

# **Mapping physical therapy research: the geographical affiliations and methodological quality of 2,959 randomized controlled trials**

## **ABSTRACT**

Evidence suggests that research benefits from diversity, yet science is concentrated to a small group of countries. Diversity in physical therapy research has so far not been studied thoroughly and this is the first study to map physical therapy research geographically.

The objective was to study the frequency and methodological quality of physical therapy-related randomized controlled trials (RCTs) across the world.

PEDro was searched for RCTs in physical therapy published between January 1 2015 and December 5 2016. For each trial, the first and last authors' affiliations and the PEDro scale were extracted. Using the first and last authors' affiliations, each article was geocoded using the Data Science Toolkit API.

The search located 2,959 RCTs, which were affiliated primarily with a small cluster of countries. The median PEDro score for all trials was 5 (IQR 4:7). The geographical spread of the RCTs was focused around Europe, the Middle East, Southeast Asia, Oceania, the United States, and parts of South America.

The lack of diversity might be problematic for the research field, even though the average clinical trial in physical therapy is of fair quality.

## **Keywords**

Bibliometrics, Physical Therapy Specialty, Geographic Mapping, Physical Therapy  
Modalities, Randomized Controlled Trials as Topic, Cultural Diversity

**Word count**

3395

## **BACKGROUND**

Physical therapy research is on the rise. The number of studies has increased exponentially in the last few decades (Kamper et al., 2015), as of 2010 having doubled every three and a half years (Sherrington et al., 2010). This surge in supply has been paralleled with an increasing demand for it. Prominent organizations such as the World Confederation for Physical Therapy (WCPT) and the American Physical Therapy Association (APTA) have advocated evidence-based practice (American Physical Therapy Association, 2015; WCPT Secretariat, 2011), which reflects the high regard practitioners of physical therapy have for evidence-based practice (Iles and Davidson, 2006; Jette et al., 2003).

The backbone of evidence-based practice is good research, of which a cornerstone is the randomized controlled trial (RCT) (and systematic reviews of such). RCTs minimize biases that otherwise risk influencing study outcomes and have in recent years emerged as one of the most frequent study types in physical therapy (Wiles, Matricciani, Williams, and Olds, 2012). Many of the most influential RCTs in the field (The Centre of Evidence-Based Physiotherapy, 2014) have challenged then-current practices, such as traction for low-back pain (Beurskens et al., 1995), or rebuked new interventions, such as early rehabilitation in the wake of exacerbations of chronic respiratory disease (Greening et al., 2014).

RCTs are available through a range of academic databases—some that are free to access. One such is the Physiotherapy Evidence Database (PEDro) (Sherrington, Herbert, Maher, and Moseley, 2000), which houses an extensive index of RCTs in physical therapy (Michaleff et al., 2011; Moseley et al., 2009) and is continually updated with articles from databases and systematic reviews (among other sources). Moreover, PEDro's articles are all assessed with the PEDro scale (Maher et al., 2003), which provides a concise measure of the methodological quality of a trial. The PEDro scale is increasingly being adopted by

researchers to examine trials for inclusion in systematic reviews—even outside the realms of physical therapy (Elkins et al., 2013).

The trials in PEDro constitute a sample of physical therapy research that has been, and continue to be, used in several reviews summarizing research in the field (Elkins et al., 2013; Kamper et al., 2015; Maher et al., 2008; Sherrington et al., 2010). Among other aspects, those reviews have examined the distribution of research types (for the three that are available in PEDro), trends over time, languages in studies, and their PEDro scores. However, the geographical distribution of these studies has yet to be researched; in fact, little is known about those who conduct physical therapy research and where in the world they do it. As of yet, the only source of data on this are the SCImago Country Ranks (SCImago Lab, 2015), which indicate that the United States (US), as in other subjects, is by far the most frequently affiliated country, followed primarily by other English-speaking countries. These data, however, excludes domains such as manual therapy and rehabilitation (which are provided separately) and thus provides a fragmented view of the overall distribution of research in physical therapy; moreover, it comes without details on how the data were collected.

