If exercise is medicine, why don't we know the dose? An overview of systematic reviews assessing reporting quality of exercise interventions in health and disease

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ABSTRACT

Objective To determine how well exercise interventions are reported in trials in health and disease.

Design Overview of systematic reviews.

Data sources PubMed, EMBASE, CINAHL, SPORTDiscus and PsycINFO from inception until June 2021.

Eligibility criteria Reviews of any health condition were included if they primarily assessed quality of exercise intervention reporting using the Consensus on Exercise Reporting Template (CERT) or the Template for Intervention Description and Replication (TIDieR). We assessed review quality using a modified version of A MeaSurement Tool to Assess systematic Reviews.

Results We identified 7804 studies and included 28 systematic reviews. The median (IQR) percentage of CERT and TIDieR items appropriately reported was 24% (19%) and 49% (33%), respectively. TIDieR items 1, *Brief name* (median=100%, IQR 4) and 2, *Why* (median=98%, IQR 6), as well as CERT item 4, *Supervision and delivery* (median=68%, IQR 89), were the best reported. For replication of exercise interventions, TIDieR item 8, *When and how much*, was moderately well reported (median=62%, IQR 68) although CERT item 8, *Description of each exercise to enable replication* (median=23%, IQR 44) and item 13, *Detailed description of the exercise intervention* (median=24%, IQR 66) were poorly reported. Quality of systematic reviews ranged from moderate to critically low quality.

Conclusion Exercise interventions are poorly reported across a range of health conditions. If exercise is medicine, then how it is prescribed and delivered is unclear, potentially limiting its translation from research to practice.

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INTRODUCTION

The benefits of exercise for preventing and managing chronic disease have been well described.[1] Indeed, 'with the possible exception of diet modification, we know of no single intervention with greater promise than physical exercise to reduce the risk of virtually all chronic diseases simultaneously'.[2] Systematic reviews and meta-analyses show exercise to be similarly effective to medications for managing several chronic conditions,[3–7] adding credibility to the notion that 'exercise is medicine'.[8] However, compared with trials of medicines, exercise trials tend to be of lower quality, at higher risk of bias and are less likely to report adverse events.[3–7] Admittedly, some contribution to the reduced quality and higher risk of bias of exercise trials arises from difficulties in blinding participants and intervention providers. However, other important methodological features (eg, allocation concealment, analysis using intention-to-treat and blinding of assessors for objective measures) that should be used, often are not.[9] Together, these methodological weaknesses limit confidence in the findings of exercise trials.[3–7]

Notably, the reporting of interventions in exercise trials is also often poor,[10] especially when compared with similar trials of medicines.[11] This is significant because poor reporting of interventions in clinical trials impairs quality appraisal, evidence synthesis and replication, and limits the ability of stakeholders (eg, patients, clinicians, policymakers) to implement them into clinical practice.[12] If the reporting of an intervention is poor, the intervention itself, or its 'dose' is unknown. To combat poor reporting of exercise interventions in clinical trials, the Consensus on Exercise Reporting Template (CERT)—a 16-item minimum data set considered necessary to report exercise interventions—was developed in 2016.[13] The CERT adds to other intervention-specific reporting guidelines such as the Template for Intervention Description and Replication (TIDieR),[12] developed in 2014, which aim to improve the reporting of interventions in clinical trials. Despite the advent of these checklists, and several others,[13–16] reporting of exercise interventions remains poor and does not appear to have improved over time.[17–20]

To illustrate the importance of reporting from research to clinical practice, take the example of a clinician who wants to prescribe an evidence-based exercise programme for their patient with patellofemoral pain.[19] They find a methodologically rigorous systematic review showing that, based on moderate certainty evidence, exercise reduces patellofemoral pain compared with usual care. Hence, they deemed the exercise to be effective, and wish to replicate the intervention in practice. However, on reading the review, they discover the

exercise interventions were poorly described, with little information on the type and dose, level of supervision and what co-interventions, if any, were delivered. The clinician is now uncertain what the 'effective' exercise programme was. The same could be said for clinicians working in exercise oncology, where key principles of training (eg, progression and reversibility) and prescriptive components of exercise (eg, frequency, intensity, time and type) are poorly reported.[21]

Several systematic reviews have been published that investigated the reporting quality of exercise interventions for various health conditions (eg, cardiovascular, musculoskeletal, neurological),[19 22–24] but these are yet to be synthesised. These individual systematic reviews provide evidence for quality of reporting of specific health conditions; however, they do not inform on the quality of reporting across the entire field more broadly. Hence, the quality of reporting across exercise medicine literature remains unknown. The aim of this overview of systematic reviews was to determine how well exercise interventions have been reported in clinical trials of exercise for health and disease. For clinical research to be translated into practice, clinicians must be able to identify the intervention components in sufficient detail to replicate them. This is particularly important for complex interventions like exercise given the many modifiable variables that may impact its effectiveness.[25–27]

METHODS

This overview of systematic reviews was conducted in accordance with the Cochrane Handbook for Systematic Reviews of Interventions (Chapter V—Overviews) recommendations[28] and reported in line with the Preferred Reporting Items for Systematic review and Meta-Analysis (PRISMA) 2020 statement.[29] The protocol was registered prospectively on the Open Science Framework (OSF) (osf.io/my3ec/) and PROSPERO (CRD42021261285) prior to conducting searches. All data and code are publicly available on OSF (osf.io/my3ec/).

Eligibility criteria

We included systematic reviews of exercise interventions that specifically examined, as a primary aim, how well the exercise interventions were reported.

Searches

We searched electronic databases (PubMed, EMBASE, CINAHL, SPORTDiscus and PsycINFO) up to June 2021, using search terms relating to 'exercise' or 'physical activity' and 'reporting' (eg, CERT or TIDieR). We did not restrict the inclusion of reviews by year of publication, publication status or language. The search strategy for PubMed was as follows: *(exercis*[Title] OR sport*[Title] OR physical activity[Title] OR train*[Title] OR aerobic[Title] OR resistance[Title] OR physical training[Title] OR active[Title] OR move*[Title] OR rehab*[Title]) AND (cert[TiAb] OR tidier[TiAb] OR "template for intervention description and replication"[TiAb] OR report*[Title] OR complet*[TiAb] OR describ*[TiAb] OR replic*[TiAb] OR characteristics[TiAb] OR design[TiAb] OR program[TiAb]) OR (consensus on exercise reporting template)* with a filter for systematic reviews in humans. The search strategy for all other databases is shown in online supplemental appendix 1. We also identified systematic reviews previously known to the authors and conducted forward and backward citation tracking up to July 2021 using Google Scholar,[30] to identify any other relevant reviews not discovered in the initial search.

