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<th>Occupational therapy interventions for multiple sclerosis: A scoping review</th>
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Abstract

Aim We reviewed the evidence regarding the effectiveness of occupational therapy interventions in improving outcomes for adults with multiple sclerosis.

Method We completed a scoping review of literature in the area of occupational therapy and multiple sclerosis following a methodological framework for conducting scoping reviews. Search included all articles published up until June 2019. Studies were included if they were original research that included adults with multiple sclerosis published in English and assessed interventions delivered by occupational therapists.

Result The database search yielded 1646 results. Following screening and review of articles thirty papers (twenty-five studies) met the inclusion criteria and were included in the review. The studies were charted and discussed in the areas of 1) fatigue management or energy conservation 2) upper-limb rehabilitation 3) occupation-focused cognitive rehabilitation and 4) other types of interventions.

Conclusion The quality of evidence that exists for occupational therapy with people with multiple sclerosis is mixed but there are studies that show that occupational therapy can improve occupational and other outcomes in this population. It is essential to build on the evidence that exists in the area.

Keywords: occupational therapy; multiple sclerosis; rehabilitation; activities of daily living; fatigue; evidence-based practice
Introduction:

It is estimated that approximately 2,500,000 people worldwide have a diagnosis of multiple sclerosis [MS; 1]. Occupational therapists typically work with people with MS in the area of symptom management and have knowledge and expertise of occupation and the complex relationship between occupation and well-being [2]. Occupational therapists are well-placed to intervene when MS symptoms (e.g. fatigue, mood, pain, spasticity, tremor, mobility, cognition) impact on the ability to carry out meaningful and essential daily tasks in self-care, productivity and leisure [3]. Evidence for the effectiveness of occupational therapy for people with MS is, however, yet to be established [4]. The only Cochrane review published on the topic [4] could not conclude whether occupational therapy for people with MS was effective. At the time of publication the authors [4] identified only one randomised controlled trial [RCT]. This review was, however, carried out in 2003 and the evidence base has shifted since this time.

Occupational therapy practice requires the integration of clinical reasoning, available evidence, and the values and preferences of clients [5, 6]. Therapists often report barriers such as finding the time and training to search for, review, and implement findings [5]. Here we sought to provide a holistic view of the impact occupational therapy intervention has on people with multiple sclerosis – taking into consideration its effect on quality of life, work status, occupational performance and occupational participation. Given the limited number of RCTs that were available in occupational therapy and MS when the Cochrane review was completed [4], we decided to synthesise the evidence in the area using a scoping approach.

The aim of this review was to investigate what is known from the existing literature about the effectiveness of occupational therapy intervention for people with MS.

Method:

A scoping review methodology was used to address the research aim. Scoping reviews synthesise evidence and assess research need, where existing reviews are not already available. They address broad topic areas [7] and thus this methodology was deemed appropriate. A scoping review was also believed to be the most appropriate method given the need to include different study designs [7] as well as the resource demands involved in completing a systematic review [8].

The review followed Arksey & O’Malley’s [7] methodological framework for conducting scoping reviews with amendments where appropriate as recommended by Levac, Colquhoun & O’Brien [9]. We completed the following stages:

1. **Stage 1: Identifying the research question**
   
   Here we defined the parameters of the review through setting a clear research question. The question set was broad enough in nature to answer the question without generating unmanageable numbers of references.

2. **Stage 2: Identifying relevant studies**
   
   Primary studies were included that were identified from various sources- electronic databases, hand searching.

3. **Stage 3: Study selection**
Criteria was set for inclusion into the review. This was done post hoc once familiar with the available literature. Two reviewers applied the inclusion and exclusion criteria. A deadline was set for completing this.

4. **Stage 4: Charting the data**

   Key data was charted from the included studies. The method of charting and the information to be charted was agreed on at this stage. Suggested data from Arskey & O’ Malley [7] were included.

5. **Stage 5: Collating, summarising and reporting the results.**

   The approach taken to reporting data was decided on once the studies had been collected and reviewed.

Relevant studies were identified in June 2019. CINAHL, EMBASE, MEDLINE, PsycInfo, the Cochrane Library, Pubmed, Scopus and OTSeeker were searched using the terms ‘occupational therap*’ AND ‘multiple sclerosis’. MESH terms, Boolean logic and truncation were used where appropriate (see Table 1), no search limits were set to ensure the breadth of the literature included all relevant studies on the topic [7].

INSERT TABLE 1 AROUND HERE

The search strategy was adjusted for use in each database with assistance from a librarian experienced in reviews. As recommended [7], key journals, reference lists, conferences and organisation websites were hand-searched.

Rayyan, a web application for systematic reviews [10], was used throughout the study selection stage process. Duplicates were removed and the screening was completed in three stages using the Rayyan software. The title screen was conducted by one researcher while the abstract and full-text screen was conducted by two independent researchers, blinded to the others’ decisions. The authors resolved any conflicting decisions through discussion and deliberation.

An iterative process was employed for the study selection stage as recommended by Levac and colleagues [9]. The two researchers collaboratively decided on the inclusion and exclusion criteria throughout the process. Studies were included if:

- They were intervention studies delivered by an occupational therapist.
- The sample included only people with MS
- They were in the English language
- They were primary research including randomised controlled trials, quasi-experimental design, pilot studies and qualitative studies.

