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Is there resource wastage in the research for spinal diseases? An observational analysis of discontinuation and non-publication in randomised controlled trials

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ABSTRACT

Introduction: The scale of waste in research funding systems is large and detrimental to research capacity. Both incompleteness and non-publication of Randomised Controlled Trials (RCTs) have been increasingly reported in the literature. This is a serious consequence as RCTs demand monumental amounts of healthcare resources leading to wastage. Most importantly, both under-reporting and non-publication can distort the evidence landscape and obscure rationale behind clinical decisions.

Research question: We, therefore, aimed at conducting the first systematic assessment of registered trial discontinuation and non-publication in the field of spinal disorders.

Material and methods: A list of RCTs was obtained from the U.S National Library of Medicine ClinicalTrials.gov database from January 1st, 2013, to December 31st, 2020. Two independent authors excluded all non-RCTs, trials unrelated to spinal diseases, and trials that are in or before the recruitment phase. We extracted the progress status, sources of funding, the number of centres, type of intervention, principal investigator's department affiliation, publication status, location, the reason for discontinuation, publication date, and subtopics.

Results: 112 trials were included in the study. 25 (22%) trials were discontinued early, with slow recruitment being the major reason (38%). Only 56 (50%) of the trials were published in peer-reviewed journals. The publication rate amongst discontinued trials was significantly lower compared to completed trials ($P < 0{\cdot}001$). The trial discontinuation rate was much higher in trials registered in the United States (US) compared to other countries ($P = 0{\cdot}009$). Industry-sponsored studies had 11 trials (23·4%) that were discontinued whilst there was 20% of non-industry-sponsored studies that were unfinished. Only 20% of the trials were compliant with the FDA reporting requirements over the study period.

Discussion and conclusion: Nearly a quarter of all trials in spinal disorders were discontinued. Half of the trials were unpublished. There was over a third of trials that were completed but not published. These rates remain worrisome from an ethical and financial perspective. Both under-reporting and non-publication adversely affect efforts in evidence synthesis and can compromise clinical guideline development.

1. Introduction

1.1. Background

When making decisions about clinical interventions, randomised controlled trials (RCTs) are defined as the most highly weighted type of primary study in the traditional hierarchy of evidence-based medicine, following systematic reviews and meta-analysis. Conversely, there is an increasing body of literature reporting both an incompleteness of such trials and the non-publication of results. This poses a threat to the field of clinical research as it jeopardises the bias and credibility of data, the availability and accessibility of healthcare research resources and

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ultimately patient wellbeing. Whether trials are commercially funded or academically rooted, their under-reporting has consistently surfaced as an issue, particularly in the drug and devices industry. More recently, light has been shed on RCTs in surgical specialties, which share similar adversities with the traditional pharmaceutical trials. Both under-reporting and non-publication distorts evidence and obscures rationale behind clinical decisions (Jamjoom et al., 2017; Chalmers et al., 2013; Chapman et al., 2014; Briel et al., 2016). Furthermore, RCTs demand monumental amounts of resources, both financial and not, rendering the harmful effects of non-publication even more serious (Glass and Hollander, 2009; Ravinetto et al., 2015; Speich et al., 2018). This can compromise efforts in evidence synthesis and clinical guideline development.