Record management and screening

Results of electronic database searches were imported to Covidence[31] where duplicate records were removed automatically. Two reviewers independently conducted two stages of eligibility screening: (1) title and abstract; (2) full text. Any disagreements on screening were resolved through discussion, with arbitration of a third author if required.

Data extraction

Data from included reviews were extracted in duplicate by independent authors using Covidence extraction V.2.0.[31] Disagreements were resolved through discussion or arbitration from a third author if required.

Data items: characteristics of included reviews

We extracted data relating to the review characteristics (included study design, health condition(s), sample size, number of interventions, exercise intervention type, comparator(s)) and reporting guideline used (CERT and/or TIDieR). If investigated by an included review, we also extracted data related to changes in reporting quality over time.

Data items: reporting characteristics

From the included systematic reviews, we extracted the completeness of reporting (primary outcome), expressed as the percentage of interventions that reported each item in sufficient detail for replication, according to the relevant checklist, TIDieR or CERT. All items of each of these checklists were considered in this overview (table 1). If a combined or hybrid checklist was used, we separated the items from CERT and TIDieR and considered these separate checklists. We ourselves did not evaluate the completeness of reporting, rather, completeness of reporting was judged by the primary authors of the included systematic review. As a result, we relied on the level of reporting which the authors chose to obtain data from the primary trial manuscripts (ie, from the primary publication and supplemental material only). Similarly, we ourselves did not evaluate the change in reporting quality over time but instead used the judgements of the primary authors of the included systematic reviews. We contacted authors of the included systematic reviews when items on the relevant guideline were not reported. If a review included studies of multiple interventions, we extracted the completeness of reporting relative to the number of interventions, rather than the number of studies. We did not extract risk of bias ratings of individual studies as these were unlikely to affect the quality of reporting.

Data synthesis

We used R[32] to conduct all analyses. From each review, we extracted the number or percentage of studies that appropriately described each item of the respective scale(s) (CERT or TIDieR). When data were presented in systematic reviews as the number of studies (ie, 6 of 24 studies reported the item sufficiently), it was converted to a percentage of studies for analysis to allow comparability between reviews. Data were synthesised using simple descriptive statistics (median, IQR and range) for each item of each relevant tool. Data were visually inspected for normality. Most data were not normally distributed; therefore, for consistency, the median was chosen as the summary statistic. We performed subgroup analyses on the completeness of reporting within different health and disease areas when >3 reviews of the same area were identified (eg, cardiovascular, musculoskeletal, neurological, etc). Studies were grouped into the above areas

Table 1 Items of included reporting guidelines, TIDieR (A) items of TIDieR checklist[14] and CERT (B) items of CERT checklist[13]

TIDieR items	Item description
1	Brief name: provide the name or a phrase that describes the intervention
2	Why: describe any rationale, theory or goal of the elements essential to the intervention
3	What (materials): describe any physical or informational materials used in the intervention, including those provided to participants or used in intervention delivery or in training of intervention providers. Provide information on where the materials can be accessed (for example, online appendix, URL)
4	What (procedures): describe each of the procedures, activities, and/or processes used in the intervention, including any enabling or support activities
5	Who provided: for each category of intervention provider (for example, psychologist, nursing assistant), describe their expertise, background and any specific training given
6	How: describe the modes of delivery (such as face to face or by some other mechanism, such as internet or telephone) of the intervention and whether it was provided individually or in a group
7	Where: describe the type(s) of location(s) where the intervention occurred, including any necessary infrastructure or relevant features
8	When and how much: describe the number of times the intervention was delivered and over what period of time including the number of sessions, their schedule, and their duration, intensity or dose
9	Tailoring: if the intervention was planned to be personalised, titrated or adapted then describe what, why, when and how
10	Modifications: if the intervention was modified during the course of the study, describe the changes (what, why, when and how)
11	How well (planned): if intervention adherence or fidelity was assessed, describe how and by whom, and if any strategies were used to maintain or improve fidelity, describe them
12	How well (actual): if intervention adherence or fidelity was assessed, describe the extent to which the intervention was delivered as planned
CERT items	**Item description**
1	Detailed description of the type of exercise equipment (eg, weights, exercise equipment such as machines, treadmill, bicycle ergometer, etc)
2	Detailed description of the qualifications, teaching/supervising expertise, and/or training undertaken by the exercise instructor
3	Describe whether exercises are performed individually or in a group
4	Describe whether exercises are supervised or unsupervised and how they are delivered
5	Detailed description of how adherence to exercise is measured and reported
6	Detailed description of motivation strategies
7a	Detailed description of the decision rule(s) for determining exercise progression
7b	Detailed description of how the exercise programme was progressed
8	Detailed description of each exercise to enable replication (eg, photographs, illustrations, video, etc)
9	Detailed description of any home programme component (eg, other exercises, stretching, etc)
10	Describe whether there are any non-exercise components (eg, education, cognitive–behavioural therapy, massage, etc)
11	Describe the type and number of adverse events that occurred during exercise
12	Describe the setting in which the exercises are performed
13	Detailed description of the exercise intervention including, but not limited to, number of exercise repetitions/sets/sessions, session duration, intervention/programme duration, etc
14a	Describe whether the exercises are generic (one size fits all) or tailored to the individual
14b	Detailed description of how exercises are tailored to the individual
15	Describe the decision rule for determining the starting level at which people commence an exercise programme (such as beginner, intermediate, advanced, etc)
16a	Describe how adherence or fidelity to the exercise intervention is assessed/measured
16b	Describe the extent to which the intervention was delivered as planned

CERT, Consensus on Exercise Reporting Template; TIDieR, Template for Intervention Description and Replication.

