

Professional issue

Using the template for intervention description and replication (TIDieR) as a tool for improving the design and reporting of manual therapy interventions



Gerard Alvarez ^{a, b, 1, *}, Francesco Cerritelli ^a, Gerard Urrutia ^{b, c}

^a Clinical-based Human Research Department, Centre for Osteopathic Medicine – C.O.M.E. Collaboration, Pescara, Italy

^b Iberoamerican Cochrane Centre – Biomedical Research Institute Sant Pau (IIB Sant Pau), Barcelona, Spain

^c CIBEResp, Barcelona, Spain

ARTICLE INFO

Article history:

Received 12 December 2015

Received in revised form

1 March 2016

Accepted 3 March 2016

Keywords:

Research report

Checklist

Reproducibility of results

Musculoskeletal manipulations

Manual therapy

ABSTRACT

The detailed reporting of any research intervention is crucial to evaluate its applicability into a routinely practice-based context. However, it has been estimated that, especially in non-pharmacological interventions, the published literature typically includes incomplete intervention details. In the field of manual medicine, where interventions are delivered with a high degree of individualization and variability, poorly reported studies could compromise internal and external validity of the results. Among the various initiatives that have been undertaken to improve the intervention description, the **Template for Intervention Description and Replication (TIDieR)** has to be highlighted as the most promising. **TIDieR** offers both to researchers and clinicians a helpful and comprehensive guidance on how manual therapy interventions have to be designed and reported, taking into account the clinical complexity of manual therapy and the need to satisfy research gold standards.

© 2016 Elsevier Ltd. All rights reserved.

1. Introduction

The detailed reporting of any research intervention in clinical trials is crucial to evaluate the applicability of the findings into a routinely practice-based context (external validity). Over the past decade, biased under-reporting and over-reporting of research has increasingly been acknowledged as unacceptable on both scientific and ethical grounds. However, new research is useless in many cases because of inadequate attention to important elements of study design. As a matter of fact, if clinicians are to be expected to implement treatments that have been shown in research to be useful, they need adequate descriptions of the interventions assessed. Without this information, clinical research loses its potential utility in improving patient care and involves a waste of resources (Chalmers and Glasziou 2009; Glasziou et al., 2014).

It has been estimated that, in any medical field, as much as 60% of the published literature reported incomplete intervention

details (Glasziou et al., 2008). A recent study that assessed 98 published clinical trials with public funding from the UK (Douet et al., 2014), showed that details of key components of the intervention were missing in 69.4% of cases. This problem, common for all types of treatments and interventions, is significantly worse for non-pharmacological trials where, as few as the 29–39% of interventions were described adequately compared to the 67% of drug interventions (Glasziou et al., 2008; Hoffmann et al., 2013). Other studies, although using different criteria to assess the “usability” of the description of interventions, have also shown the same shortcomings (Glasziou et al., 2008; Schroter et al., 2012). This will generally raise questions on how studies could be reproducible as well as how the external and internal validity of outcomes can be obtained. The generalizability of results would be significantly affected by intrinsic reporting biases. Moreover, the likelihood of translating the scientific results, with such biases, into the clinical practise is currently significantly impaired thus affecting the impact of therapies on the “health market” and consequently on “treatment choice”. Several authors have recently made the research community aware of such inconsistencies and proposed a number of recommendations for improvement, which include the change of the current research system to encourage better and more

* Corresponding author. Iberoamerican Cochrane Center, Hospital de la Santa Creu i Sant Pau, C/ Sant Antoni Maria Claret, 167, Pavelló 18, planta 0, 08025 Barcelona, Spain.

E-mail address: gerardalv@gmail.com (G. Alvarez).

¹ Gerard Alvarez is a PhD student on Biomedical Research Methodology and Public Health in the Medical Department of the Universitat Autònoma de Barcelona.

complete reporting (Glasziou et al., 2014), focussing in particular on interventions (Hoffmann et al., 2014).