Studies were excluded if:

- The intervention was delivered by someone other than an occupational therapist e.g. physiotherapist, nursing, psychology
- It was not clear from the study if an occupational therapist delivered the intervention.
- The study addressed a multidisciplinary team intervention.
- The sample had mixed diagnosis.
- It included populations other than people with MS e.g caregivers, family, occupational therapists.
• It was a systematic-review, meta-analysis, audit, book review, opinion piece, case study, abstract from conference proceeding, editorial, letters to the editor or study protocol.
• The focus was on outcome measurement, an exploratory study not related to intervention, or drug trial.
• The article was retracted or the full-text was not available after appropriate steps to locate the paper were taken.

Studies were assessed for inclusion and data was extracted and charted using Excel software. The data-charting form was continually updated and adapted throughout the charting process. The evidence level and quality guide in John Hopkins nursing evidence-based practice evidence level and quality guide [11] was used to evaluate the level and quality of the included studies. Critical review forms from McMaster University were used for qualitative [12] and quantitative studies [13]. Mixed-method studies were evaluated using the Mixed-Method Appraisal Tool [14]. The results were collated and summarised thematically according to intervention type.

Results:

Search Results:

The database search yielded 1646 results (see Table 1). The following key journals yielded results not already identified in the database search: Multiple Sclerosis Journal (n=29), International Journal of Multiple Sclerosis Care (n=147), British Journal of Occupational Therapy (n=7), American Journal of Occupational Therapy (n=4), Canadian Journal of Occupational Therapy (n=2) and Scandinavian Journal of Occupational Therapy (n=1). Researchgate [15] (n=19) and OpenGrey [16] (n=1) identified grey literature in the area. Relevant resources were identified on the Consortium of Multiple Sclerosis Centers website [17] (n=7) and the European Committee for Treatment and Research in Multiple Sclerosis website [18] (n=3). The reference list of a Cochrane review on occupational therapy for multiple sclerosis [4] and a systematic review of occupational therapy-related interventions for people with MS [19, 20] were hand-searched and a further 55 studies were identified. After the removal of duplicates 964 records remained.

A PRISMA flow diagram [21] indicates each stage of the study selection phase (see Figure 1).

INSERT FIGURE 1 (PRISMA) HERE

The title screen was the next step in the process. Following this, the abstracts of 852 records were screened by two independent researchers. Any record the researchers were unsure about at this phase was included for the full-text screen. There were 267 conflicting decisions at this phase. To take into consideration the high level of conflicts between the researchers, they set stricter definitions of inclusion/exclusion criteria to eliminate the possibility for ambiguity.

The full-texts were assessed using the inclusion/exclusion criteria, leaving 49 studies included and 139 conflicts. The researchers met and discussed each conflicting paper leaving 65 records to be assessed for eligibility. One researcher assessed these studies in detail for eligibility and excluded a further 39 studies because of: study design (n = 16), population (n = 1), intervention not delivered by an occupational therapist (n = 9), duplicate paper (n = 3), foreign language (n =
2) and full-text not available (n = 8). Two additional studies were included after contacting the author requesting a full-text [22]. One of these was an abstract for a conference presentation, based on the articles included [23, 24]. Another study [25] was included after reviewing the reference of its associated qualitative paper identified from the initial search [26].

**Description of studies**

A total of 30 papers discussing 25 interventional studies were included. Seventeen of these papers were interventions addressing fatigue management and energy conservation. Table 2 summarises the included studies. The sections to follow discuss an overall description of the included papers, and following this, the study results will be presented according to intervention type: 1) interventions addressing fatigue management or energy conservation 2) upper-limb interventions 3) occupation-focused cognitive rehabilitation and 4) other types of interventions.

There were a total of 1396 people with MS included in this review. The most common form of MS address in the studies was Relapsing Remitting. More women than men were included in studies, which is representative of this population. This review includes level I-III evidence of different quality (See Table 2) including randomised controlled trials, quasi-experimental designs and qualitative studies, published in peer-reviewed journals, studies not yet published, and pilot studies and research posters presented at academic conferences. Despite limitations in some of these publication types, they were included because of the nature of a scoping review and the research question aimed to address all primary research in the area of occupational therapy for MS.

**Fatigue Management or Energy Conservation Interventions**

Seventeen papers discussed ten interventions addressing fatigue management or energy conservation techniques for people with MS delivered by an occupational therapist. The majority of the studies were based on Packer and colleagues’ [27] group-based fatigue management course for people with chronic fatigue [25, 26, 28-36]. Other group-based interventions included an inpatient course [37, 38], a participant-led, community rehabilitation intervention [39], a self-directed technology based programme [23, 24], self-study modules [33] and an individual self-management intervention [40].

A large-scale RCT [30] using a crossover design with 169 participants evaluated the efficacy and effectiveness of a six-week, group-based energy conservation course based on Packer and colleagues [27]. This study followed a smaller-scale study (N=54) that showed significant effects on fatigue impact, self-efficacy and quality of life [29]. The RCT [30] found that the intervention decreased fatigue impact, increased self-efficacy and some aspects of quality of life. These results were maintained at one-year follow-up with a trend towards continuing improvement overtime [32]. There was a high attrition rate of 23%, though the authors accounted for this in the data analysis. From the course evaluation forms, participants found the concepts of the course and social interaction helpful with some small modification to the format [31]. These descriptive results should be interpreted with caution as it was a post-hoc analysis of data which may influence results. Self-study modules were given to those who did not attend one of the six
sessions; this was explored in a secondary analysis, which compared two naturally occurring groups from the RCT, those who completed all six sessions and those who received self-study modules. There was no significant differences between the two groups. This should be interpreted with a high level of caution as it is secondary analysis and was not the intent of the original study, thus there may be some level of bias in the reporting [33].