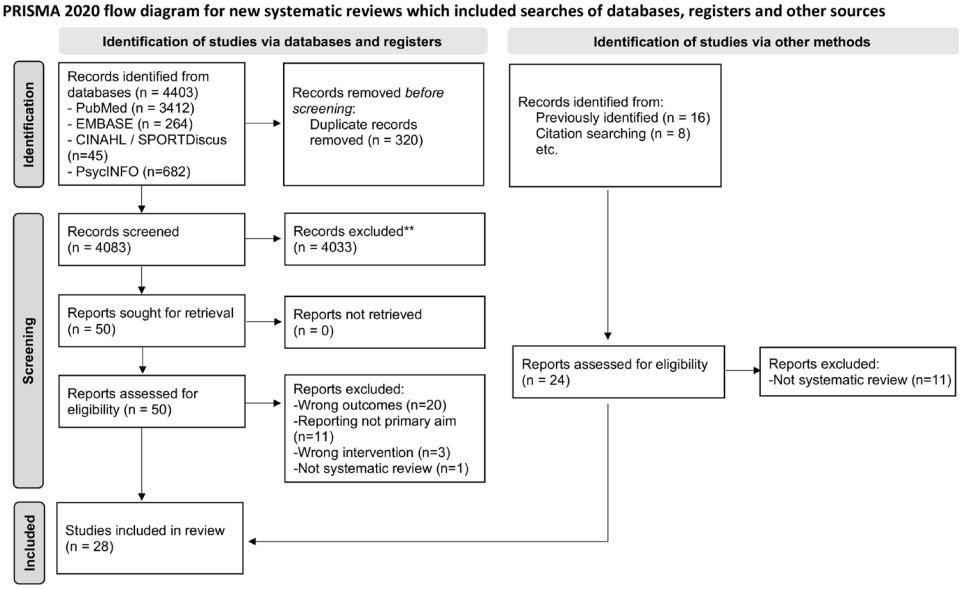
based on the domains described in Exercise and Sports Science Australia's standards.[33] As several methods were used by review authors to analyse changes in quality of reporting over time (eg, correlations, linear regression, completeness of reporting across different time periods or before and after the introduction of CERT and TIDieR), we did not pool these results. Instead, our analysis of changes in reporting over time was described narratively. We did not assess the certainty of evidence as this was not relevant to the purpose of our overview of systematic reviews. CERT and TIDieR do not define 'good' or 'poor' reporting[13 14]; however, post hoc, we categorised reporting quality as 'good' when ≥80% of interventions included in the reviews reported the item(s) sufficiently, 'moderate' when 79% to 50% reported the items sufficiently and 'poor' when <50% reported items sufficiently; in line with included reviews' cut-offs.[34 35]

Quality of systematic reviews

Review quality was assessed independently and in duplicate using a modified version of A MeaSurement Tool to Assess systematic Reviews (AMSTAR 2)[36] (online supplemental appendix 3). In our modified version, we excluded the items pertaining to meta-analysis or risk of bias within individual studies (items 9, 11, 12, 13, 14 and 15) as these were not relevant to our review question. The quality of each review was deemed 'high', 'moderate', 'low' or 'critically low' based on the number of critical flaws (a rating of 'no' in items 2, 4 and 7)[36] or non-critical weaknesses (a 'no' or 'partial yes' in any other domain) with the review (online supplemental appendix 4).

RESULTS

We identified 7804 studies and included 28 systematic reviews[18–20 22 24 34 35 37–57] (figure 1). These 28 reviews included 1467 studies comprised of 1724 interventions. We found only one article published in a language other than English—German—which was translated using Google Translate.[58] A list of the studies excluded during full-text assessment, with reasons, is provided in online supplemental appendix 5. Ten reviews only used CERT,[35 38 41 42 44 48 52–54 56] 11 reviews only



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit:

Figure 1 Preferred Reporting Items for Systematic review and Meta-Analysis flow diagram of studies.

used TIDieR,[18–20 24 39 45–47 50 51 55] and 6 reviews[22 34 37 40 43 57] used both CERT and TIDieR (table 2). One review[38] used a hybrid tool comprised of items 1–5, 7, and 9–12 from TIDieR, complemented and expanded upon by items 6 and 8 of CERT. The median number of interventions included in the reviews was 24 (range 3–287, IQR 67). Twelve reviews assessed quality of reporting in musculoskeletal conditions,[19 34 35 37 38 40–42 45 48 56 57] four in neurological conditions,[39 47 51 53] six in cardiovascular conditions,[18 20 22 24 49 55] one in cancer[50] and five in 'other' conditions including urinary dysfunction (n=1),[44] pelvic organ prolapse (n=1)[43] organ transplant patients (n=2),[46 52] and older adults (n=1).[54] See table 2 for all characteristics of included reviews. We contacted two review authors, who provided data not reported in the review manuscripts.

Quality of included reviews (AMSTAR 2)

Nine reviews were rated moderate quality, 11 low quality and 8 critically low quality. The most common methodological shortcomings were item 10, *Reporting sources of funding of included studies*, where 28 reviews (100%) did not report the item sufficiently, and item 3, *Rationale for selection of study designs*, where 22 reviews (79%) did not report the item sufficiently. The most adhered to item was item 6, *Conducting data extraction in duplicate*, with 23 reviews (82%) reporting this sufficiently (see online supplemental appendix 6 for the complete results of the AMSTAR 2 assessment).

Quality of reporting: CERT

Sixteen reviews used CERT to assess quality of reporting (n=643 studies, n=757 interventions). The median percentage of all CERT items appropriately reported was 24% (range 5%–68%, IQR 19). The median score for each CERT item across the 16 reviews can be seen in figure 2. Item 4, *Describe whether exercises are supervised or unsupervised and how they are delivered* (median=68%, range 0%–100%, IQR 89) and Item 14, *Describe whether the exercises are generic (one size fits all) or tailored to the individual* (median=59%, range 0%–100%, IQR 70) were the best reported. In contrast, item 16a, *Describe how adherence or fidelity to the exercise intervention is assessed/measured* (median=5%, range 0%–93%, IQR 21) and item 16b, *Describe the extent to which the intervention was delivered as planned* (median=5%, range 0%–77%, IQR 38) were the most poorly reported. Some of the items most important for replication, item 8, *Description of each exercise to enable replication* (median=23%, range 0%–95%, IQR 44) and item 13, *Detailed description of the exercise intervention, including sets, reps, duration, etc* (median=24%, range 0%–100%, IQR 66) were also poorly reported. There were no obvious differences in CERT scores between health condition subgroups (online supplemental appendix 7).

Quality of reporting: TIDieR

Eighteen reviews used TIDieR to assess quality of reporting (n=1099 studies, n=1353 interventions). The median percentage of all TIDieR items appropriately reported was 49% (range 0%–100, IQR 33). The median score for each TIDieR item across the 18 reviews can be seen in figure 3. Item 1, *Brief name* (median=100%, range 0%–100%, IQR 4) and item 2, *Why* (median=98%, range 0%–100%, IQR 6) were the best reported. In contrast, item 10, *Modifications* (median=0%, range 0%–55%, IQR 12) and item 11, *How well (planned)* (median=23%, range 0%–70%, IQR 26) were the most poorly reported. The most relevant item to the 'dose' of exercise, item 8, *When and how much*, was moderately well reported (median=62%, range 0%–100%, IQR 68). Subgroup analyses (8online supplemental appendix 8) showed the neurological area had the highest median score (65% (range 2%–100%, IQR 62)), followed by the cardiovascular area (48% (range 0%–100%, IQR 23)) and the 'other' area (43% (range 0%–100%, IQR 30)).

Changes in reporting over time

Five reviews[18–20 40 57] investigated changes in reporting quality over time, but the findings were mixed. Three reviews[18–20] found no changes over time. One review[57] found slight decreases in reporting quality over time, whereas another[40] found improvements in reporting quality over time (table 3).