In fact, over the last 20 years, a set of general guidelines have been developed to promote a better and more consistent reporting of research. Between 1996 and 2010, the Consolidated Standards for Reporting Trials (CONSORT) statement and its revised versions were published to significantly improve the quality of clinical trials reporting in scientific journals (Plint et al., 2006). Indeed, focussing on intervention details, the CONSORT Statement evolved from the inclusion of one general item (CONSORT 2001 revised), to a larger and more detailed item in the 2008 extension of CONSORT for Trials Assessing of Non-pharmacologic Treatments (Boutron et al., 2008) and the 2010 guidelines (Moher et al., 2010). Notwithstanding this progress, specific recommendations on how to report interventions remained very limited (see Fig. 1).

A step closer to an appropriate reporting form was made by the Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) (Chan et al., 2013). This is a more recent guideline for protocols (see Table 1), which was released to specifically improve the design of clinical trials. Within the context of the 33-items SPIRIT checklist, Chan et al. (2013) dedicated a single multi-composite item (item 11) to the description of the intervention. This should be considered a consistent step forward towards an adequate and robust description, in the light of the growing awareness regarding intervention-reporting guidelines. However, it should be highlighted again, that the details included seemed to be insufficient to adequately describe interventions, especially for non-pharmacological treatments.

Among the various initiatives that have been undertaken to improve the intervention description, the Template for Intervention Description and Replication (TIDieR) (Hoffmann et al., 2014) has to be highlighted as the most promising. The checklist is an extension of the CONSORT 2010 (item 5) statement (Moher et al., 2001) and SPIRIT 2013 (item 11) (Chan et al., 2013) and focuses specifically on interventions. TIDieR consists of a checklist with 12 items and specific guidelines developed by an international group of experts and stakeholders. Those items represent the minimum information recommended for describing both (co-)interventions and comparisons (see Table 2). Beyond those 12 items, any additional information that can improve intervention replicability has to be included (if possible in the primary paper, if not as supplementary material). Checklist outlines the procedures to systematically report the rationale (item “Why”) behind the use of the intervention and the materials and procedures planned (items “What”, “How”, “Where”, “When and How Much”, “Tailoring”, “Modifications and How Well”). The primary target is to improve treatment reporting in clinical trials, however, TIDieR could be considered a substantial support for describing any type of intervention within any type of study design. This is relevant for non-

pharmacological trials but could be considered essential for manual therapy research.

2. Relevance of TIDieR for manual medicine

Considering the state of the art of manual medicine and manual therapies (MTs), scientific literature has been increasing significantly during the last few decades. Research findings seemed to demonstrate the effectiveness of several types of manual therapies in different clinical fields (Alcantara et al., 2011; Dobson et al., 2012; Pennick and Liddle, 2013; Cicchitti et al., 2015). However, considering the evidence-based health practice, there still are concerns regarding the following issues: appropriateness of using MTs in the context of complex interventions (Dobson et al., 2012; Pennick and Liddle, 2013); safety of procedures (Gouveia et al., 2009; Carnes et al., 2010; Hunsinger et al., 2014; Cicchitti et al., 2015); cost-effectiveness and cost-utility (Canter et al., 2005; Tsertsvadze et al., 2014; Cerritelli et al., 2015); and the consequent inclusion into national health care systems (Canter et al., 2005).

On the one hand, the political and lobbyist local scenario could influence the evolution of health systems and the effectiveness of multidisciplinary collaboration, although cross-disciplinary partnerships are considered a key part of science nowadays (Knapp et al., 2015). On the other hand, scientists reported that the quality of research is debatable (Jäkel and Hauenschild, 2012; Franke et al., 2015), reflecting the insufficient quality of reporting in the general scientific literature (Glasziou et al., 2014).