A number of studies included also ran Packer et al. [27] energy conservation course with some adaptations. One study with a quasi-experimental, crossover design [34] examined the effects of an adapted version (eight week duration of one hour sessions with smaller groups and no written homework assignments) for people with moderate to severe disability with progressive MS. The intervention had a significant effect of fatigue impact and 84% of participants reported to have made up to four behavioural changes after the intervention. This was a small-scale study (N=37), with no randomisation or blinding in a specialised community MS centre and thus, the generalisability of the results should be carefully considered. Additionally, this energy conservation course was adapted for use and tested in an Argentinian population [35]. Positive results were seen on measures of fatigue, community integration and independence. However, the study was presented as a poster and therefore key material about the design, intervention, data analysis and results are unclear, making the rigor of the study hard to establish.

A more recent RCT [36] of an energy conservation course based on Packer et al. [27] for ambulatory people with MS with severe fatigue found no effects when compared to an information only control group. This study used the CIS20r, a self-report similar to the Fatigue Impact Scale, as the primary outcome measure alongside the Impact on Participation and Autonomy questionnaire. Overall there were unfavourable results for both outcomes for the intervention group. This may be because the self-report measures may not be an appropriate measure of change for people with MS as the assessments are not responsive to change [41].

Packer and colleagues’ [27] energy conservation course was also adapted appropriately for use as a teleconference intervention. A pilot study with 29 participants showed the positive effects of the adapted course on fatigue impact and severity [25]. Data gathered indicate that the course was overall a positive experience for participants who appreciated the peer support and resources provided but had some challenges around time and logistics. The questions asked may have led to biased responses and Hawthorne effect [26]. Following on from this, a large-scale, two-group time-series RCT design [28] was completed. The intervention was found to be effective in reducing fatigue impact/improve aspects of health-related quality of life, but not fatigue severity. These results are especially important for those who would not otherwise be able to access occupational therapy services.

Other studies investigating alternative energy conservation interventions were included. An individual self-management occupational therapy programme SMOoTh [40] showed clinically relevant results in a self-report occupation measure compared to a control relaxation group. However, this was a pilot study with a small sample size, warranting further investigation to confirm the effectiveness with a larger sample size.

A qualitative study [39] of a group-based, participant led fatigue management highlighted that this intervention type allowed for active participation and empowerment through a shared and supported experience. Participants reported a positive change in lifestyle, occupations, thinking
about fatigue and social support network. This was a well-designed phenomenological study looking at the lived experience of participants who engaged in a fatigue management group and provided valuable insights for therapists and researchers.

Two studies [37, 38] investigated an inpatient energy conservation programme for people with MS. A qualitative study (N=11) evaluated Inpatient Energy Management Education which incorporates energy conservation and cognitive behavioural management in a 3-week inpatient setting. Participant and facilitator-gathered information found the materials and tasks very useful for facilitating behavioural change. The impact of the programme was reported in a pilot mixed-method study (including a small scale RCT and telephone interviews). Outcomes were assessed in self-efficacy, fatigue, and quality of life. The intervention group improved significantly more than the control group (progressive muscle relaxation) in perceived physical function, self-efficacy and perception of competence in performing daily activities. There was little significant difference in fatigue impact between the control and intervention group. Participants applied the course content to real life and some strategies were easier to implement than other, according to qualitative data gathered; though this was a poster presentation of a pilot study so details are lacking such as the exact outcome measures used.

One mixed-method pilot study [23, 24] investigated the feasibility of an interactive, self-directed fatigue management computer resource for people with MS. This study indicates the potential of this resource to decrease fatigue and increase knowledge and confidence in managing fatigue, with participants reporting a positive experience, behaviour changes and outcomes from the resource. Although mixed-method studies can be useful in understanding a new phenomenon and measure its cause and effects [42], the limitations of this study cannot be ignored as there is a high attrition rate of 34%, the quantitative and qualitative results are reported separately and the pilot had a single group design and a small sample leaving it underpowered.

**Upper-limb Rehabilitation Interventions**

Five studies included in the review reported on upper-limb interventions that aimed to improve intention tremor [43], manual dexterity [44-46], and limb use [47].

Hawes et al. [43] used a pre-test post-test feasibility design to improve eating and handwriting in people with MS with intention tremor. The intervention, which focused on occupations, using a number of upper limb techniques such as weighted wrist, splinting, and hand-over-hand, was completed daily for one week. The study results are inconclusive due to the very small sample (n=6) and the lack of comparator. The authors do not report consistent results in the sample, with some techniques reported effective for some participants and not others on the measures used.

Improved manual dexterity was the focus of three studies that looked at home-based sensory education [44], home-based dexterity training [45] and a virtual reality video training programme with occupational therapy [46]. Participants in all three studies had an average age of 46.44-50.6 years and all three studies used a control group. The home-based education (3 weeks) and training (4 weeks) programmes [45; 44] consisted of 20-30 minutes of training five days a week. The virtual reality and occupational therapy programme [46] was also 30 minutes
but only took place twice a week and ran for ten weeks. This intervention was less intense than the other upper-limb interventions reported. The authors reported no differences between virtual reality and occupational therapy and the control (occupational therapy) with a small sample of 16 participants (intention to treat=26). The two home-based education and training programmes, on the other hand, reported improvements in the intervention group compared to the controls. Kamm et al. [45] reported improved strength and dexterity following intervention. Though a small sample was used (n=38) the random group allocation and use of blinded raters adds strength to the study findings. Though the focus on the home-based sensory education intervention [44] was on sensory training for those with sensory deficits (n=25), the improvements that were seen were in dexterity (as measured by the Nine Hole Peg Test) and not on any of the sensory outcomes (e.g. monofilaments and two point discrimination). All participants in this study had relapsing and remitting MS.