DISCUSSION

Our overview of systematic reviews revealed that exercise interventions are poorly reported across all health and disease

Table 2 Characteristics of included reviews

Study (author, year)	Trial designs included	Health condition	Number of participants	Number of interventions	Type of exercise	Template used	AMSTAR 2 rating
Abell *et al*[18] 2015	RCTs	Coronary artery disease	NR	74	Supervised or unsupervised exercise programme, with or without the addition of lifestyle modification and counselling	TIDieR	Critically low quality
Barros *et al*[37] 2020	RCTs	Low back pain	NR	10	Pilates	Both	Low quality
Bartholdy *et al*[38] 2019	Clinical guidelines	Knee osteoarthritis	9819	130	Exercise*	Hybrid	Moderate quality
Berti *et al*[39] 2020	Randomised, controlled and uncontrolled clinical trials, and case reports	Parkinson's disease	386	21	Argentine tango	TIDieR	Moderate quality
Burgess *et al*[40] 2021	RCTs	Hip osteoarthritis	707	14	Exercise*	Both	Low quality
Charlton *et al*[41] 2017	RCT, case study, case series, risk stratified prevention	Prevention or treatment of groin pain in athletes	2042	14	Exercise*	CERT	Moderate quality
Davidson *et al*[57] 2021	RCTs	Low back pain	NR	180	Exercise*	Both	Moderate quality
Dischiavi *et al*[42] 2021	RCTs	Patellofemoral pain	NR	19	Exercise*	CERT	Low quality
Giagio *et al*[43] 2021	RCTs	Pelvic organ prolapse	4076	26	Pelvic floor muscle training	Both	Moderate quality
Hall *et al*[44] 2018	Any study type	Men with urinary dysfunction	NR	108	Pelvic floor muscle training	CERT	Moderate quality
Holden *et al*[19] 2018	RCTs	Patellofemoral pain	NR	38	Exercise*	TIDieR	Moderate quality
Kattackal *et al*[34] 2020	RCTs	Juvenile idiopathic arthritis	NR	10	Physical activity interventions	Both	Low quality
Keene *et al*[45] 2020	RCT or quasi-RCT	Fragility fracture of lower limb or pelvis	3564	65	Exercise*	TIDieR	Moderate quality
Knols *et al*[46] 2018	RCTs	Lung transplant patients	369	7	Exercise*	TIDieR	Moderate quality
Knols *et al*[47] 2019	RCTs	Traumatic brain injury	81	3	Early mobilisation	TIDieR	Critically low quality
Lohse *et al*[20] 2018	RCTs	Stroke	12 847	287	Any physical or occupational therapy intervention that required active movement on the part of the participant	TIDieR	Low quality
Mack *et al*[35] 2018	RCTs	Osteoporosis	NR	23	Exercise*	CERT	Critically low quality
Major *et al*[48] 2019	RCTs	Rotator cuff disease	NR	34	Strengthening, scapula stabilising, stretching and 'corrective' exercises	CERT	Critically low quality
McEwen *et al*[22] 2019	RCTs	Stroke	1267	16	Group circuit class therapy	Both	Low quality
McGregor *et al*[49] 2018	Randomised and non-randomised controlled trials, non-controlled prospective observational studies	Pulmonary hypertension	NR	19	Aerobic or strength exercise	CERT	Low quality
Meneses-Echavez *et al*[50] 2019	RCTs	Cancer	NR	138	Aerobic, resistance and flexibility training, as well as yoga, Qi-gong and Tai-Chi	TIDieR	Low quality
Neele *et al*[51] 2016	RCTs	Traumatic brain injury	NR	58	Exercise*	TIDieR	Critically low quality
Raje *et al*[52] 2021	RCTs	Solid organ transplant recipients	NR	21	Aerobic, resistance or combination	CERT	Low quality
Tew *et al*[24] 2016	RCTs	Peripheral arterial disease	NR	76	Supervised exercise	TIDieR	Critically low quality
Torres-Pareja *et al*[53] 2019	RCTs and uncontrolled studies	Multiple sclerosis	163	10	Flexibility/range of motion	CERT	Critically low quality

Continued

Table 2 Continued

Study (author, year)	Trial designs included	Health condition	Number of participants	Number of interventions	Type of exercise	Template used	AMSTAR 2 rating
Vasquez-Araneda *et al*[54] 2021	RCTs	Older adults in Latin America	5013	101	Exercise*	CERT	Low quality
Yamato *et al*[55] 2016	RCTs	Cardiac rehabilitation	NR	200	Physiotherapy intervention	TIDieR	Critically low quality
Zhang *et al*[56] 2021	Any clinical study	Osteoarthritis	NR	22	Movement-based mind–body exercises	CERT	Low quality

*Exercise means specific information on the type(s) of exercise included in the review was not given, or a generic term was used.
AMSTAR, A MeaSurement Tool to Assess systematic Reviews; CERT, Consensus on Exercise Reporting Template; NR, not reported; RCTs, randomised controlled trials; TIDieR, Template for Intervention Description and Replication.

areas. This was true regardless of the reporting template used, though completeness of reporting was slightly higher according to TIDieR than CERT. Completeness of reporting does not appear to have improved over time, and most reviews were of low quality. Based on these findings, if exercise is medicine, then how it is prescribed and delivered is unclear, potentially limiting its translation from research to practice.

Maintaining a high quality of intervention reporting is important in all fields of medicine, including exercise. Poor reporting of interventions may limit the ability of clinicians and policymakers to implement interventions in clinical practice, as it may be unclear how interventions should be delivered.[12] For example, if any intervention was shown to improve an important aspect of health (eg, blood pressure) or fitness (eg, aerobic capacity or muscle strength), it is important to know the characteristics of the intervention that led to this improvement. Further, in an increasingly global field, it can be confusing with many different naming conventions of exercise(s) within and between disciplines both nationally and internationally. Descriptions of exercises, including pictures, could help combat this issue and enhance the quality of reporting.[59 60] Evidence synthesis is also impaired by poor reporting as comparators and interventions may not be pooled for meta-analysis if the content of the treatments is unclear.[61] High-quality reporting is needed in the field of exercise in order to promote clinical translation, evidence synthesis and clear appraisal of studies.