In the clinical context, MTs are session-based treatment plans where dosage (i.e., frequency, intensity) can vary significantly. In fact, in patients with low back pain, the variance of sessions seemed to be more associated to demographic factors and patients' complaint attitudes compared to type of treatment and therapists peculiarities (Swinkels et al., 2005). Concerning the correlation between dosage and pain, some authors reported no differences in pain pressure thresholds, despite the rate or amplitude of manoeuvre (Krouwel et al., 2010; Willett et al., 2010). Conversely, other authors pointed out that specific sets of mobilizations produced a significant reduction in pain (Pentelka et al., 2012). In addition, specific sets applied during mobilizations in chronic neck pain patients seemed to be necessary for reducing stiffness and potentially pain (Snodgrass et al., 2014) although the different type of manual manoeuvres were demonstrated to be not associated with long-term outcome effects (Izquierdo Perez et al., 2014). Conversely, the number of sessions in MTs treatments can have relevant cost-effective implications (Licciardone, 2014). Due to the degree of individualization and the high variability in the procedures (Snodgrass et al., 2006, 2007; Gorgos et al., 2014), both the description of each manoeuvre and how it is applied are mandatory in MTs studies to warrant applicability, replicability and health-care benefit assessment. TIDieR covers all these aspects including in the checklist item 4 (“What – procedures”) and item 8 (“When and How Much”), which address the full and detailed description of intervention in terms of explanation of the procedure and dosage.

Another key aspect in MTs and other non-pharmacological interventions is the therapist profile. Notwithstanding the usual cognitive, affective and psychomotor practitioners' abilities (Sizer et al., 2007, 2008), it has been suggested that musculoskeletal therapists should develop additional skills including research awareness, critical appraisal or educational capacities to obtain better clinical outcomes (Moore and Jull, 2002). The description of the intervention provider and their competencies appear, therefore, to be fundamental. TIDieR addresses this aspect in item 5 (“Who”) where the background, expertise and any training given to therapists are required.

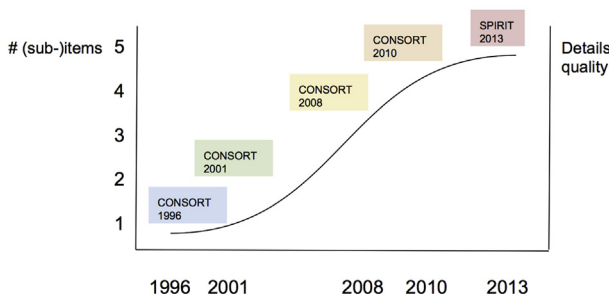


Fig. 1. Intervention description details: evolution of the different versions of CONSORT statement and SPIRIT.

Table 1
Guidelines highlighting the differences on reporting the intervention descriptions.

CONSORT statement 1996	Item: "Describe planned interventions and their timing."
CONSORT Statement (revised) 2001	Item 4: "Precise details of the interventions intended for each group and how and when they were actually administered."
Extension of CONSORT for Trials Assessing Nonpharmacologic Treatments 2008	Item 4: "Precise details of both the experimental treatment and comparator. The item was disaggregated into 3 subsections: item 4A) Description of the different components of the interventions and, when applicable, descriptions of the procedure for tailoring the interventions to individual participants; item 4B) Details of how the interventions were standardized; and item 4C) Details of how adherence of care providers with the protocol was assessed or enhanced."
CONSORT Statement (revised) 2010	Item 5: "The interventions for each group with sufficient details to allow replication, including how and when they were actually administered"
CONSORT 2010 explanation & elaboration paper	"As for the description of the interventions, this document stresses the need to describe the interventions for each group with sufficient details to allow replication, including how and when they were actually administered. More particularly, it is also mentioned the need to describe in detail the control intervention, the characteristics of the placebo and the way it was prepared, the "usual treatment" that is provided as a control group and when combined interventions are used. It is also recommended in some specific cases a description of who implements the intervention as the therapist itself may be part of the intervention (eg, surgery). Finally, the paper recalls that authors should give details of when the interventions are applied (timing) and the duration, especially when it consists of multiple components."
SPIRIT 2013	Item 11: "Interventions: 11a) Interventions for each group with sufficient detail to allow replication, including how and when they will be administered; 11b) Criteria for discontinuing or modifying allocated interventions for a given trial participant (eg, drug dose change in response to harms, participant request, or improving/worsening disease); 11c) Strategies to improve adherence to intervention protocols, and any procedures for monitoring adherence (eg, drug tablet return, laboratory tests); 11d) Relevant concomitant care and interventions that are permitted or prohibited during the trial."