Mark et al. [47] used constraint-induced movement therapy to improve upper limb use for people with MS in a small (n=20), randomly allocated pilot trial. Here constraint-induced movement therapy, in which participants were required to wear a constraint on their affected arm 90% of waking hours, was compared to a control condition of massage, yoga and relaxation. The intervention had a duration of 2 weeks, 5 days/week but a large treatment effect was seen on the Motor Activity Log in favour of constraint-induced movement therapy, which was maintained at one-year follow-up. The other outcome used in the study, Wolf Motor Function Test, showed no post-treatment effects but improvements were seen at follow-up. Though a RCT design was used in this study, due to the small sample size and findings related to WMFA this study needs to be replicated in a larger study before any conclusions can be drawn from the results.

Occupation-focused Cognitive Rehabilitation Interventions

Three cognitive rehabilitation studies met the inclusion criteria. One study evaluated an external memory aid [48], one examined an internal memory strategy [49] and one assessed an occupational therapy programme focused on cognition [50]. A personal digital assistant was evaluated in an uncontrolled quasi-experimental study (n=20) by Gentry [48]. The intervention involved four 60-90 minute sessions with an occupational therapist over three weeks to support the use of the technology. The self-report measure used in the study found improved performance in everyday tasks but no change in objective memory assessment. Given the advances in technology and mobile phone applications, it is unlikely that a personal digital assistant such as that used in this study would be accepted by participants as the device would be considered outdated. Many phones now have superior functionality and this older technology is obsolete. Even if the design of this study were more robust and the results more encouraging, it would not be useful to replicate this study in a larger trial though it provides some useful data in the area of personal digital assistants.

Assessing the impact of cognitive rehabilitation on meal preparation and finance management was the aim in study by Goverover et al. [49]. Self-generation was used to improve task recall in people with MS and healthy controls and was found to be effective for both groups at three different time-points (immediately, after 30 minutes and after one week.). It is important to note that recall reduced significantly by the one-week interval [49].
Reilly and Hynes [50] aimed to improve daily life function through a cognitive rehabilitation programme. The intervention (Cognitive Occupational-Based Programme for People with MS) was a mixture of group and individual sessions (eight in total) focused on education, mediation and adaption. In this small and uncontrolled sample the authors found improvements in goal attainment and some areas of cognition [50]. This is, however, no proof that the programme is effective as there was self-selecting bias in recruitment and the study had no comparator.

**Other types of Occupational Therapy Interventions**

Five studies assessed interventions other than those discussed above—falls management [51], self-efficacy and community reintegration [52], vocational rehabilitation [53] and client-centred occupational therapy [54-55].

Three of the five studies reported positive results [51-53] following a 5-12 week occupational therapy intervention. The falls prevention programme (Safe at home BAASE) was aimed at people over the age of 55 living with MS [51]. In the sample of thirty participants, improvements were seen on a number of different falls measures, though two of these were created by authors. No control group was used in this study although the assessors were blind to study timepoints.

An evaluation of a self-efficacy-focused programme (CRISP) [52], randomised 91 participants (CRISP or usual care). Those in the intervention (CRISP) group participated in a programme that used education and self-management strategies to address self-efficacy in activities of socialising and recreation. The CRISP occupation-based programme reported improvements in self-efficacy and loneliness in the intervention group over usual care controls [52], though not in depression. There was no follow-up reported so it is unclear if these gains were maintained. Here per-protocol analysis was completed and not intention-to-treat which could bias the comparability between groups that was obtained through randomisation.

Jellie et al. [53] report results of in-depth interviews with 19 participants who completed a vocational rehabilitation intervention. The results found that the intervention was valued by people with MS and it allowed for greater understanding of how their MS symptoms affect their work and how this can be managed. The effectiveness of the intervention was not assessed and so it is not clear if the positive results reported by participants in the interviews transfer to improvement in vocational function, though this was not the aim of the study.

Eyssen and colleagues [54] report the results of a very well-designed double-blinded cluster randomised controlled trial of client-centred occupational therapy with 269 participants with MS. Occupational therapists who were trained delivered the intervention and those in the control group received usual occupational therapy care. No significant positive (or negative) effect was found following intervention on measures of disability impact, participation and autonomy. One reason may be because occupational therapists are trained to work in a client-centred way already so “regular occupational therapy care” may still include many of the aspects of the Canadian Practice Process Framework training, even if not consciously included. This study had a high retention rate, reported sample size calculation, treatment fidelity analysis, used blinded raters, and was adequately powered using a large sample in the study. As with the CRIPS programme [52] per-protocol analysis was reported here. The follow-up study
[55] exploring the reasons for these results found that the interventions (client-centred therapy) resulted in more intensive assessment and goal setting sessions but there was a less intensive treatment period. The authors suggested that this balance should be redressed.

Discussion:

The quality of the studies included in this review varied. A number of poor quality studies were reported but there were also examples of high quality rigorously designed studies e.g. [54,55]. The improved quality and quantity in occupational therapy research for people with MS when compared to that reported by Steultjens et al. [4] is promising for the field. A total of ten RCTs, though some were pilot studies and not adequately powered, were reported here.