Poor reporting of interventions is not unique to exercise. Indeed, similar issues have been observed across a range of medical interventions,[62] but exercise studies appear to more poorly report interventions.[11] Our results show that the names of, and rationale for, exercise (TIDieR items 1 and 2) were very well reported, but this is of little use for researchers or clinicians trying to replicate the intervention. In contrast, key intervention components needed to optimise translation to practice, for example, detailed description of exercises to enable replication and, perhaps most crucially, detailed description of the exercise prescription, were poorly reported (figure 2). Moreover, items crucial to assessing intervention fidelity, adherence and adverse events were also poorly reported (figure 2). Intervention fidelity has important implications for the internal validity of a study,[63] whereas reporting of adherence and adverse events is crucial to enable assessment of how tolerable and feasible the intervention was. To improve quality appraisal, evidence synthesis, replication and translation of exercise interventions to practice, reporting of exercise interventions must improve.

Several templates have been developed to assist in improving the reporting of exercise interventions. These include condition-specific tools (eg, CERT-PFMT[64]) for pelvic floor muscle training and more general templates.[13–16] We chose to use CERT and TIDieR for this overview of systematic reviews as they are valid and reliable[14 65] and focus on key intervention variables such as how, how much and how well, among others.[13 14] The CERT was designed to build upon TIDieR to provide additional detail of important exercise intervention components.[13] Interestingly, while the included reviews scored poorly well on TIDieR (median=49%, IQR 33) they scored much worse on CERT (median=24%, IQR 19). This disparity may be explained by the broad nature of TIDieR whereby, in trying to cover all healthcare interventions,[62] it is too general for exercise. Based on the specificity of CERT to exercise, we recommend that authors use CERT to guide reporting of their exercise interventions. Our overview of systematic reviews showed that when important intervention components are defined and examined with more

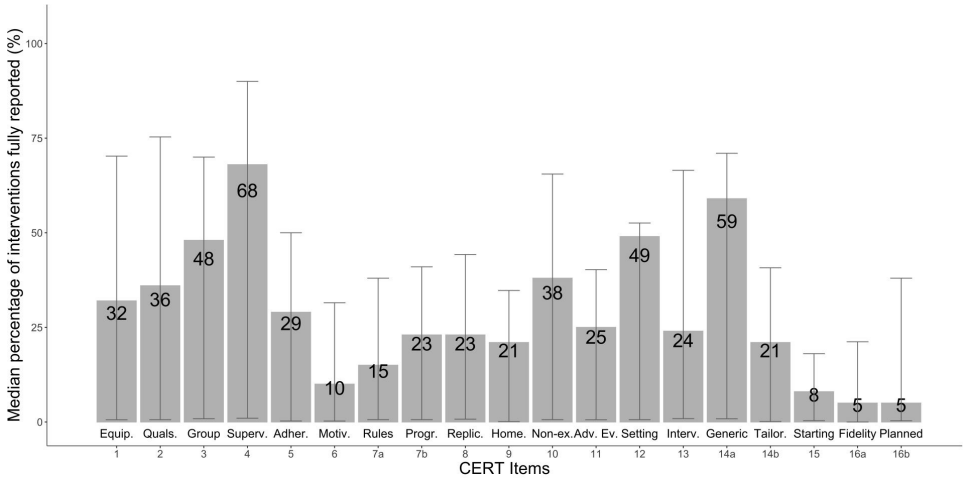


Figure 2 Completeness of reporting across systematic reviews of exercise using the Consensus on Exercise Reporting Template (CERT). Items' names are fully described in online supplemental appendix 2. Adher, description of how adherence is measured and reported; Adv Ev, description of type and number of adverse events; Equip, description of exercise equipment; Fidelity, how adherence or fidelity to intervention is measured; Generic, description of whether exercises are generic or tailored; Group, description of whether exercise performed in group or individually; Home, description of any home programme; Interv, description of exercise intervention (ie, sets, reps, duration, etc); Motiv, description of motivation strategies; Non-ex, description of non-exercise components; Planned, description of the extent to which the intervention was delivered as planned; Progr, description of how exercise was progressed; Quals, description of qualifications of instructor; Replic, description of exercise to enable replication; Rules, description of rules for determining exercise progression; Setting, description of setting of exercise; Starting, description of rule for the starting level of participants; Superv, description of whether exercises are supervised and how they are delivered; Tailor, description of how exercises are tailored.

scrutiny, as exercise is with CERT, items crucial to the replicability of exercise interventions are poorly reported.

Despite the advent of TIDieR and CERT, there has been little change in the quality of reporting of exercise interventions over time. The reason for this is not clear. It may be that authors are unaware of these templates. Indeed, it can be difficult to navigate the hundreds of reporting guidelines available on the Enhancing the QUAlity and Transparency Of health Research Network (equator-network.org). Alternatively, authors may be aware of these templates but simply choose not to use them. We acknowledge that full adherence to reporting guidelines can be difficult, particularly with the stringent word limits of many journals. In this instance, we suggest authors provide as much detail as possible within the manuscript and provide all other additional information required by CERT or TIDieR (or other relevant reporting guideline) as supplemental material. There may also be other methods to improve reporting of exercise trials. Journals have previously mandated the use of reporting guidelines such as Consolidated Standards of Reporting Trials[66] and PRISMA,[67] which significantly improved the reporting of trials and systematic reviews, respectively.[67–70] Therefore, exercise medicine journals may be well positioned to improve the reporting quality of the research they publish by encouraging, or preferably requiring, submission of a completed CERT checklist when exercise trials are submitted. Without this, the quality of reporting of exercise interventions may remain poor, limiting the possibility of potentially impactful exercise interventions being implemented in clinical practice.

A noted limitation of the evidence included in our overview of systematic reviews was that, using a modified AMSTAR 2 tool,

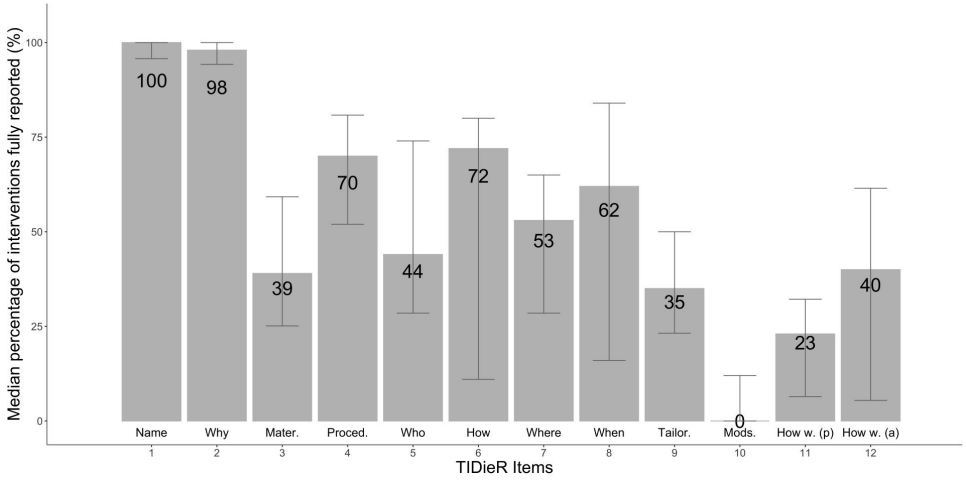


Figure 3 Completeness of reporting across systematic reviews of exercise using the Template for Intervention Description and Replication (TIDieR). Items' names are fully described in online supplemental appendix 2. How w. (a), how well (actual); How w. (p), how well (planned); Mater, what (materials); Mods, modifications; Proced, what (procedures); Tailor, tailoring; When, when and how much.