The interest in MTs efficacy (specific treatments effects) on targeted subgroups of patients has been increasing during recent years (Fersum et al., 2010; Kent et al., 2010; Slater et al., 2012). From a research perspective, some authors argued that subgrouping by patient profile and tailoring interventions lead to better outcomes (Fersum et al., 2010; Schafer et al., 2011, 2012), whereas other scientists showed inconclusive data (Hoeksma et al., 2005; Kent et al., 2005, 2010). However, in the clinical practice, MTs are mainly applied with a high degree of tailoring. This debating aspect is covered on item 9 ("Tailoring") where the adaptation, modification and tailoring of intervention according to patient's profile is taken into account. Interestingly, including this item, the **TIDieR** guide makes a significant advance compared to other guidelines, recognizing the peculiarities of some interventions – i.e., person-based

or person-centred treatment including MTs and other non-pharmacological interventions- and claiming for a detailed treatment description. While experimental designs such as randomized clinical trials (RCTs) have been criticised by some MTs researchers (Littlewood, 2011; Milanese, 2011) as a type of research methodology not applicable in a clinical-based context, **TIDieR** can be seen as a useful tool to find a better balance between internal and external validity of MTs studies.

Finally, adherence and compliance to protocol are other key aspects for a comprehensive study. Non-pharmacological interventions such as MTs are commonly used for some chronic conditions (Reimold and Chandran, 2014; Chang et al., 2015) whose treatment can last several weeks. However, the success of interventions or research studies, which involves long-term

Table 2
Items included in the Template for Intervention Description and Replication (TIDieR) checklist (Hoffmann et al., 2014).

No.	Item	Details
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 (such as 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 (such as 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 ^a	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 ^a	How well enacted	If intervention adherence or fidelity was assessed, describe the extent to which the intervention was delivered as planned

^a If checklist is completed for a protocol, these items are not relevant to protocol and cannot be described until the study is complete.

outcomes, was shown to be influenced by the degree by which patients accurately follow the study protocol (World Health Organization (WHO), 2003; Robiner, 2005; Deutscher et al., 2009). Adherence and compliance are, therefore, important features for setting up high-quality experimental studies. Again, **TIDieR** recognises these aspects and includes 2 items (11 and 12 – “How well”) to fulfil these needs (“Please refer to Table 2 here”).

3. Implications

Improvements in the general reporting of manual interventions could have several implications. These improvements could result in a synergistic and skilful combination of different disciplines, which would help gain insights beyond current borders and generate novel solutions to complex problems. In addition, the combination of better methods applied and how they are reported can have a meaningful impact on the planning and conduction of further research in manual medicine as well as on data obtained and interpretation. As possible effects, it would lead to: a) the possibility to explore and discuss underpinning mechanisms of actions still unexplained; b) provide insights into processes that are inaccessible using current experimental techniques; c) validate predictions against experimental data, which is of utmost importance from a scientific perspective; d) suggest adaptations of health care systems to the evolution of scientific and clinical manual medicine, which can be considered an ultimate long term outcome and e) facilitate more accurate assessment in terms of cost-effectiveness and cost-utility in the implementation of these disciplines.

4. Conclusions

In general, **TIDieR** offers both researchers and clinicians a helpful and comprehensive guidance on how MT interventions have to be designed and reported taking into account the clinical complexity of MTs and the need to satisfy research gold standards. Following the **TIDieR** checklist would increase the probability of studies being replicated and reproduced, extending the external validity of results and yielding, potentially, the generalizability of benefits. Moreover, it can contribute to several other positive changes such as: 1) increased awareness of what is regarded as a complete description of intervention by authors and reviewers as well as by journals and editors; 2) better understanding of manual practice for external professionals, unfamiliar with the given manual medicines; 3) enhancing the scientific credibility of MTs; 4) increasing the likelihood of creating profitable cross-disciplinary and inter-disciplinary discussions; 5) defining clearer competencies, magnifying strengths or limitations to patients and for policymakers.