In previous work from our team, the discontinuation, non-publication, and quality of RCTs in neurosurgery were assessed. The discontinuation rate and non-publication rate were found to be 27% and 30% respectively. It is worthy of note that the spinal subspecialty has had reportedly the largest portion (27%) of registered neurosurgical trials (Jamjoom et al., 2017). This concurs with the 2019 Global Burden of Disease study published in *The Lancet* reporting 'low back pain' as one of the top 10 burdens in all ages (Diseases and Injuries, 2020). Additional literature supports that spinal RCTs are the most prevalent (49%) amongst neurosurgical trials, delineating the copious amount of healthcare resources being consumed for research in this subspecialty (Martin et al., 2019). Of course, the field of spine is not only limited to neurosurgical research but also extends in true multi-disciplinary fashion to orthopaedic surgery, pain management, physical therapy, and other medical specialties; it also spans across a wide spectrum of pathological processes including degenerative diseases, tumours, infections, injuries, and rheumatological conditions (Topics, 2021). In 2019, National Institutes of Health (NIH) reported its estimates for research funding of spinal cord injuries alone to be as much as 76 million dollars (Diversity Awards, 2021). Despite such sizable investments, a previous assessment of spinal surgery RCTs reported substandard quality. Naunheim and colleagues used a standardised checklist for evidence-based grading of RCTs, namely the Consolidated Standards of Reporting Trials (CONSORT) formulated in 1996. RCTs in average only met 65% of the CONSORT-derived criteria. Most lacked details of successful blinding, specification of primary outcomes, and external validity (Naunheim et al., 2011). However, while that study reported limitations of published studies, it did not address the issue of discontinued and non-published trials.

Over the past few decades, many have endeavoured to ensure transparency in the reporting of clinical trials. Since its establishment, CONSORT had been updated twice, in 2001 and then again in 2010, when an extension for non-pharmacological trials was added (Nagendran et al., 2013). A major clinical trial registry- European Union Drug Regulating Authorities Clinical Trials Database (EduraCT)- was established in 2004 with the aim of incorporating all clinical trials on medicinal products. Moreover, the European Union Clinical Trials Register has contributed to making details publicly available since 2011 (EudraCT Public website, 2021). The American counterpart of EduraCT is ClincalTrials.gov, a web-based open access repository of clinical trials conducted internationally. This database is highly regarded for its inclusivity and its positive impact in research involving human subjects (Bourgeois, 2010).

In 2008, the American Food and Drugs Administration (FDA) mandated reporting of results within a year of trial completion. Despite the efforts of FDA, low compliance and lack of enforcement of the requirement has been identified in studies that reviewed ClinicalTrials.gov (Prayle et al., 2012). Therefore, even more recent attempts have been made through projects such as the AllTrials campaign, advocating for publication of results, elimination of bias and wastage of resources generated by unregistered, unreported trials (Chalmers et al., 2013).

1.2. Aim

We aimed at conducting the first systematic assessment of registered trial discontinuation and non-publication in the field of spinal disorders. This study has the potential to expose and highlight the current need for greater transparency and accountability in outcome reporting within the field.

2. Methods

2.1. Search

A list of randomised controlled clinical trials in the field of "Spinal Disease" was obtained from the U.S. National Library of Medicine ClincalTrials.gov database. The search string containing relevant medical subject headings (MeSH) was informed by ClinicalTrials.gov glossary and devised by a consultant neurosurgeon (A.K.D.); the full search string used in this study was "(Spinal OR spine OR back OR neck) AND (Degeneration OR infection OR deformity OR tumour OR cancer OR congenital OR trauma OR cord injuries OR pain OR medication)". Within our search parameters, the study period from January 1, 2013, to December 31, 2020, was used to prevent overlap with previously published data (3).

The initial screen yielded 8879 clinical trials. Further filters were applied to exclude all phase 1 and 2 clinical trials, as well as to exclude any ongoing trials that were classed as "Not yet recruiting", "Recruiting", "Enrolling by invitation", "Active, not recruiting" or "Unknown".

After the application of search filters, a total of 397 clinical trials were identified. These trials were then screened by two independent reviewers (J.T., J.J.P.) to exclude all the non-RCTs, as well as trials that were not considered directly relevant to the field of "Spinal Diseases". This yielded a total of 112 trials that met all our inclusion and exclusion criteria (Fig. 1).

2.2. Data items

The identified trials were screened by the same reviewers for their progress status, sources of funding status (industry or non-industry funding), number of centres (single or multi-centre), type of intervention (procedure, device, drug, other), personal investigator's background and/or department affiliation, publication status, location, and subtopic. All the published trials were further screened for their publication date, completeness of trial objectives and journal impact factor. For trials that were discontinued, the reason for discontinuation was sought. Any disagreement between the two reviewers was settled with discussion amongst all authors.