Table 3 Qualitative summary of changes in reporting over time (n=5)

Study	Template assessed	Description of changes over time using data provided from reviews
Abell *et al*[18]	TIDieR	Percentage of interventions completely reporting all core TIDieR intervention items in both published sources and after contact with trial authors, by decade of publication. 1975–1984 (n=28)–18% 1985–1994 (n=14)–14% 1995–2004 (n=16)–13% 005–2014 (n=16)–13%
Burgess *et al*[40]	Both	Pearson correlation coefficient demonstrated moderate, positive relationship (r=0.71; p=0.004) between total TIDieR score and year published. Similarly, there was a moderate, positive relationship between total CERT score and year of publication (r=0.57; p=0.03). This suggests that the quality of intervention reporting has improved over time.
Davidson *et al*[57]	Both	Completeness of reporting, results displayed as median (IQR) TIDieR overall (n=180)–59.2% (45.5%–72.7%) Pre-TIDieR (n=112)–59.2% (45.5%–72.7%) Post-TIDieR (n=68)–55.1% (45.5%–72.7%) CERT overall (n=180)–33.3% (22.2%–52.6%) Pre-CERT (n=144)–35.3% (23.4%–52.6%) Post-CERT(n=36)–29.4% (15.0%–53.9%) Completeness of reporting by time period TIDieR (n=180) 1990–1999 (n=17)–63.6% (54.5%–72.7%) 2000–2009 (n=35)–63.6% (54.5%–72.7%) 2010–2015 (n=83)–54.5% (44.9%–72.7%) 2016–present (n=45)–63.6% (45.5%–80.0%) CERT (n=180) 1990–1999 (n=17)–46.7% (26.3%–64.7%) 2000–2009 (n=35)–38.9% (24.9%–52.6%) 2010–2015 (n=83)–33.3% (21.1%–47.4%) 2016–present (n=45)–35.3% (15.8%–52.6%)
Holden *et al*[19]	TIDieR	No increase in the details reported over time
Lohse *et al*[20]	TIDieR	Linear mixed-effects regression revealed no reliable relation between the year of publication and the total TIDieR score ($t_{212.4}$=0.80; p=0.48) There was considerable variation in the quality of reporting; and controlling for year of publication, the difference between experimental and control groups remained statistically significant ($t_{313.2}$=15.37; p<0.001).

CERT, Consensus on Exercise Reporting Template; TIDieR, Template for Intervention Description and Replication.

no reviews were deemed to be of high quality, with most deemed moderate quality (n=9) or low quality (n=11). We chose only to include data that the authors of the included systematic reviews could extract from the main articles and supplemental materials, rather than information gathered by seeking out protocols or contacting trial authors. This may have reduced the completeness of reporting observed in our overview, as reporting does improve when these additional sources are used.[18 24] This was not often done in the systematic reviews included in our overview, but when it was, reporting improved by 12%–34%.[18 24] We chose only to include data that the primary review authors could extract from the main articles and supplemental materials, rather than information gathered by seeking out protocols or contacting trial authors. This may have reduced the completeness of reporting observed in our overview, as reporting does improve when these additional sources are used.[24] However, it has been argued[13 14] that contacting authors for more information about an intervention should not be necessary given the impact the intervention has on the study's findings. We believe that the manuscript and supplemental information should, at a minimum, describe all items of the reporting guidelines to allow replication. We did not predefine a cut-off to categorise the quality of reporting (eg, as good or poor). However, we did make a judgement on these categorisations post hoc using suggested cut-offs from included systematic reviews[34 35] to support our claims, and indeed, CERT and TIDieR do not provide criteria to do so.[13 14] While outside the scope of this overview of systematic reviews, it is also important to note that many trials often do not sufficiently report comparators,[62] which is important for assessing the internal validity of the trial.

CONCLUSION

Exercise is an intervention with widespread positive effects on many health conditions. But, across all fields involving exercise medicine, the quality of exercise intervention reporting is poor. High-quality reporting is needed to improve quality appraisal, enable evidence synthesis and replication, and improve translation in clinical settings. There has been little change in quality of reporting over time despite the presence of reporting checklists. Researchers, and the journals they submit to, have the opportunity to improve intervention reporting in exercise medicine by following TIDieR or CERT and encouraging or requiring inclusion of a completed checklist as part of standard practice when

What is already known

⇒ Exercise is effective for improving a range of health conditions, although exercise interventions are often poorly reported.
⇒ Poor reporting of interventions can reduce the ability for readers and researchers to assess quality, synthesise evidence, replicate and implement potentially effective interventions into practice.
⇒ The quality of reporting across studies of exercise medicine is unknown.

What are the new findings

- ⇒ Exercise interventions are poorly reported across all health areas of exercise medicine.
- ⇒ The quality of intervention reporting has not improved over time.
- ⇒ If exercise is medicine, then how it is prescribed and delivered is unclear, potentially limiting its translation from research to practice.

submitting exercise studies. This would likely lead to improved reporting quality over time, and a better understanding of the 'dose' of exercise medicine needed to optimise health outcomes.

Correction notice This article has been corrected since it published Online First. Author names have been updated.

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Contributors MDJ is the guarantor and conceived the study. HJH and MDJ wrote the first draft of the protocol and manuscript. HJH, MAW, AGC and MDJ conducted article screening. HJH, MAW, AGC, AH, BKC and MDJ extracted data. MDJ assisted in interpreting the data. HJH conducted data analysis. All authors contributed importantly to the content and style of the protocol and manuscript. All authors approved the final version.