The reviewed evidence shows that occupational therapy for people with multiple sclerosis can be effective in improving symptoms when targeted by certain interventions. Fatigue was the symptom targeted by the majority of the studies included in the review. Fatigue is one of the most commonly reported symptoms by people with MS [26] with 50-60% of people stating that it is the most disabling symptom experienced [56]. There is evidence to show that the energy conservation course designed by Packer et al. [27] and evaluated by multiple authors [25, 26, 28-33] is effective in improving fatigue symptoms, self-efficacy and aspects of quality of life. Given the short duration of this intervention and that the benefits appear to be maintained at one year follow-up [32], this course can be recommended to occupational therapists working with people with MS experiencing fatigue.

A number of studies adapted the programme developed by Packer et al. [27], including incorporating self-study modules for those who miss out on group sessions [33-40]. The effects from these adapted programmes are less clear. The studies involved report mixed results with many being underpowered or methodologically weak. It is not conclusive at present whether an adapted version of the original energy conservation programme is effective when delivered by occupational therapists. One adapted method that holds promise is the delivery of the Packer et al. [27] programme by teleconference [28]. Promising results in reducing the impact of fatigue and improved health-related quality of life mean that this programme could be effective in reaching geographically disperse and difficult-to-access communities.

Telerehabilitation has been used to target other important aspects in MS, such as relationship satisfaction [57], self-management [58], physical activity [59] and cognitive behavioural therapy programme for fatigue [60] with programmes being delivered over the phone or via the internet. Telerehabilitation has been found to be beneficial in improving function, psychological health and quality of life [61]. Delivering occupational therapy interventions via teleconference for people with MS has the potential to reduce the burden on patients and could be a cost-effective method if proven effective but robust trials are recommended to build on the existing evidence in the area [61].

Evidence-based rehabilitation strategies for upper extremity function are essential for improving performance in daily activities [62]. From the studies that were included in this review no conclusions can be made in relation to the efficacy of occupational therapy intervention focused on improving upper limb symptoms in MS. The results included in the review were mixed and although some studies reported modest effects the risk of bias was high. The quality of included
studies was low and resultantly further high-quality research focusing on occupational therapy interventions for upper limb rehabilitation is necessary. There are positive results shown in upper-limb rehabilitation in other disciplines with multidisciplinary rehabilitation [63], robot-based rehabilitation [64, 65], sensory education [66] and callisthenic exercise [67] showing significant improvements in upper limb outcomes. The optimal dosage and the exact content of the most effective therapy for the upper limb is not currently clear [68] and more research focused on direct rehabilitation as well as investigating the optimal dosage for rehabilitation in MS is necessary.

Cognitive rehabilitation has never been an area exclusive to occupational therapy but the synthesis and application of occupational concepts to cognitive symptoms is what is unique about occupational therapy-led cognitive rehabilitation programmes. There have not, however, been many such programmes to date that have been evaluated formally. The self-generation strategy presented by Goverover et al. [49] shows promise but it is relatively limited in its’ real-life application. There is a need for more well-designed studies that focus on function and the impact cognitive symptoms have on everyday life.

Outside of occupational therapy, there is currently only limited evidence for the effectiveness of cognitive rehabilitation [69]. In a metasynthesis of qualitative studies [70], participants reported positive impacts in a number of areas such as an increased understanding of MS and its symptoms, increase use of strategies learned, as well as indirect outcomes in emotional and social functioning and increased optimism. These findings suggest that with increased rigour and strong design in clinical trials it may be possible to see these findings reflected in objective outcome measures. Although cognitive rehabilitation is an area that has seen substantial growth in the last decade [71], much has yet to be done to develop the evidence base and show long-term functional outcomes as a result of cognitive interventions [72].

In terms of the other interventions that were included in this review, there is potential for the falls prevention programme [51] to be an effective method of reducing falls in people with MS with mobility problems. Occupational therapists routinely work in the area of falls prevention and environmental modification to reduce falls risk [73] but this is typically with older adults. It would be worth investigating if the multifactorial interventions found to be effective with older adults [74] could be adapted for use with people with MS. The CRISP programme, an intervention to improve self-efficacy showed benefits for participants with MS but the long-term effects have yet to be evaluated [52]. Self-efficacy has been found to predict improvements in self-reported health status [75] and so if targeted through intervention it could be an alternative method of modifying health status. Though the results did not show differences between the groups, it was important to see the results of the cluster RCT of client-centred practice and regular care occupational therapy published [54].

The limitations of this review cannot be overlooked. Restricting the scope of this review to studies that only focused on occupational therapy, and not multidisciplinary interventions, was a limitation. The search also excluded non-English language, unpublished or ongoing studies, as well as those behind pay walls that the authors did not have institutional access to. The review also excluded studies where participants in the group had mixed diagnoses and important studies may have been missed as a result. As this is a scoping study many of the limitations of
this type of review are relevant here- e.g. no formal appraisal of quality of evidence and the narrative style of reporting [7].

In conclusion, research in the area of occupational therapy and multiple sclerosis is evolving. Evidence suggest that certain interventions for fatigue are evidence based and improve symptoms in MS, while other promising interventions are emerging. Although more research is needed in many areas, occupational therapy practice for people with MS should certainly continue as it is likely to be effective in improving function, symptom management and quality of life. Patients have reported many benefits of occupational therapy but the evidence-base to support this needs to be developed. Here we have assessed the research needs of the future and encourage therapists and researchers to join in formal evaluation of practice for the benefit of all patients with multiple sclerosis.