Diversity is lacking within the research communities of large countries such as the United Kingdom (UK) and US. This has prompted some organizations to call for change, based on the argument that variety constitutes a prerequisite for sound research (National Science Foundation and National Center for Science and Engineering Statistics, 2015; The Royal Society, 2014), which empirical evidence corroborates (Williams and O'Reilly, 1998). By extension, this suggests that research in physical therapy too might stand to benefit from a diverse workforce in terms of, for example, culture and geography; of this, however, little is known.

This is the first time physical therapy research is mapped geographically. The aim was to investigate the frequency and methodological quality of physical therapy-related RCTs across

the world, using a sample of 2,959 RCTs from PEDro published between January 2015 and November 2016.

## **METHODS**

PEDro was searched on December 15, 2016 using *clinical trials* and *publication date: 2015 and later* as limitations. Briefly, a trial is included in PEDro if

- it compared at least two interventions, including crossover trials where participants partook in more than one intervention, provided all other criteria are met,
- at least one of its interventions was, or could become, part of physical therapy practice,
- it is a full paper from a peer-reviewed journal,
- its participants were, or were intended to be, representative of the target group, and
- it involved random allocation or intended-to-be-random allocation of subjects to interventions. (Centre for Evidence-Based Physiotherapy, 2017b; Maher et al., 2008)

The trials in PEDro are located from a range of sources, namely

- automatic searches of Medline, Embase, Cinahl and PsycInfo,
- each release of the Cochrane Database of Systematic Reviews and CENTRAL,
- citations from systematic reviews on PEDro,
- handsearches of approximately 200 allied health journals from *Nederlands Paramedisch Instituut*, and
- personal databases of the Steering Committee of the Centre for Evidence-Based Physiotherapy and recommendations from users of PEDro. (Centre for Evidence-Based Physiotherapy, 2017a)

PEDro contains a comprehensive index of physical therapy RCTs. In one study, its coverage was estimated at 92% (Michaleff et al., 2011) and in another 99% (Moseley et al., 2009).

The search located 2,959 trials in the database, which at the time had last been updated December 5, 2016. Each article was manually searched to locate the affiliation of its first and last authors. PubMed was first searched; if the affiliation was unavailable there, it was instead retrieved from the publisher's webpage, *Scopus*, or *Research Gate*. If the first author had listed several affiliations, the first of these was selected. However, if the last author had listed several affiliations and any of these had been affiliated with an author preceding them, one was selected at random. In papers with a single author ( $n = 24$ ), those authors were counted as both last and first authors. Taken together, this amounted to 5,918 first and last authors.

Each affiliation was mapped automatically to geographic coordinates using the Data Science Toolkit (Data Science Toolkit, 2013). In order to ensure locations were set properly, a random sample of 50 articles were examined manually using the API, resulting in no mismatches.

### The PEDro scale

The PEDro scale was used to measure the methodological quality of the trials. It has 11 items and can be used on an item-by-item basis or as a score, in which case all but the first item are summed. This study included both individual items and scores, which were extracted from PEDro for each article except those that at the time had not yet been assessed. The PEDro scale items are scored as *yes* or *no* and, in order, require that

1. eligibility criteria were specified,
2. subjects were randomly allocated to groups (in a crossover study, subjects were randomly allocated an order in which treatments were received),
3. allocation was concealed,
4. the groups were similar at baseline regarding the most important prognostic indicators,
5. there was blinding of all subjects,
6. there was blinding of all therapists who administered the therapy,

7. there was blinding of all assessors who measured at least one key outcome,
8. measures of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups,
9. all subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least one key outcome was analyzed by “intention to treat”,
10. the results of between-group statistical comparisons are reported for at least one key outcome, and
11. the study provides both point measures and measures of variability for at least one key outcome. (Maher et al., 2003)

The reliability of the PEDro total score has been estimated as fair for individual ratings (ICC = 0.56) and good (ICC = 0.68) for consensus ratings (Maher et al., 2003). The PEDro staff aims for each article to be rated twice, and in case of disagreements, a third rater to break the tie, although PEDro does not indicate when an article has needed a third rater.

Macedo et al. has studied the construct and convergent validity of the PEDro scale by comparing it with similar scales (Macedo et al., 2010). The PEDro total score correlates modestly with the Jadad scale (Jadad et al., 1996),  $\rho = 0.35$ , and strongly with the van Tulder 2003 scale (van Tulder, Furlan, Bombardier, and Bouter, 2003),  $\rho = 0.71$ . They also studied the construct validity, by comparing it with impact factors and SCImago journal rankings: associations were weak,  $R^2 = 0.02$  and  $0.03$  respectively, yet the authors regarded these as considerable given the context. De Morton took another approach to examine the scale's construct validity, applying a Rasch model that verified its validity (de Morton, 2009).