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REFERENCES

1 Pedersen BK, Saltin B. Exercise as medicine - evidence for prescribing exercise as therapy in 26 different chronic diseases. *Scand J Med Sci Sports* 2015;25 Suppl 3:1–72.
2 Booth FW, Gordon SE, Carlson CJ, *et al*. Waging war on modern chronic diseases: primary prevention through exercise biology. *J Appl Physiol* 2000;88:774–87.
3 Henriksen M, Hansen JB, Klokker L, *et al*. Comparable effects of exercise and analgesics for pain secondary to knee osteoarthritis: a meta-analysis of trials included in Cochrane systematic reviews. *J Comp Eff Res* 2016;5:417–31.
4 Naci H, Salcher-Konrad M, Dias S, *et al*. How does exercise treatment compare with antihypertensive medications? A network meta-analysis of 391 randomised controlled trials assessing exercise and medication effects on systolic blood pressure. *Br J Sports Med* 2019;53:859–69.
5 Perrot S, Russell IJ. More ubiquitous effects from non-pharmacologic than from pharmacologic treatments for fibromyalgia syndrome: a meta-analysis examining six core symptoms. *Eur J Pain* 2014;18:1067–80.
6 Rao S, Pandey A, Garg S, *et al*. Effect of exercise and pharmacological interventions on visceral adiposity: a systematic review and meta-analysis of long-term randomized controlled trials. *Mayo Clin Proc* 2019;94:211–24.
7 Naci H, Ioannidis JPA. Comparative effectiveness of exercise and drug interventions on mortality outcomes: metaepidemiological study. *Br J Sports Med* 2015;49:1414–22.
8 Sallis RE. Exercise is medicine and physicians need to prescribe it! *Br J Sports Med* 2009;43:3–4.
9 Cashin AG, Lee H, Bagg MK, *et al*. A systematic review highlights the need to improve the quality and applicability of trials of physical therapy interventions for low back pain. *J Clin Epidemiol* 2020;126:106–15.
10 Slade SC, Keating JL. Exercise prescription: a case for standardised reporting. *Br J Sports Med* 2012;46:1110–3.
11 Adams SC, McMillan J, Salline K, *et al*. Comparing the reporting and conduct quality of exercise and pharmacological randomised controlled trials: a systematic review. *BMJ Open* 2021;11:e048218.
12 Hoffmann TC, Glasziou PP, Boutron I, *et al*. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ* 2014;348:g1687.
13 Slade SC, Dionne CE, Underwood M, *et al*. Consensus on exercise reporting template (CERT): explanation and elaboration statement. *Br J Sports Med* 2016;50:1428–37.
14 Hoffmann TC, Glasziou PP, Boutron I, *et al*. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *BMJ* 2014;348:g1687.
15 Hoogeboom TJ, Oosting E, Vriezekolk JE, *et al*. Therapeutic validity and effectiveness of preoperative exercise on functional recovery after joint replacement: a systematic review and meta-analysis. *PLoS One* 2012;7:e38031.
16 Toigo M, Boutellier U. New fundamental resistance exercise determinants of molecular and cellular muscle adaptations. *Eur J Appl Physiol* 2006;97:643–63.
17 Hacke C, Nunan D, Weisser B. Do exercise trials for hypertension adequately report interventions? A reporting quality study. *Int J Sports Med* 2018;39:902–8.
18 Abell B, Glasziou P, Hoffmann T. Reporting and replicating trials of exercise-based cardiac rehabilitation: do we know what the researchers actually did? *Circ Cardiovasc Qual Outcomes* 2015;8:187–94.
19 Holden S, Rathleff MS, Jensen MB, *et al*. How can we implement exercise therapy for patellofemoral pain if we don't know what was prescribed? A systematic review. *Br J Sports Med* 2018;52:385.
20 Lohse KR, Pathania A, Wegman R, *et al*. On the reporting of experimental and control therapies in stroke rehabilitation trials: a systematic review. *Arch Phys Med Rehabil* 2018;99:1424–32.
21 Bland KA, Neil-Sztramko SE, Zadravec K, *et al*. Attention to principles of exercise training: an updated systematic review of randomized controlled trials in cancers other than breast and prostate. *BMC Cancer* 2021;21:1179.
22 McEwen D, O'Neil J, Miron-Celis M, *et al*. Content reporting in post-stroke therapeutic Circuit-Class exercise programs in randomized control trials. *Top Stroke Rehabil* 2019;26:281–7.
23 Slade SC, Finnegan S, Dionne CE, *et al*. The consensus on exercise reporting template (CERT) applied to exercise interventions in musculoskeletal trials demonstrated good rater agreement and incomplete reporting. *J Clin Epidemiol* 2018;103:120–30.
24 Tew GA, Brabyn S, Cook L, *et al*. The completeness of intervention descriptions in randomised trials of supervised exercise training in peripheral arterial disease. *PLoS One* 2016;11:e0150869.
25 Clark JE. The impact of duration on effectiveness of exercise, the implication for periodization of training and goal setting for individuals who are overfat, a meta-analysis. *Biol Sport* 2016;33:309–33.
26 Hayden JA, van Tulder MW, Tomlinson G. Systematic review: strategies for using exercise therapy to improve outcomes in chronic low back pain. *Ann Intern Med* 2005;142:776–85.
27 Lamb SE, Becker C, Gillespie LD, *et al*. Reporting of complex interventions in clinical trials: development of a taxonomy to classify and describe fall-prevention interventions. *Trials* 2011;12:125.
28 Higgins JPT TJ, Chandler J, Cumpston M, eds. *Cochrane Handbook for Systematic Reviews of Interventions Version 6.0 ed: Cochrane*, 2019.
29 Page MJ, McKenzie JE, Bossuyt PM, *et al*. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71.
30 Google Scholar, 2021. Available: https://scholar.google.com/2021
31 Covidence systematic review software [program]. Melbourne Australia: Veritas Health Innovation 2019.
32 R: A language and environment for statistical computing [program]. Vienna, Austria: R Foundation for Statistical Computing 2020.
33 Exercise and sports science Australia. accredited exercise physiologist professional standards. Albion, Queensland 2015.
34 Kattackal T-R, Cavallo S, Brosseau L, *et al*. Assessing the reporting quality of physical activity programs in randomized controlled trials for the management of juvenile idiopathic arthritis using three standardized assessment tools. *Pediatr Rheumatol Online J* 2020;18:41.
35 Mack DE, Wilson PM, Santos E, *et al*. Standards of reporting: the use of consort pro and CERT in individuals living with osteoporosis. *Osteoporos Int* 2018;29:305–13.
36 Shea BJ, Reeves BC, Wells G, *et al*. AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. *BMJ* 2017;358:j4008.