2.3. Statistical analysis

The primary study outcomes were trial discontinuation and non-publication rate. The secondary outcomes included reasons for discontinuation and nonpublication; time from the end of the trial to publication; personal investigator's background; funding status; intervention type; subtopic distribution; and location. Statistical analysis was conducted in Microsoft Office Excel 2020 Software Package, with additional support of statistics calculators publicly available on the Social Science Statistics website. Where different groups were compared, a two-tailed independent student t-test and chi-squared test were used. A P value of <0.05 was considered statistically significant.

3. Results

3.1. Study characteristics

Among the 112 analysed randomised controlled trials included in this study, 47 (42%) were industry funded, while the remaining 65 (58%) were led by non-industry sponsors such as universities (51%, 33/65), hospitals (46%, 30/65), non-profit organizations (1.5%, 1/65), and private individuals (1.5%, 1/65). As many as 45 (43%) were large trials enrolling participants from multiple centres, while 59 (57%) were run at a single clinical centre. The majority of trials were conducted in the United States

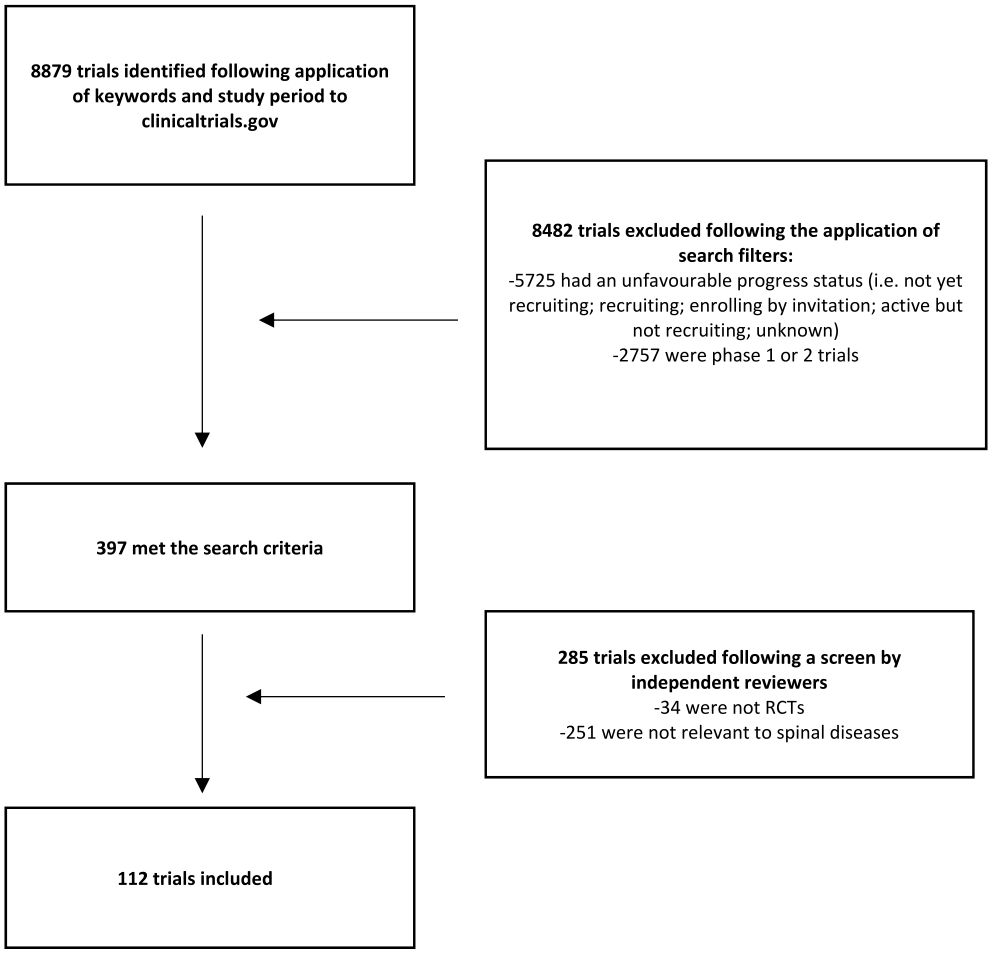

Fig. 1. Flow diagram highlighting trial inclusion and exclusion criteri

(44%), China (13%) and Turkey (5%), with 14% being labelled as "International"; the remaining 24% were carried out in South Korea (2·5%), Denmark (1·5%), Russia (1·5%), France (1·5%), Egypt (1·5%), Germany (1·5%), Canada (1·5%), Japan (1·5%), Greece (0·7%), Taiwan (0·7%), Austria (0·7%), Finland (0·7%), Norway (0·7%), Thailand (0·7%) and Lebanon (0·7%). The median time from start to completion of analysed trials was 667 days, with a range from 98 to 2039 days.

The main study areas were "Back pain" (42·5%), "Postoperative pain management" (21%), and "Ankylosing Spondylitis" (19·5%). Other topics included "Spinal cord injuries" (4%), "Degenerative spinal diseases" (2·5%), "Radiculopathies" (2·5%), "Spinal tumours" (1.5%), "Congenital spinal diseases" (1·5%), "Inflammatory spinal diseases" (1·5%), "Back and neck pain (mixed population)" (1·5%), "Neck