Additional data on the number of physical therapists per country were retrieved from WCPT's home page (World Confederation for Physical Therapy, 2016).

## **RESULTS**

### **Geographical spread**

The geographical spread of RCTs in physical therapy (Figure 1) was focused around Europe, the Middle East, Southeast Asia, Oceania, the United States, and Brazil. Detailed sections of the map, for instance Europe, have been published electronically on the journal's webpage.

By a large margin, the United States emerged as the most frequently affiliated nation, representing 17% of authors (Table 1). In total, 66 countries were represented in the data. Of these, the top 15, in terms of most affiliated authors, together made up 78% of the total. Supplementary data on the remaining countries has been published electronically on the journal's webpage.

In terms of trials relative to the country's population of physical therapists, South Korea and Turkey stood out with 182 and 320 authors per 10,000 practicing physical therapists respectively.

### **The PEDro scale**

PEDro scores were available for all but 169 (5.7 %) of the trials. The median score for all trials was 5 (IQR 4;7). Australia (n = 384, median 7, IQR 5;7) and Norway (n = 112, median 6.5, IQR 5;7) were the only countries with a median score above 6 among countries with more than 50 affiliated authors.

PEDro scores are available for the top 15 countries in Table 1; for the remaining countries, please see the supplementary data on the journal's webpage. The geographical distribution of the articles, along with their PEDro scores, can be found in Figure 1.

Fulfillment of the individual PEDro items has been plotted for the top 15 countries (in terms of number of affiliated authors) in Figure 2. The percentage of authors whose articles fulfilled the criteria were highest for items 1 (80%), 2 (99%), 4 (88%), 10 (96%), and 11



(95%), low for items 5 (4%) and 6 (0%), and in the mid-range for items 3 (37%), 7 (43%), 8 (58%), and 9 (38%); these items, in the midrange, also showcased the greatest variability between countries.

## **DISCUSSION**

The bulk of RCTs in physical therapy are affiliated with a small cluster of countries, out of which the United States (US) stands out through its 17% share of this study's sample of 5,918 affiliations to first and last authors. The median PEDro total score for all trials was 5 (IQR 4:7). On the PEDro scale, items 5 and 6 were rarely fulfilled; 1, 2, 4, 10, and 11 often so; and 3, 7, 8, and 9 were fairly often satisfied, although with considerable variability between countries.

This study benefits from using PEDro, which comprehensively covers physical therapy trials (Michaleff et al., 2011; Moseley et al., 2009). This also enabled the use of the PEDro scale, resulting in a unique world map of physical therapy research. However, given that PEDro is predominantly administered by English speakers, it is possible that the database is biased towards English articles. Moreover, usage of PEDro is disproportionate across the world: users from Australia, for instance, are particularly overrepresented relative to its population (Elkins et al., 2013). And since some articles are entered into PEDro as a result of user contributions, this might have affected the results within this paper. That PEDro is available in 11 languages, however, may alleviate some concerns of language-related bias.

The reader should note that these results concern physical therapy-related research, regardless of whether it was conducted by physical therapists. Many other professions, such as doctors, nurses, chiropractors, and occupational therapists, also engage in physical therapy-related research, even if the extent to which they do is unknown; hence, the reader is advised to avoid interpreting these findings as a comparison of the productivity or proficiency

of physical-therapist researchers; consequently, the measure of trials per 10,000 physical therapists (Table 1) should be considered crude.

The results are limited to randomized controlled trials, which excludes many studies—most notably all qualitative studies. Countries wherein qualitative inquiries are common may have been disadvantaged by this.

This is the first study of the geography of physical therapy research. The SCImago database of Country Ranks (SCImago Lab, 2015) provides similar information—albeit without the PEDro scale—yet its data collection is not transparent, apart from being based on Scopus, which is moreover not the most comprehensive database in terms of indexing of physical therapy-related research (Fell et al., 2011). And as previously mentioned, SCImago separates topics such as Physical Therapy, Rehabilitation, and Manual therapy into discrete categories, which hinders comparisons.