37 Barros BSde, Imoto AM, O'Neil J, *et al*. The management of lower back pain using pilates method: assessment of content exercise reporting in RCTs. *Disabil Rehabil* 2020:1–9.
38 Bartholdy C, Nielsen SM, Warming S, *et al*. Poor replicability of recommended exercise interventions for knee osteoarthritis: a descriptive analysis of evidence informing current guidelines and recommendations. *Osteoarthritis Cartilage* 2019;27:3–22.
39 Berti A, Pini M, Ferrarello F. Argentine tango in the care of Parkinson's disease: a systematic review and analysis of the intervention. *Complement Ther Med* 2020;52:102474.
40 Burgess LC, Wainwright TW, James KA, *et al*. The quality of intervention reporting in trials of therapeutic exercise for hip osteoarthritis: a secondary analysis of a systematic review. *Trials* 2021;22:388.
41 Charlton PC, Drew MK, Mentiplay BF, *et al*. Exercise interventions for the prevention and treatment of groin pain and injury in athletes: a critical and systematic review. *Sports Med* 2017;47:2011–26.
42 Dischiavi SL, Wright AA, Tarara DT, *et al*. Do exercises for patellofemoral pain reflect common injury mechanisms? A systematic review. *J Sci Med Sport* 2021;24:229–40.
43 Giagio S, Innocenti T, Salvioli S, *et al*. Completeness of exercise reporting among randomized controlled trials on pelvic floor muscle training for women with pelvic organ prolapse: a systematic review. *Neurourol Urodyn* 2021;40:1424–32.
44 Hall LM, Aljuraifani R, Hodges PW. Design of programs to train pelvic floor muscles in men with urinary dysfunction: systematic review. *Neurourol Urodyn* 2018;37:2053–87.
45 Keene DJ, Forde C, Sugavanam T, *et al*. Exercise for people with a fragility fracture of the pelvis or lower limb: a systematic review of interventions evaluated in clinical trials and reporting quality. *BMC Musculoskelet Disord* 2020;21:435.
46 Knols RH, Fischer N, Kohlbrenner D, *et al*. Replicability of physical exercise interventions in lung transplant recipients; a systematic review. *Front Physiol* 2018;9:946.
47 Knols RH, Hellweg S, Häni N. Zusammenfassung, Replizierbarkeit und methodologische Qualität von Frühmobilisation Im Akutkrankenhaus bei Patienten MIT Schädel-Hirn-Trauma – Systematische Literaturübersicht. *Physioscience* 2019;15:164–72.
48 Major DH, Røe Y, Grotle M, *et al*. Content reporting of exercise interventions in rotator cuff disease trials: results from application of the consensus on exercise reporting template (CERT). *BMJ Open Sport Exerc Med* 2019;5:e000656.
49 McGregor G, Powell R, Finnegan S, *et al*. Exercise rehabilitation programmes for pulmonary hypertension: a systematic review of intervention components and reporting quality. *BMJ Open Sport Exerc Med* 2018;4:e000400.
50 Meneses-Echavez JF, Rodriguez-Prieto I, Elkins M, *et al*. Analysis of reporting completeness in exercise cancer trials: a systematic review. *BMC Med Res Methodol* 2019;19:220.
51 Neele V, Esser P, Collett J. A systematic review of the current reporting quality of TBI rehabilitation interventions. *Brain Injury* 2016;30:659–60 https://cris.maastrichtuniversity.nl/en/publications/a-systematic-review-of-the-current-reporting-quality-of-tbi-rehab
52 Raje U, Saumur TM, Pesce de Souza F, *et al*. Quality of the reporting of exercise interventions in solid organ transplant recipients: a systematic review. *McGill Journal of Medicine* 2021;19.
53 Torres-Pareja M, Sánchez-Lastra MA, Iglesias L, *et al*. Exercise interventions for improving flexibility in people with multiple sclerosis: a systematic review and meta-analysis. *Medicina* 2019;55. doi:10.3390/medicina55110726. [Epub ahead of print: 02 Nov 2019].
54 Vásquez-Araneda E, Solís-Vivanco RI, Mahecha-Matsudo S, *et al*. Characteristics of physical exercise programs for older adults in Latin America: a systematic review of randomized controlled trials. *Int J Environ Res Public Health* 2021;18:2812–27.
55 Yamato TP, Maher CG, Saragiotto BT, *et al*. How completely are physiotherapy interventions described in reports of randomised trials? *Physiotherapy* 2016;102:121–6.
56 Zhang W, Roster K, Hays RD, *et al*. Analysis of movement-based mind-body interventions to guide the implementation of osteoarthritis exercise programs: a descriptive review of randomized controlled trials. *J Altern Complement Med* 2021;27:442–57.
57 Davidson SRE, Kamper SJ, Haskins R, *et al*. Exercise interventions for low back pain are poorly reported: a systematic review. *J Clin Epidemiol* 2021;139:279–86.
58 Google;. Google translate, 2020. Available: https://translate.google.com.au/
59 Ding D, Ramirez Varela A, Bauman AE, *et al*. Towards better evidence-informed global action: lessons learnt from the Lancet series and recent developments in physical activity and public health. *Br J Sports Med* 2020;54:462–8.
60 Franzen SRP, Chandler C, Lang T. Health research capacity development in low and middle income countries: reality or rhetoric? A systematic meta-narrative review of the qualitative literature. *BMJ Open* 2017;7:e012332–e32.
61 Greco T, Zangrillo A, Biondi-Zoccai G, *et al*. Meta-analysis: pitfalls and hints. *Heart Lung Vessel* 2013;5:219–25.
62 Dijkers MP. Overview of reviews using the template for intervention description and replication (TIDieR) as a measure of trial intervention reporting quality. *Arch Phys Med Rehabil* 2021;102:1623–32.
63 Moncher FJ, Prinz RJ. Treatment fidelity in outcome studies. *Clin Psychol Rev* 1991;11:247–66.
64 Slade SC, Morris ME, Frawley H, *et al*. Comprehensive reporting of pelvic floor muscle training for urinary incontinence: CERT-PFMT. *Physiotherapy* 2021;112:103–12.
65 Slade SC, Finnegan S, Dionne CE, *et al*. The consensus on exercise reporting template (CERT) applied to exercise interventions in musculoskeletal trials demonstrated good rater agreement and incomplete reporting. *J Clin Epidemiol* 2018;103:120–30.
66 Schulz KF, Altman DG, Moher D. Consort 2010 statement: updated guidelines for reporting parallel group randomised trials. *Trials* 2010;11:1–8.
67 Agha RA, Fowler AJ, Limb C, *et al*. Impact of the mandatory implementation of reporting guidelines on reporting quality in a surgical Journal: a before and after study. *Int J Surg* 2016;30:169–72.
68 Plint AC, Moher D, Morrison A, *et al*. Does the CONSORT checklist improve the quality of reports of randomised controlled trials? A systematic review. *Med J Aust* 2006;185:263–7.
69 Turner L, Shamseer L, Altman DG, *et al*. Does use of the consort statement impact the completeness of reporting of randomised controlled trials published in medical journals? A Cochrane reviewa. *Syst Rev* 2012;1:1–7.
70 Panic N, Leoncini E, de Belvis G, *et al*. Evaluation of the endorsement of the preferred reporting items for systematic reviews and meta-analysis (PRISMA) statement on the quality of published systematic review and meta-analyses. *PLoS One* 2013;8:e831 38–e38.