pain" (1%) and "Postoperative infections prevention" (1%) (Table 1). A large majority of trials explored the effects of a new drug, or the use of an old compound for a new clinical indication (77%). The remaining trials explored the application of innovative procedures (11%), the use of novel medical devices (3%) or other therapeutic approaches (9%). The principal investigators' (PIs) backgrounds were only available for 60 (54%) trials. Out of the trials where PIs' backgrounds were obtained, 30% of PIs were anaesthesiologists, 13% rheumatologists, 10% orthopaedic surgeons, 8% neurosurgeons, 7% emergency medicine physicians, 7% neurologists, 7% physical therapists, 5% rehabilitation medicine physicians, 5% traditional oriental medicine practitioners, 5% pain medicine specialists, 1·5% physiologists, and 1·5% internal medicine physicians.

Table 1
The study areas of reviewed trials.

Subtopic	Number of trials (%)
Back Pain	47 (42.5%)
Postoperative Pain Management	23 (21%)
Ankylosing Spondylitis	21 (19.5%)
Spinal Cord Injuries	5 (4%)
Degenerative Spinal Diseases	3 (2.5%)
Radiculopathy	3 (2.5%)
Spinal Tumours	2 (1.5%)
Congenital Spinal Diseases	2 (1.5%)
Inflammatory Spinal Disease	2 (1.5%)
Back and Neck Pain (mixed population)	2 (1.5%)
Postoperative Infection Prevention	1 (1%)
Neck Pain	1 (1%)

3.2. Trial discontinuation rate

Out of the 112 analysed trials, 25 (22%) were discontinued early. Specifically.

- 12 trials were "Terminated" (i.e. stopped early and will not start again),
- 12 were "Withdrawn" (i.e. stopped early, before enrolling its first participant), and
- 1 was "Suspended" (i.e. stopped early but may start again)

The reasons for discontinuation were obtained directly from clinicaltrials.gov website, where trial PIs were required to provide a brief comment when requesting trial discontinuation.

The main reasons listed were:

- slow recruitment (38%, 10/25)
- logistical issues (12%, 3/25),
- lack of funding (12%, 3/25),
- failure to achieve desired endpoints (12%, 3/25),
- PI factors (i.e. PIs leaving the institution or deciding not to proceed with the trial) (12%, 3/25),
- COVID-19 (8%, 2/25), and
- failure to obtain ethical approval (4%, 1/25) (Fig. 2).