In a bibliometric analysis of data from the journal *Physical Therapy*, Wiles et al. reported that the proportion of articles originating outside the US has risen from 5 in 1945 to 40% in 2010 (Wiles, Matricciani, Williams, and Olds, 2012). They also presented the geographical distribution of these other countries, which focused on the western hemisphere, and notably Canada. Because *Physical Therapy* is based in the US, however, those figures are likely skewed and cannot be compared with the figures in this study.

Of the world's approximately 200 countries, only 66 (including Taiwan) were represented. And out of these, the top 15 were responsible for roughly 4 in 5 out of all articles. Ten of these 15 countries are found in lists of research across all disciplines (SCImago Lab, 2015). Compared with this article's list, Russia, France, Italy, Japan, and India have been replaced by Denmark, Turkey, Iran, Sweden, and South Korea. These differences manifest no clear-cut pattern: the countries' densities of physical therapists vary, as do the presence of peer-reviewed publications, length and academic status of educations,

as well as the age of the member organizations (World Confederation for Physical Therapy, 2016). However, analyzing these countries and their attributes' influence lies beyond the scope of this study, but should be considered in future inquiries.

It may raise concerns that a few countries are responsible for most research. It means that they—and by proxy their member organizations, financial backers, and legislative bodies—may unduly influence the directions that physical therapy research takes on a large scale. In particular, the US' contribution is great enough to influence the world's aggregate distribution of research, consequently putting the parties in that country, such as the APTA, in a position of some clout.

This may be problematic because research interests may vary across the world, in part because individuals in different regions of the world have divergent needs. As an example, it is well-established that people of different ethnicities experience pain differently (Rahim-Williams, Riley, Williams, and Fillingim, 2012), which—given that pain is a common target for physical therapy—affects many therapists as well as patients. That holds true also for persistent pain, with people across different nations reporting varying pain intensity, duration, and localizations (Gureje, Korff, Simon, and Gater, 1998). In turn, this may have implications for the type of research that is conducted and how it is conducted, considering that some areas of the world are underrepresented in this field of science.

The median PEDro score for all articles was 5. Given the close-to absolute correlation between medians and means on the PEDro scale (de Morton, 2009), this score is similar to the grand mean for articles in PEDro of 5.4 (Kamper et al., 2015). Taken together with the interquartile range of 4 to 7, the methodological quality of the average clinical trial in PEDro is fair—few articles are either poor or excellent.

The majority of the top 15 countries (in terms of total count of affiliated articles) have a slightly higher median score at 6, with Australia having the highest such at 7 (Table 1).

Reasons for this may include Australia's longer-than-average physical therapy educations, the high-impact *Journal of Physiotherapy* that is based there, and the elevated status of the profession (Turner, 2001). It may also be owed the relatively high number of PEDro users in Australia (Elkins et al., 2013) that in turn could be linked to the Australian Physiotherapy Association's role in founding PEDro.

The distribution of fulfillment of the PEDro items is comparable to previous results (de Morton, 2009). PEDro items 5 (subject blinding) and 6 (therapist blinding) are seldom fulfilled, particularly therapist blinding, which was featured in only 10 trials. Therapist blinding is notoriously difficult to achieve in trials on physical therapy interventions, but this is less true for subject blinding; improvements in this area would surely benefit physical therapy research and should be achievable. Interestingly, there is much variability between countries on PEDro items 3 (concealed allocation), 7 (assessor blinding), 8 (85% follow through), and 9 (intention-to-treat analysis). Fulfillment of these items was mediocre to fair. It is possible that these items might offer an opportunity to improve the quality of trials, seeing as how authors in some countries successfully satisfied these criteria.

Much remains to be discovered about the geography of physical therapy research. First, the reasons for the geographical patterns in these articles need to be investigated. Several approaches are possible: questionnaires could map the perspectives of physical therapists across different countries, cultures, and subdisciplines; quantitative studies could investigate how a country's physical therapy research relates to, for example, systems of education, sociodemographic profiles, and professional attributes; and the specific items on the PEDro score could be investigated in relation to geography. Finally, upcoming research might expand to study types beyond randomized controlled trials to examine if the results in this study might extrapolate beyond randomized controlled trials.

**Declaration of interest**

There were no conflicts of interest influencing the work on this paper.

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