Implications for Rehabilitation

- Occupational therapists are well-placed to intervene with multiple sclerosis symptoms.
- Evidence for the effectiveness of occupational therapy for people with multiple sclerosis is yet to be established.
- Fatigue management programmes delivered by occupational therapists are effective in reducing symptoms.
- Additional training in client-centred practice is no more effective than usual occupational therapy.

Declaration

The authors report no conflicts of interest.
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<td>(&quot;occupational therapy&quot;[MeSH Terms] OR &quot;occupational therapy&quot;[Title/Abstract] OR &quot;occupational therapist&quot;[Title/Abstract] OR &quot;occupational therapies&quot;[Title/Abstract] OR &quot;occupational therapists&quot;[Title/Abstract]) AND (&quot;multiple sclerosis&quot;[MeSH Terms] OR &quot;multiple sclerosis&quot;[Title/Abstract])</td>
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<td>PsycINFO</td>
<td>81</td>
<td>‘occupational therapy’ [MESH] OR occupational therap*.tw.</td>
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<tr>
<td></td>
<td></td>
<td>AND</td>
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<td>Cochrane</td>
<td>127</td>
<td>#1  MeSH descriptor: [Occupational Therapy] explode all trees 691</td>
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<td></td>
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<td>#2  occupational therap* 6660</td>
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<td>#3  #1 OR #2 6660</td>
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<td>#4  &quot;multiple sclerosis&quot; 9282</td>
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<td>#5  MeSH descriptor: [Multiple Sclerosis] explode all trees 2943</td>
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<td>#6  #4 OR #5 9282</td>
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<td></td>
<td></td>
<td>#7  #3 AND #6 127</td>
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<td>Scopus</td>
<td>417</td>
<td>&quot;occupational therap*&quot; AND &quot;multiple sclerosis&quot; (title, abstract, keywords)</td>
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<td>OTSeeker</td>
<td>12</td>
<td>occupational therap* AND multiple sclerosis</td>
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Table 1: Database Search Results
Figure 1
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Sample</th>
<th>Level of Evidence</th>
<th>Study Design</th>
<th>Intervention</th>
<th>Frequency, Intensity, Duration</th>
<th>ITT</th>
<th>PP</th>
<th>F/M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Akbar et al. [23]; Pétrin et al. [24]</td>
<td>Canada, PwMS with mild to moderate fatigue (FS: 2.0-5.4), N=35, Mean age= 49.1.</td>
<td>IIc</td>
<td>Single-group, mixed-methods, before-after pilot study with interpretive description.</td>
<td><em>Intervention:</em> Multiple Sclerosis An Interactive Fatigue Management Resource (MS INFoRm): self-directed interactive PowerPoint presentation discussing fatigue management and energy conservation techniques.</td>
<td>Participants used the resource for a median of 315 mins over a period of 3-months.</td>
<td>23</td>
<td>35*</td>
<td>27/8</td>
</tr>
<tr>
<td>Blikman et al. [36]</td>
<td>Netherlands, PwMS with severe fatigue (CIS20r&gt;35), ambulatory, N=86, Mean Age= 47.15</td>
<td>Ia</td>
<td>RCT</td>
<td><em>Intervention:</em> EC course based on Packer et al. <em>Control:</em> information only nurse consultations</td>
<td><em>Intervention:</em> 12 2 hr sessions over 4 months <em>Control:</em> 3 45 mins sessions over 4 mths</td>
<td>76</td>
<td>86*</td>
<td>64/22</td>
</tr>
<tr>
<td>Eyssen et al. [54; 55]</td>
<td>Netherlands, outpatient, N=269, Mean Age= 45.5</td>
<td>Ia</td>
<td>Multicentre cluster RCT, double-blinded [54] Follow-up study [55]</td>
<td><em>Intervention:</em> OT intervention structured by the CPPF, 6 day training in CPPF <em>Control:</em> Usual OT</td>
<td>Dependent on patient specific needs</td>
<td>269</td>
<td>259</td>
<td>184/85</td>
</tr>
<tr>
<td>Finlayson et al. (2011)</td>
<td>US, PwMS, moderate to sever fatigue (FSS &gt;4), N=181, Mean Age= 56</td>
<td>I</td>
<td>RCT, two-group time series design</td>
<td><em>Intervention:</em> fatigue management via group-based, teleconference calls with homework <em>Control:</em> Wait-list control</td>
<td>6 wk, 70 mins, weekly</td>
<td>138</td>
<td>181*</td>
<td>143/38</td>
</tr>
<tr>
<td>Finlayson, Peterson &amp; Cho [51]</td>
<td>US, PwMS over 55 yrs, experience 1 fall in the last year, use mobility aid, N=30, Mean age= 56.7</td>
<td>IIc</td>
<td>Pilot</td>
<td><em>Intervention:</em> Safe at Home BAASE, manualised group based fall management program</td>
<td>6, 2 hr session, 5-consecutive weeks, final 1 month after</td>
<td>30*</td>
<td>23</td>
<td>25/5</td>
</tr>
<tr>