Interestingly, the discontinuation rate was much higher in trials registered in the United States (US) when compared to trials run in other countries (30% vs 12%; $P = 0{\cdot}009$). The discontinued trials were more likely to be smaller single centre studies, although this was not statistically significant ($P = 0{\cdot}3$). It was less surprising that the mean duration of discontinued trials was shorter than the mean duration of completed trials - 649 days (SD = 235) vs 762 days (SD = 454). Furthermore, the publication rate among discontinued trials was much lower when compared to completed trials ($P < 0{\cdot}0001$). An in-depth comparison between the completed and discontinued trials across a range of parameters is presented in [Table 2].

3.3. Trial publication outcomes

Our search found that only 56/112 (50%) trials were published in peer-reviewed journals. A detailed comparison between published and non-published trials is presented in [Table 2].

Table 2
A comparison of completed and discontinued trials based on a range of parameters.

Parameter	Completed (%)	Discontinued (%)	p-value
Topic			
Back Pain	40 (46%)	7 (28%)	
Postoperative Pain Management	18 (20%)	5 (20%)	
Ankylosing Spondylitis	16 (18.5%)	5 (20%)	
Spinal Cord Injuries	2 (2.5%)	3 (12%)	
Degenerative Spinal Diseases	1 (1%)	2 (8%)	
Radiculopathy	1 (1%)	2 (8%)	
Spinal Tumours	2 (2.5%)	0 (0%)	
Congenital Spinal Diseases	2 (2.5%)	0 (0%)	
Back and Neck Pain (mixed population)	2 (2.5%)	0 (0%)	
Inflammatory Spinal Disease	1 (1%)	1 (4%)	
Neck Pain	1 (1%)	0 (0%)	
Postoperative Infection Prevention	1 (1%)	0 (0%)	
Intervention type			p = 0.63
Drug	67 (78%)	19 (76%)	
Device	3 (3%)	1 (4%)	
Procedure	8 (9%)	4 (16%)	
Other	9 (10%)	1 (4%)	
Funding status			p = 0.89
Industry	37 (43%)	11 (44%)	
Non-industry	50 (57%)	14 (56%)	
Number of centres			p = 0.3
Multi-centre	38 (46%)	7 (33%)	
Single centre	45 (54%)	14 (67%)	

4. Discussion

4.1. Study areas of spinal RCTs

Back pain was the major topic of investigation in the RCTs, followed by postoperative pain management, and ankylosing spondylitis (AS). The focus on back pain research can be explained by a significant global burden of this presentation. Eighty percent of the population is likely to suffer from back pain during their lifetime. For two decades, back pain has been the leading cause of years lived with disability (YLD) globally (Wu et al., 2020). Additionally, our study demonstrates that the field of back pain is investigated across a variety of specialties: pain management, neurosurgery, emergency medicine, internal medicine, oriental medicine, anaesthesiology, family medicine, orthopaedic surgery, rheumatology, physiology, physical therapy, and traditional Chinese medicine.

The patient burden of postoperative pain after spinal surgery is well iterated throughout the literature. It has been reported that one-fifth of patients who have received lumbar surgery met the criteria of persistent postoperative pain, leading to additional use of healthcare resources (Weir et al., 2017). Successful management of postoperative pain has shown a correlation with good prognosis for functional recovery, early discharge, and prevention of chronic pain (Bajwa and Haldar, 2015). In the larger context, postoperative pain has surfaced as an issue for being poorly controlled in 80% of the patients undergoing any form of surgical procedure in the US. (Gan, 2017)

Ankylosing spondylitis has also been consistently highlighted globally and in the US for its significant direct and indirect cost for management (Reveille et al., 2012). AS patients have been shown to need up