References

Alcantara J, Alcantara JD, Alcantara J. The chiropractic care of infants with colic: a systematic review of the literature. *Explore (NY)* 2011 May;7(3):168–74.

Boutron I, Moher D, Altman DG, Schulz KF, Ravaud P, CONSORT Group. Extending the CONSORT statement to randomized trials of nonpharmacologic treatment: explanation and elaboration. *Ann Intern Med* 2008 Feb 19;148(4):295–309.

Canter PH, Coon JT, Ernst E. Cost effectiveness of complementary treatments in the United Kingdom: systematic review. *BMJ* 2005 Oct 15;331(7521):880–1. British Medical Journal Publishing Group.

Carnes D, Mars TS, Mullinger B, Froud R, Underwood M. Adverse events and manual therapy: a systematic review. *Man Ther* 2010 Aug;15(4):355–63.

Cerritelli F, Pizzolorusso G, Renzetti C, Cozzolino V, D'Orazio M, Lupacchini M, et al. A multicenter, randomized, controlled trial of osteopathic manipulative treatment on preterms. In: Rubens C, editor. *PLoS One*, 10(5). Public Library of Science; 2015. e0127370.

Chalmers J, Glasziou P. Avoidable waste in the production and reporting of research evidence. *Lancet* 2009 Jul 4;374(9683):86–9.

Chan A-W, Tetzlaff JM, Gøtzsche PC, Altman DG, Mann H, Berlin JA, et al. SPIRIT 2013 explanation and elaboration: guidance for protocols of clinical trials. *BMJ* 2013 Jan 08;346(15):e7586. British Medical Journal Publishing Group.

Chang K-L, Fillingim R, Hurley RW, Schmidt S. Chronic pain management: non-pharmacological therapies for chronic pain. *FP Essent* 2015 May;432:21–6.

Cicchetti L, Martelli M, Cerritelli F. Chronic inflammatory disease and osteopathy: a systematic review. In: d'Acquisto F, editor. *PLoS One*, 10(3). Public Library of Science; 2015. e0121327.

Deutscher D, Horn SD, Dickstein R, Hart DL, Smout RJ, Gutvirtz M, et al. Associations between treatment processes, patient characteristics, and outcomes in outpatient physical therapy practice. *Arch Phys Med Rehabil* 2009 Aug;90(8):1349–63.

Dobson D, Lucassen PLBJ, Miller JJ, Vliieger AM, Prescott P, Lewith G. Manipulative therapies for infantile colic. In: Dobson D, editor. *Cochrane Database Syst Rev*, 12. Chichester, UK: John Wiley & Sons, Ltd; 2012. CD004796.

Douet L, Milne R, Anstee S, Habens F, Young A, Wright D. The completeness of intervention descriptions in published National Institute of Health Research HTA-funded trials: a cross-sectional study. *BMJ Open* 2014;4(1):e003713. British Medical Journal Publishing Group.

Fersum KV, Dankaerts W, O'Sullivan PB, Maes J, Skouen JS, Bjordal JM, et al. Integration of subclassification strategies in randomised controlled clinical trials evaluating manual therapy treatment and exercise therapy for non-specific chronic low back pain: a systematic review. *Br J Sports Med* 2010 Nov;44(14):1054–62.

Franke H, Fryer G, Ostelo RWJG, Kamper SJ. Muscle energy technique for non-specific low-back pain. In: Franke H, editor. *Cochrane Database Syst Rev*, 2. Chichester, UK: John Wiley & Sons, Ltd; 2015. CD009852.

Glasziou P, Meats E, Heneghan C, Shepperd S. What is missing from descriptions of treatment in trials and reviews? *BMJ* 2008 Jun 28;336(7659):1472–4. British Medical Journal Publishing Group.

