional approaches, and management models have kept pace with contemporary demands, fostering significant improvements in teaching competence, the training of medical professionals, and the cultivation of medical humanities. Nevertheless, a predominant emphasis on innovating teaching theories, methods, and administration has led to the relative neglect of critical dimensions such as educational ethics, acquisition of participants' informed consent, and assessment of potential benefits and risks. Moreover, the absence of standardized implementation and oversight protocols across the research process—particularly within empirical educational studies—constitutes a pressing concern, substantially impeding the standardized development of pedagogical research [58].

While PT is commonly perceived as primarily being implemented in academic settings, our systematic literature search revealed its broader applicability across diverse educational contexts [59]. The identified RCTs demonstrate PT's utilization not only in traditional school environments [5], but also in professional medical training for practitioners, patient education programs, and general public health initiatives [60,61,62,63]. This empirical evidence suggests PT's adaptability to various instructional scenarios with potentially differential outcomes. The accumulated research findings establish a robust evidentiary foundation for expanding PT applications across multiple domains of teaching and learning.

Our findings indicate suboptimal reporting quality among PT-related RCTs. During our systematic literature search utilizing keywords including "PT" and "RCT", we encountered substantial retrieval challenges stemming from terminological ambiguity, as "PT" carries multiple meanings across medical contexts. This observation underscores the critical need for refined search methodologies, standardized terminology, and optimized retrieval strategies to enhance both the precision of literature identification and the accuracy of subsequent quality assessments.

An additional factor contributing to the suboptimal quality of PT-related RCTs is the absence of a weighted evaluation system for items in the CONSORT 2010 Statement. Current assessment approaches fail to account for the differential importance of various checklist items in determining overall trial quality. For instance, methodological elements like proper randomization and allocation concealment carry substantially greater weight in ensuring trial validity than comparatively peripheral components such as abstract structure. While the academic community generally acknowledges the need for item-specific weighting in CONSORT-based evaluations, empirical research establishing appropriate weighting schemes remains remarkably limited. Although several methodological studies have proposed weighted scoring systems for RCT quality assessment, these attempts lack robust theoretical foundations and have not been formally incorporated into the CONSORT framework. Notably, none of these proposed weighting systems have been adequately validated against the gold-standard CONSORT 2010 guidelines.

In summary, this study highlights that two primary factors contribute to the suboptimal reporting quality of PT-related RCTs. First, the current CONSORT 2010 Statement demonstrates limited applicability for educational intervention studies and lacks differential weighting for checklist items of varying importance. Second, researchers conducting pedagogical RCTs were not highly attuned to the CONSORT guidelines compared to their clinical research counterparts, resulting in frequent omissions of fundamental elements like trial registration and protocol documentation.

To address these limitations, we strongly recommend that investigators, peer reviewers, and journal editors enhance their understanding of CONSORT standards to improve research reporting. Furthermore, we advocate for methodological experts to develop CONSORT extensions specifically tailored for educational research, incorporating weighted scoring systems that reflect the relative significance of different reporting items.

Although this study primarily employed descriptive analyses, exploratory comparisons suggested potential patterns. Studies published after 2015 did not show marked improvement in reporting quality compared with earlier publications, indicating that the dissemination of CONSORT standards in educational research remains limited. Similarly, trials published in journals with higher impact

factors did not consistently demonstrate better adherence, suggesting insufficient enforcement of reporting guidelines across publication venues. Regional differences were also noted, with European and North American studies constituting the majority of trials; however, many still failed to report key methodological domains, such as allocation concealment. These findings underscore that the suboptimal quality of PT-related RCTs is not confined to specific settings but represents a systemic issue in medical education research.

5. Limitations

This study has several limitations. First, although a comprehensive search of three major databases was performed, some relevant studies indexed elsewhere or unpublished might have been missed. One limitation is that we restricted our search to studies published after 2010. Although this decision was made to enhance the novelty and adequacy of included studies, it may have led to the exclusion of some relevant earlier trials. Second, our use of a dichotomous scoring system (0/1) for CONSORT items may oversimplify reporting quality. Third, the assessment inevitably involved subjective judgment, although inter-rater reliability was quantified using Cohen's κ. Finally, as the study focused solely on PT in medical education, generalizability to other educational interventions may be limited.

Our findings confirm the suboptimal reporting adherence of PT-related RCTs to CONSORT 2010 guidelines, highlighting the need for approaches that go beyond generic recommendations to strengthen reporting practices. One practical step would be to pilot a weighted version of the CONSORT checklist, assigning higher importance to critical methodological items such as randomization and allocation concealment. Furthermore, a draft CONSORT extension tailored for educational interventions, incorporating items such as educational context, tutor characteristics, and assessment methods, could be implemented on a trial basis in medical education journals. Such targeted measures would provide more concrete tools for improving reporting quality and enhancing the credibility of evidence in PT research.

6. Conclusion

This study demonstrated that while RCTs on PT in medical education have become increasingly common, their overall reporting quality remains suboptimal. Although certain items such as structured abstracts, intervention descriptions, and outcome definitions were well reported, major omissions were identified in key methodological domains, including randomization, allocation concealment, trial registration, and protocol availability. These deficiencies limit the interpretability, reproducibility, and credibility of PT-related evidence. To improve the quality of future research, we recommend targeted training for investigators, peer reviewers, and journal editors on CONSORT standards, the adoption of stricter reporting requirements by medical education journals, and the development of CONSORT extensions specifically tailored to educational interventions.

Key Points

• PT has gained traction as a pedagogical approach utilized in medical education, but the reporting quality of related RCTs based on CONSORT 2010 guidelines remains suboptimal.

• Among 48 RCTs evaluated against the CONSORT 2010 checklist, good compliance was demonstrated for items such as structured abstracts, intervention details, and outcome definitions, but key elements—randomization, allocation concealment, trial registration, and protocol availability—were frequently missing, potentially compromising the reliability and interpretability of their findings.

• Future RCTs should adopt more rigorous reporting practices and pilot weighted CONSORT-based checklists, and a CONSORT extension tailored to educational interventions should be developed to accommodate the unique reporting considerations of education-themed RCTs.

Availability of Data and Materials

The data and materials are available from the corresponding authors upon reasonable request.

Author Contributions

XLZ and SML conceived and designed this project; XLZ collected and analyzed the literatures and wrote the draft; YJG, FWW, and YRC collected and analyzed the literatures, and reviewed and polished the draft. FWW and SML also provided financial support; JL provided technical support for statistical issues and contributed to data acquisition, analysis, and interpretation. All authors contributed to revising the manuscript critically for important intellectual content. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

Not applicable.

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Conflict of Interest

The authors declare no conflict of interest.

Supplementary Material

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.31083/BJHM56148.

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