<td>Study</td>
<td>Location</td>
<td>Participants</td>
<td>Design</td>
<td>Intervention</td>
<td>Duration</td>
<td>Year</td>
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<tr>
<td>Gentry [48]</td>
<td>US, MS</td>
<td>N=20, Med Age: 50</td>
<td>IIc</td>
<td>Quasi-experimental A-B-C repeated measures design</td>
<td>Intervention: home visits over 3 week period 1st/2nd session: computer software loaded onto participant computer and learned how to use, 3rd/4th sessions: reviewed and trouble-shooted</td>
<td>4 sessions over 3 weeks, 60-90 mins</td>
<td>21</td>
<td>16/4</td>
</tr>
<tr>
<td>Goverover, Chiaravalloti &amp; Deluca [49]</td>
<td>US, 20 PwMS and 18 N = 20 PwMS N = 18 HC's, Mean Age = 43.35</td>
<td>Iic</td>
<td>Mixed-design with both a within- and between-subject factor</td>
<td>Intervention: 1 meal prep (AMPS) and 1 financial management tasks (made for study) were presented in a generated condition i.e. work word left blank in steps. Control: 1 meal prep (AMPS) and 1 financial management tasks (made for study) were presented in a provided condition i.e. with a set of steps</td>
<td>Once off</td>
<td>38</td>
<td>27/11</td>
<td></td>
</tr>
<tr>
<td>Hawes, Billups &amp; Forwell [43]</td>
<td>Canada, PwMS with upper limb intention tremor, N=6, Mean Age=48</td>
<td>Iic</td>
<td>Feasibility study- pre-test post tets, qualitative</td>
<td>Intervention: education on ULIT, proximal stabilisation, hand-over-hand, weighted tool, weighted wrist and splinting. Participants used VAS to decide preferred technique.</td>
<td>Once a day for 1 week</td>
<td>6</td>
<td>4/2</td>
<td></td>
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<tr>
<td>Hersche et al. [37]</td>
<td>Switzerland, inpatient, MS related fatigue, N=11 (9 PwMS, 3 Ots), Mean Age=45</td>
<td>IIIc</td>
<td>Pilot- qualitative, focus groups</td>
<td>Intervention: individual/group sessions of a manualised inpatient energy management programme (IEME)</td>
<td>Individual: 2 sessions (1.5 hrs) Group: 5 sessions (1 hr long) Over 3 weeks</td>
<td>9</td>
<td>5/4</td>
<td></td>
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<tr>
<td>Hersche et al. [38]</td>
<td>Switzerland, inpatient, MS related fatigue, N=47, Mean Age=51.5</td>
<td>Ic</td>
<td>Poster: Pilot-mixed-method small scale RCT and qualitative, telephone interviews (N=6), N=47, Mean 51.5</td>
<td>Intervention: individual/group sessions of a manualised inpatient energy management programme (IEME) Control: progressive muscle relaxation</td>
<td>Individual: 2 sessions (1.5 hrs) Group: 5 sessions (1 hr long) Over 3 weeks (IEME total= 427 mins, PMR total= 474 mins)</td>
<td>35</td>
<td>47*</td>
<td>31/16</td>
</tr>
<tr>
<td>Jellie et al. [53]</td>
<td>UK, PwMS, N=19, Median Age=40</td>
<td>IIib</td>
<td>Qualitative: interviews, coding, constant comparative method</td>
<td>Intervention: Vocational rehabilitation</td>
<td>Dependent on patient specific needs</td>
<td>19</td>
<td>15/4</td>
<td></td>
</tr>
<tr>
<td>Kalina et al. [52]</td>
<td>US, PwMS, N=91, Mean Age= 47.75</td>
<td>Ib</td>
<td>RCT, pretest-posttest</td>
<td>Intervention: CRISP- occupation-based intervention using education and self-management strategies to address self-efficacy in activities of socialising and recreation. Education &amp; social outings Control: routine neurological treatment. Given opportunity to participate after study</td>
<td>12 sessions over 12 weeks (selected which sessions, held 4-8 times per week), 45 mins</td>
<td>118</td>
<td>91*</td>
<td>69/22</td>
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<tr>
<td>Kalron et al. [44]</td>
<td>Israel, People with relapsing remitting MS with sensory deficits in one or both hands, N=25, Mean Age= 50.6</td>
<td>IIC</td>
<td>Quasiexperimental: pretest-posttest with control</td>
<td>Intervention: sensory training tool. Familiarization and blindfolding. Second task-placed hand in pouch of all 12 tubes and told to isolate specific tube. Given tool to practice at home. Control: 7 week, twice weekly OT sessions with non-specific repeated exposure to stimuli varying in texture, shape, size, weight, hardness, temp.</td>
<td>20 mins, 5 days a week for 3 weeks</td>
<td>25</td>
<td>18/7</td>
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</tr>
<tr>
<td>Kamm et al. [45]</td>
<td>Switzerland, impaired manual dexterity (Coin Rotation test&gt;19 secs, 9HPT 2 standard deviations below the norm), N=39, Mean Age= 49.55</td>
<td>Ib</td>
<td>RCT</td>
<td>Intervention: Dexterity Training Program-standardised, home based training programme to improve manual dexterity and dexterity related-ADL (n=20) Control: Theraband Training Program-standardised, home-based, upper limb, strength-training exercises (n=19)</td>
<td>4 wks, 5 days, 30 mins (both)</td>
<td>39*</td>
<td>38</td>
<td>26/13</td>
</tr>
<tr>
<td>Kos et al. [40]</td>