Glasziou P, Altman DG, Bossuyt P, Boutron I, Clarke M, Julious S, et al. Reducing waste from incomplete or unusable reports of biomedical research. *Lancet* 2014 Jan 18;383(9913):267–76.

Gorgos KS, Wasyluk NT, Van Lunen BL, Hoch MC. Inter-clinician and intra-clinician reliability of force application during joint mobilization: a systematic review. *Man Ther* 2014 Apr;19(2):90–6.

Gouveia LO, Castanho P, Ferreira JJ. Safety of chiropractic interventions: a systematic review. *Spine* 2009 May 15;34(11):E405–13.

Hoeksma HL, Dekker J, Ronday HK, Breedveld FC, Van den Ende CHM. Manual therapy in osteoarthritis of the hip: outcome in subgroups of patients. *Rheumatology* 2005 Apr;44(4):461–4.

Hoffmann TC, Erueti C, Glasziou PP. Poor description of non-pharmacological interventions: analysis of consecutive sample of randomised trials. *BMJ* 2013 Sep 10;347(1):f3755.

Hoffmann TC, Glasziou PP, Boutron I, Milne R, Perera R, Moher D, et al. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. *Br Med J* 2014:g1687.

Hunsinger M, Smith SM, Rothstein D, McKeown A, Parkhurst M, Hertz S, et al. Adverse event reporting in nonpharmacologic, noninterventional pain clinical trials: ACTION systematic review. *Pain* 2014 Nov;155(11):2253–62.

Izquierdo Perez H, Alonso Perez JL, Gil Martinez A, La Touche R, Lerma-Lara S, Commeaux Gonzalez N, et al. Is one better than another?: a randomized clinical trial of manual therapy for patients with chronic neck pain. *Man Ther* 2014 Jun;19(3):215–21.

Jäkel A, Hauenchild von P. A systematic review to evaluate the clinical benefits of craniosacral therapy. *Complement Ther Med* 2012 Dec;20(6):456–65.

Kent P, Marks D, Pearson W, Keating J. Does clinician treatment choice improve the outcomes of manual therapy for nonspecific low back pain? A metaanalysis. *J Manipulative Physiol Ther* 2005 Jun;28(5):312–22.

Kent P, Mjosund HL, Petersen DHD. Does targeting manual therapy and/or exercise improve patient outcomes in nonspecific low back pain? A systematic review. *BMC Med* 2010;8(1):22.

Knapp B, Bardenet R, Bernabeu MO, Bordas R, Bruna M, Calderhead B, et al. Ten simple rules for a successful cross-disciplinary collaboration. *PLoS Comput Biol* 2015 Apr;11(4):e1004214. Public Library of Science.

Krouwel O, Hebron C, Willett E. An investigation into the potential hypoalgesic effects of different amplitudes of Pa mobilisations on the lumbar spine as measured by pressure pain thresholds (PPT). *Man Ther* 2010 Feb;15(1):7–12.

Licciardone JC. Short-term dosing of manual therapies for chronic low back pain. *Spine J* 2014 Jun 1;14(6):1085–6.

Littlewood C. The RCT means nothing to me! *Man Ther* 2011 Dec;16(6):614–7.

Milanes S. The use of RCT's in manual therapy – are we trying to fit a round peg into a square hole? *Man Ther* 2011 Jan 8;16(4):403–5.

Moher D, Schulz KF, Altman DG. The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomised trials. *The Lancet* 2001 Apr;357(9263):1191–4.

Moher D, Hopewell S, Schulz KF, Montori V, Gøtzsche PC, Devereaux PJ, et al. CONSORT 2010 explanation and elaboration: updated guidelines for reporting parallel group randomised trials. *BMJ* 2010 Mar 23;340(1):c869.

Moore A, Jull G. Reflections on the musculoskeletal therapists' multifaceted role and influences on treatment outcomes. *Man Ther* 2002;7(3):119–20.