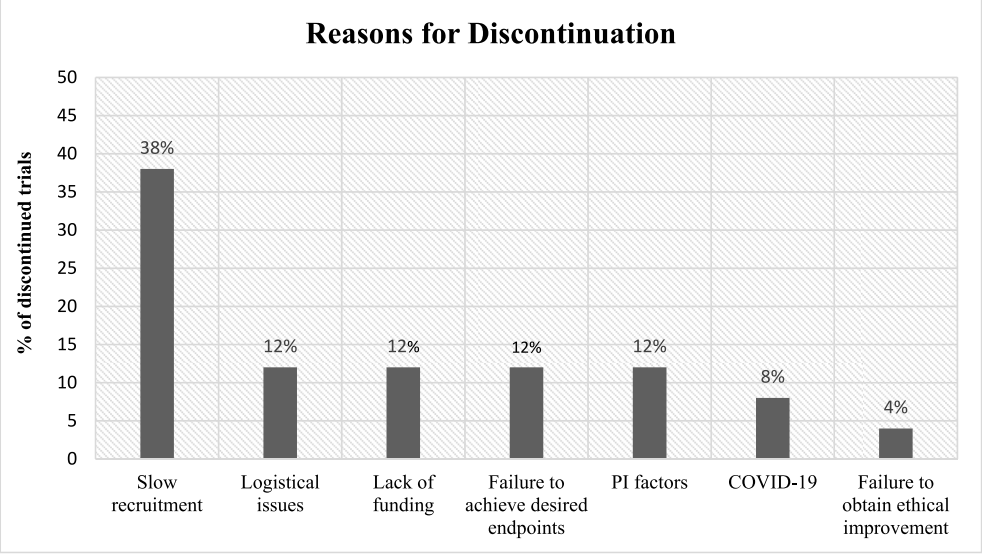

Fig. 2. Reasons for trial discontinuation (as per information provided on clinical.gov database).

to ten times more healthcare costs than their matched controls (Counting the costs of ankylosing, 2021). Without a doubt, the copious number of clinical trials reflect the patient and societal burden (Boonen and Van der Linden, 2006).

4.2. Affiliated specialties

In terms of the affiliated specialty or the specialty of the PI, non-surgical trials were responsible for most of the spinal RCTs. Out of the identifiable specialties, only 20% (22/112) were from surgical specialties – 11% (12/112) from orthopaedic surgery and 9% (10/112) from neurosurgery. Such a disproportionately low amount of RCTs from a surgical specialty is reflected throughout literature. Surgical RCTs face more difficulties than pharmacological RCTs in terms of standardising operative measures, varying surgical team experience, applying a placebo control, participant recruitment, and blinding (Rosenthal et al., 2015). Spinal surgical RCTs are of no exception (Naunheim et al., 2011). Most of the trials being conducted by anaesthesiologists can be explained by the prevalence of trials on pain management, and the fact that this is a much larger specialty than neurosurgery/spine surgery.

4.3. Discontinuation outcome

In our study, over one fifth (22%, 25/112) of the clinical trials were discontinued, which is similar to other studies (Briel et al., 2016), but better than the 43% discontinuation rate of surgical studies in general by Rosenthal et al. (2015)

In our previous study, 17 out of 64 trials related to the spinal subspecialty. Out of 17 of the spinal trials, 29% (5/17) were discontinued (Chapman et al., 2014). In comparison, discontinuation rates of spinal clinical trials in the neurosurgical specialty were higher than the average discontinuation rate of all spine-related trials. Only five trials in this current study were identifiable to be from the neurosurgical specialty and all were completed. Three out of the five trials were on drug interventions; therefore, the neurosurgical trials represented in this study may not share the same difficulties delineated in our previous study, which included difficulties with obtaining consent, ethical concerns of sham surgery, and patient drop-out (Chapman et al., 2014).