<td>Belgium, PwMS, ambulatory, high impact of fatigue, N=31, Mean Age= 41</td>
<td>Ic</td>
<td>RCT: pilot study</td>
<td>Intervention: SMOoTh: Individual self-management &amp; energy conservation strategies Control: Relaxation therapy, information &amp; practice PT led</td>
<td>1 session, 3 weeks, 60-90 mins</td>
<td>31</td>
<td>Not reported</td>
<td></td>
</tr>
<tr>
<td>Lamb et al. [33]</td>
<td>US, PwMS who received self-study module if they missed a session in EC course, N=92, Mean age=47.9</td>
<td>IIc</td>
<td>Secondary Analysis of RCT (Mathiowetz et al., 2005)</td>
<td>Group 1: participants who attended all 6 sessions of EC course, no self-study modules (n=43) Group 2: participants who received at least one self-study module (n=49)</td>
<td>6 wk, 2hr, weekly</td>
<td>92*</td>
<td>76/16</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Participants</td>
<td>Design</td>
<td>Intervention</td>
<td>Control</td>
<td>Duration</td>
<td>Participants</td>
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<tr>
<td>Mark et al. [47]</td>
<td>US</td>
<td>reduced real-world use of more affected arm (MAL&lt;3/5), N=20, Mean Age=48</td>
<td>Ib RCT, pilot study</td>
<td>Intervention: CIMT- intensive training using more-affected arm, less-affected arm restraint 90% of waking hours using mitt</td>
<td>Control: CAM- aquatic, massage, yoga, relaxation</td>
<td>3.5 hrs, 5 days, 2 wks</td>
<td>22</td>
<td>20*</td>
</tr>
<tr>
<td>Mathiowetz et al. [29]</td>
<td>US, PwMS with moderate-high fatigue (FSS&lt;4), N=54, Mean Age = 50 yrs</td>
<td>IIB Repeated-measures study design</td>
<td>Intervention: EC course based on Packer et al. manual. Control: Support group, not fatigue-management related.</td>
<td>6 wk, 2 hr, weekly</td>
<td>54*</td>
<td>79</td>
<td>36/18</td>
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</tr>
<tr>
<td>Mathiowetz et al. [30-32]</td>
<td>US, PwMS with moderate-high fatigue (FSS &gt;4), including people with mild cognitive impairment (NSBMS), N=54, Mean Age= 48.34.</td>
<td>Ia RCT Crossover-design with secondary analysis and follow-up.</td>
<td>Intervention: energy conservation, based on Packer et al. Control: delayed control group</td>
<td>6 wk, 2hr, weekly</td>
<td>131</td>
<td>169*</td>
<td>140/29</td>
<td></td>
</tr>
<tr>
<td>Reilly &amp; Hynes [50]</td>
<td>Ireland, mild cognitive difficulties (MSNQ&gt;22), N=12 Mean Age= 55.08</td>
<td>Ilc Pilot Study: experimental pretest/posttest design</td>
<td>Intervention: Cognitive Occupation-Based Programme for people with MS (COB-MS) with 2 individual and 6 group sessions including aspects of education, remediation and adaptation.</td>
<td>8 sessions over 9 weeks, 60 mins</td>
<td>12</td>
<td>12</td>
<td>11/1</td>
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<tr>
<td>Scaffa et al. [35]</td>
<td>Argentina, PwMS with fatigue (FSS&gt;2), N=51, Mean Age=47.59</td>
<td>Ilc Quasi-experimental design, poster</td>
<td>Intervention: group-based fatigue management based on Packer et al.</td>
<td>Biweekly for 12 weeks</td>
<td>51</td>
<td>32/19</td>
<td></td>
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<tr>
<td>Twomey &amp; Robinson [39]</td>
<td>Ireland, MS-related fatigue affecting everyday life, N=8, Mean Age= 42.875</td>
<td>Illa Pilot Study: Qualitative design; phenomenological perspective</td>
<td>Intervention: fatigue management programme based on community based rehabilitation philosophy that is participant-led. Telephone interviews; constant comparative analysis</td>
<td>8 weeks, weekly, 2 hrs</td>
<td>8*</td>
<td>11</td>
<td>6/2</td>
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<tr>
<td>Vanage et al. [34]</td>
<td>US, progressive MS with moderate to severe disability (&lt;5.5 on Expanded Disability Status Scale), non-ambulatory, N=37, Mean Age = 55.6</td>
<td>IIB Quasi-experimental, crossover design</td>
<td>Intervention: adapted energy conservation course based on Packer et al. Control: support group</td>
<td>8 wk, 1 hr, weekly</td>
<td>37*</td>
<td>29/8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Country</td>
<td>Type</td>
<td>Intervention</td>
<td>Control</td>
<td>Duration</td>
<td>Score</td>
<td>Evidence</td>
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<tr>
<td>Walino-Paniagua et al. [46]</td>
<td>Spain, RRMS, ambulant, N=16, Mean Age= 46.44</td>
<td>Ic</td>
<td>Intervention: OT+VR</td>
<td>Control: OT OT-activities for training manipulative and functional dexterity of upper limb aimed at ADLs. VR-video-recording of online games using handcontroller/armbands.</td>
<td>OT: 20 sessions, twice weekly, 30 mins OT+VR= same+ 20 sessions, twice weekly, 20 mins VR</td>
<td>26</td>
<td>16*</td>
<td>8/8</td>
</tr>
</tbody>
</table>

Legend: OT: occupational therapist(s); PwMS: participants with MS; ITT: Intention to treat; PP: Per protocol; F/M: Female/ Male

Table 2: Studies included in review and levels of evidence