Pennick V, Liddle SD. Interventions for preventing and treating pelvic and back pain in pregnancy. In: Pennick V, editor. *Cochrane Database Syst Rev*, 8. Chichester, UK: John Wiley & Sons, Ltd; 2013. CD001139.

- Pentelka L, Hebron C, Shapleski R, Goldshtein I. The effect of increasing sets (within one treatment session) and different set durations (between treatment sessions) of lumbar spine posteroanterior mobilisations on pressure pain thresholds. *Man Ther* 2012 Dec;17(6):526–30.
- Plint AC, Moher D, Morrison A, Schulz K, Altman DG, Hill C, et al. Does the CONSORT checklist improve the quality of reports of randomised controlled trials? A systematic review. *Med J Aust* 2006 Sep 4;185(5):263–7.
- Reimold AM, Chandran V. Nonpharmacologic therapies in spondyloarthritis. *Best Pract Res Clin Rheumatol* 2014 Oct;28(5):779–92.
- Robiner WN. Enhancing adherence in clinical research. *Contemp Clin Trials* 2005 Feb;26(1):59–77.
- Schafer A, Hall T, Muller G, Briffa K. Outcomes differ between subgroups of patients with low back and leg pain following neural manual therapy: a prospective cohort study. *Eur Spine J* 2011 Mar;20(3):482–90.
- Schroter S, Glasziou P, Heneghan C. Quality of descriptions of treatments: a review of published randomised controlled trials. *BMJ Open* 2012 Jan 1;2(6):e001978. British Medical Journal Publishing Group.
- Sizer P, Felstehausen V, Sawyer S, Dornier L, Matthews P, Cook C. Eight critical skill sets required for manual therapy competency: a Delphi study and factor analysis of physical therapy educators of manual therapy. *J Allied Health* 2007;36(1):30–40.
- Sizer P, Sawyer S, Felstehausen V, Couch S, Dornier L, Cook C. Intrinsic and extrinsic factors important to manual therapy competency development: a Delphi investigation. *J Man Manipulative Ther* 2008;16(1):e9–19.
- Slater SL, Ford JJ, Richards MC, Taylor NF, Surkitt LD, Hahne AJ. The effectiveness of sub-group specific manual therapy for low back pain: a systematic review. *Man Ther* 2012 Jun;17(3):201–12.
- Snodgrass SJ, Rivett DA, Robertson VJ. Manual forces applied during posterior-to-anterior spinal mobilization: a review of the evidence. *J Manipulative Physiol Ther* 2006 May;29(4):316–29.
- Snodgrass SJ, Rivett DA, Robertson VJ. Manual forces applied during cervical mobilization. *J Manipulative Physiol Ther* 2007 Jan;30(1):17–25.
- Snodgrass SJ, Rivett DA, Sterling M, Vicenzino B. Dose optimization for spinal treatment effectiveness: a randomized controlled trial investigating the effects of high and low mobilization forces in patients with neck pain. *J Orthop Sports Phys Ther* 2014 Mar;44(3):141–52.
- Swinkels ICS, Wimmers RH, Groenewegen PP, van den Bosch WJH, Dekker J, Van Den Ende CHM. What factors explain the number of physical therapy treatment sessions in patients referred with low back pain; a multilevel analysis. *BMC Health Serv Res* 2005;5(1):74. BioMed Central Ltd.
- Tsertsvadze A, Clar C, Court R, Clarke A, Mistry H, Sutcliffe P. Cost-effectiveness of manual therapy for the management of musculoskeletal conditions: a systematic review and narrative synthesis of evidence from randomized controlled trials. *J Manipulative Physiological Ther* 2014 Jul;37(6):343–62.
- Willett E, Hebron C, Krouwel O. The initial effects of different rates of lumbar mobilisations on pressure pain thresholds in asymptomatic subjects. *Man Ther* 2010 Apr;15(2):173–8.
- World Health Organization (WHO). Adherence to long-term therapies. 2003. p. 1–194 (accessed 12.12.15), <http://apps.who.int/iris/bitstream/10665/42682/1/9241545992.pdf>.