Slow recruitment remains one of the main reasons of trial discontinuation. In our study, 38% of discontinuation was because of this reason. Slow and poor recruitment of participants in trials is the most significant cause of trial discontinuation that has been highlighted numerous times in literature (Chapman et al., 2014; Kasenda et al., 2014). This includes our findings from our previous study where slow or insufficient enrolment was a major issue for neurosurgical trials (Jamjoom et al., 2017). Issues around this have been previously explored and suggested that 89% of the reasons for poor recruitment could have been anticipated before the start of the trial. Similarly, conducting a pilot or ensuring a feasibility phase to estimate an accurate number of eligible patients and explore the trial's eligibility criteria, can prevent the lack of eligible participants for the clinical trial (Briel et al., 2016).

Interestingly, the trial discontinuation rate was much higher in the US registered trials in contrast to trials conducted in other countries. This is concerning since trials in the US are estimated to cost 50% more than in developing countries such as India and China (May 2019). Although the exact amount of funding that is invested into RCTs in the US is unknown, Phase 3 trials for novel drugs that are approved by the FDA are estimated to cost $41,117 per patient. To put this into perspective, Phase 1, 2, 3 pharmaceutical trials have an average cost of approximately $4, $13, $20 million US dollars, respectively (Sertkaya et al., 2021). Lack of reporting of financial investments in spinal research makes an accurate estimation of funding wastage difficult. Nevertheless, there is enough evidence to suggest that the detrimental amount of resource misuse is due to a high discontinuation rate of spinal RCTs in the US.

4.4. Publication outcome

The non-publication rate at 50% (56/112) remains a concern both with regard to the costs and the potential funding wastage.

Out of the published trials, six (10·7%, 6/56) produced more than one publication. The majority of published trials were registered in clinical trial.gov database as completed, with the exception of four discontinued trials which also had their results published. The average impact factor of the published studies was 5·08, with a range from 0 to 36·1. The median time from the end of trial to publishing was 15 months, with a range from −8 to 68 months. There was no statistically significant difference between published and unpublished studies regarding the number of centres involved ($P = 0{\cdot}895$) and source of funding ($P = 0{\cdot}802$). The trials conducted in the United States had a lower publication rate compared to the rest of the world, although this was not statistically significant ($P = 0{\cdot}308$). An in-depth comparison between the published and unpublished trials across a range of parameters is presented in Table 3.

Reasons for nonpublication were not provided on the clinical.gov database; PIs were not directly contacted due to limited access to relevant contact information, low expected response rate, and significant risk of response bias. The available literature suggest that the most frequent reasons for non-publication of large clinical trials are (i) discrepancy between observed and desired results, and (ii) protection of intellectual property rights (Jones et al., 2013). Furthermore, it is common to overestimate the rate of nonpublication, as results may be published under different titles and authors (Johnson et al., 2020, 2021).

4.5. Compliance with reporting requirements

Out of 56 published trials, 22 trials had published results within 12 months of completion. This only amounts to 39% (22/56) of the published trials and 19·6% (22/112) of the total trials that are in accordance with the FDA's requirement for publication outcome. This is approximately the same compliance rate (22%) of RCTs as identified in a study conducted in 2011 (Prayle et al., 2012).

Table 3
A comparison of published and unpublished trials based on a range of parameters.

Parameter	Published (%)	Nonpublished (%)	p-value
Topic			
Back Pain	18 (32%)	27 (50%)	
Postoperative Pain Management	13 (23%)	9 (16%)	
Ankylosing Spondylitis	10 (18%)	11 (20%)	
Spinal Cord Injuries	4 (8%)	1 (2%)	
Degenerative Spinal Diseases	2 (3%)	2 (4%)	
Radiculopathy	2 (3%)	2 (4%)	
Spinal Tumours	1 (2%)	1 (2%)	
Congenital Spinal Diseases	1 (2%)	1 (2%)	
Back and Neck Pain (mixed population)	2 (3%)	0 (0%)	
Inflammatory Spinal Disease	1 (2%)	0 (0%)	
Neck Pain	1 (2%)	0 (0%)	
Postoperative Infection Prevention	1 (2%)	0 (0%)	
Intervention type			p = 0.87
Drug	47 (81%)	40 (74%)	
Device	2 (3%)	2 (4%)	
Procedure	5 (9%)	7 (13%)	
Other	4 (7%)	5 (9%)	
Funding status			p = 0.90
Industry	24 (41%)	23 (43%)	
Non-industry	34 (59%)	31 (57%)	
Number of centres			p = 0.96
Multi-centre	21 (42%)	22 (41%)	
Single centre	29 (58%)	31 (59%)	

Our results demonstrate that the compliance rate has not shown much improvement over the last decade, at least for RCTs in spinal disorders. The median time to have published results was also longer than the recommended time frame from the FDA. However, on ClinicalTrials.gov, completion of a trial was defined as the last visit of a participant. Therefore, the median time frame for publication is understandable considering the data analysis and time it takes for peer-review of the submission (The Basics, 2021).

4.6. Limitations and recommendations

Although our study is the most inclusive assessment of RCTs in spinal disorders in the literature thus far, future investigations can be improved by addressing a few of our limitations. Firstly, the study only included phase III clinical trials and used a single source of trial registry, ClinicalTrials.gov. The scope can be broadened by including phase I and II trials, as well as using other established registries such as Alltrials.net and EduraCT. Furthermore, our search for publication results was done through PubMed and Google Scholar (Google LLC) in the trials' respective titles, PIs, and keywords. However, there is a possibility that results were published under different titles, leading to an underestimation of publication outcome. Finally, this study assessed the landscape of trials in a single point in time. This might theoretically contribute to overestimating the discontinuation and non-publication rates for trials that may be resumed and published at a later time.

Assessing the quality of the trials and their adherence to validated guidelines such as CONSORT was not within the scope of this study. However, given the historical evidence of poor adherence of non-pharmacological trials and substandard quality of trials specifically in the context of spinal literature, evaluation of the quality of these trials is pivotal (Naunheim et al., 2011; Nagendran et al., 2013).

One approach that might prove effective in increasing completion of clinical trials is wider acceptance of registry-based randomised controlled trial (RRCT). This type of trial involves identification, recruitment, and data collection directly into a registry, and has been shown to facilitate patient follow-up and rates of trial completion (Li et al., 2016; Karanatsios et al., 2020). Furthermore, it remains essential that all clinical trials are registered in an established trial database such as ClinicalTrials.gov, as well as that they report their findings within 12 months of completion as required by the Final Rule of the FDA Amendments Act (FDAAA) and World Health Organisation (WHO)'s best practices in clinical research (Universities Allied for Essential Medicines, 2022).

Overall, it was interesting to note that 23·4% (11/47) of industry-sponsored studies were unfinished, and that 29·8% (14/47) of industry-sponsored studies were finished but not published. In contrast, 21·5% (14/65) of the non-industry-sponsored studies were unfinished whilst 37% (24/65) of non-industry-sponsored studies were finished but not published. To our knowledge, 34% (38/112) of the total included studies were finished but not published.

5. Conclusion

The scale of waste in research funding systems is large and detrimental to research capacity. Amongst RCTs relating to spinal conditions over the period 2013–2020, the discontinuation rate was 22% (25/112) and the non-publication rate was 50% (56/112). The proportion of studies that were completed but not published was 34%. Compliance rates with FDA reporting requirements remained low at 20% (22/112).

These rates remain worrisome from an ethical and financial perspective. Such research resource wastage can adversely affect efforts in evidence synthesis and clinical guideline development, and ultimately can influence patient care.

In order to optimise RCT completion and publication, greater transparency is needed amongst the scientific community so as to better understand the reasons behind research wastage. Only then will it be possible to minimise it and to protect research resource capacity.

Declaration of interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.

Contributions

AKD contributed to the conception of the study. ADK, JJP, JT designed the study. JJP, JT, AKD acquired data, analysed, and interpreted the data. All authors contributed to drafting the manuscript and revision of the content.

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