



## Shorter communication

## A pilot randomised controlled trial of an Internet-based cognitive behavioural therapy self-management programme (MS Invigor8) for multiple sclerosis fatigue

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## ARTICLE INFO

## Article history:

Received 17 August 2011

Received in revised form

10 January 2012

Accepted 5 March 2012

## Keywords:

Multiple sclerosis

Fatigue

Cognitive behavioural therapy (CBT)

Internet-based

Self-management

## ABSTRACT

The majority of people affected by Multiple Sclerosis (paMS) experience severe and disabling fatigue. A recent randomised controlled trial (RCT) showed that cognitive behaviour therapy with a clinical psychologist was an effective treatment for MS fatigue. An Internet-based version of this intervention, MS Invigor8, was developed for the current study using agile design and input from paMS. MS Invigor8 includes eight tailored, interactive sessions. The aim was to test the feasibility and potential efficacy and cost-effectiveness of the programme in a pilot RCT. 40 patients were randomised to MS Invigor8 ( $n = 23$ ) or standard care ( $n = 17$ ). The MS Invigor8 group accessed sessions over 8–10 weeks and received up to three 30–60 min telephone support sessions. Participants completed online standardised questionnaires assessing fatigue, mood, quality of life and service use at baseline and 10 weeks follow-up. Large between group treatment effects were found for the primary outcomes of fatigue severity ( $d = 1.19$ ) and impact ( $d = 1.02$ ). The MS Invigor8 group also reported significantly greater improvements in anxiety, depression and quality-adjusted life years. These data suggest that Internet-based CBT may be a clinically and cost-effective treatment for MS fatigue. A larger RCT with longer term follow-up is warranted.

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Multiple Sclerosis (MS) is a chronic, incurable neurological disease which affects more than 2.1 million people worldwide (National MS Society, 2011). Fatigue is reported by around 90% of people affected by MS (paMS) with over two-thirds complaining it is their most troubling symptom (Giovannoni, 2006). Fatigue is a major reason for unemployment in MS (Krupp, Serafin, & Christodoulou, 2010) and is associated with depression and inability to carry out day-to-day tasks (Branas, Jordan, Fry-Smith, Burls, & Hyde, 2000; Schwartz, Coulthard-Morris, & Zeng, 1996).

Few treatments have been shown to be effective for MS fatigue. Evidence from pharmacotherapy trials is inconsistent and effects are modest at best (Branas et al., 2000; van Kessel & Moss-Morris, 2006). Other studies have used a more behavioural approach using either exercise or energy conservation methods but again results are mixed (Krupp et al., 2010). These interventions are limited by the absence of a clear conceptualisation of MS fatigue. We recently developed a cognitive behavioural conceptualisation of MS fatigue integrating the findings across biological and psychosocial

research (van Kessel & Moss-Morris, 2006). Based on this model, we developed a cognitive behavioural therapy (CBT) programme which was shown in a randomised controlled trial (RCT) to effectively reduce fatigue up to six month follow-up (van Kessel et al., 2008).

Despite these promising results, rolling out individual CBT for MS fatigue is likely to be problematic. Few MS services have access to a CBT therapist and attending therapy sessions may be difficult for many paMS. The provision of CBT-based self-management programmes over the Internet is a rapidly evolving and potentially beneficial means of delivering treatment otherwise unsought or unobtainable (Griffiths & Christensen, 2006). There is growing evidence that Internet-based interventions are an effective form of treatment for a variety of physical symptoms, including back pain, headache and tinnitus (Andersson, Lundstrom, & Strom, 2003; Andersson, Stromgren, Strom, & Lyttkens, 2002; Cuijpers, van Straten, & Andersson, 2008; Zachriat & Kroner-Herwig, 2004) particularly when supplemented by some telephone or email support and guidance (Buhrman, Faltenhag, Strom, & Andersson, 2004).

The aim of the current study was to conduct a mixed methods pilot RCT of an Internet self-management package for MS fatigue

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(MS Invigor8) based on our therapist-delivered CBT programme and formalised feedback from paMS. The specific aims of the pilot were to 1) assess the feasibility of conducting automated trial randomisation and baseline and follow-up assessment procedures online, 2) evaluate adherence to the treatment programme, 3) assess the potential efficacy of the programme in reducing fatigue severity and impact (primary outcomes), and depressed and anxious mood (secondary outcomes) at 10 weeks post randomisation, 4) conduct a preliminary cost-effective analysis of the programme, and 5) gather detailed qualitative feedback on the programme from participants to make revisions if necessary before we consider a full sized RCT.

## Method

### Design and trial procedures

The pilot RCT study was approved by the University of Southampton ethics committee. The website was designed to incorporate all trial and treatment procedures. Participant information sheets including eligibility criteria were presented online with the facility to contact the investigators for more information. paMS who wanted to participate consented online and completed an online screening questionnaire to confirm eligibility. Those who were eligible could then consent to enter the trial and complete the baseline questionnaire. They were allocated to MS Invigor8 or a control group by an automated simple randomisation system built into the website. Participants were alerted to complete the online follow-up questionnaire at 10 weeks post randomisation. Control participants were given access to MS Invigor8 once they

had completed the 10 week questionnaire, but they did not receive the telephone support.

### Recruitment and eligibility

Recruitment was through advertisements on the MS Society and MS Trust websites and a local press release. Participants were required to be UK Resident, have a definite diagnosis of MS from a neurologist, have significant fatigue indicated by a score  $>4$  on the Fatigue scale using the binary scoring method (Chalder et al., 1993), and be ambulatory with or without a stick for at least 100 m. Participants had to be willing to abstain from starting new treatments for fatigue for the study duration.

The recruitment target was to randomise 40 participants within the two month recruitment period. A pilot Phase II trial of at least 30 subjects is considered adequate for obtaining reasonably reliable sample size estimates (Browne, 1995). A slightly larger sample size allowed us to account for possible loss to follow-up to estimate sample size for a full Phase III trial as well as to assess trial methodologies and procedures across a range of people.

112 people underwent the automated screening process. 74 of the 112 screened did not register for the trial. Reasons for non-registration are outlined in Fig. 1.

48 of the 112 people screened registered for the trial of whom 8 had to be withdrawn. 3 people were excluded as they were subsequently found to be non-UK resident. Five participants who registered and were randomised to the control group were withdrawn because a website bug allowed them to access sessions on MS Invigor8 during the control period. Twenty-three people were

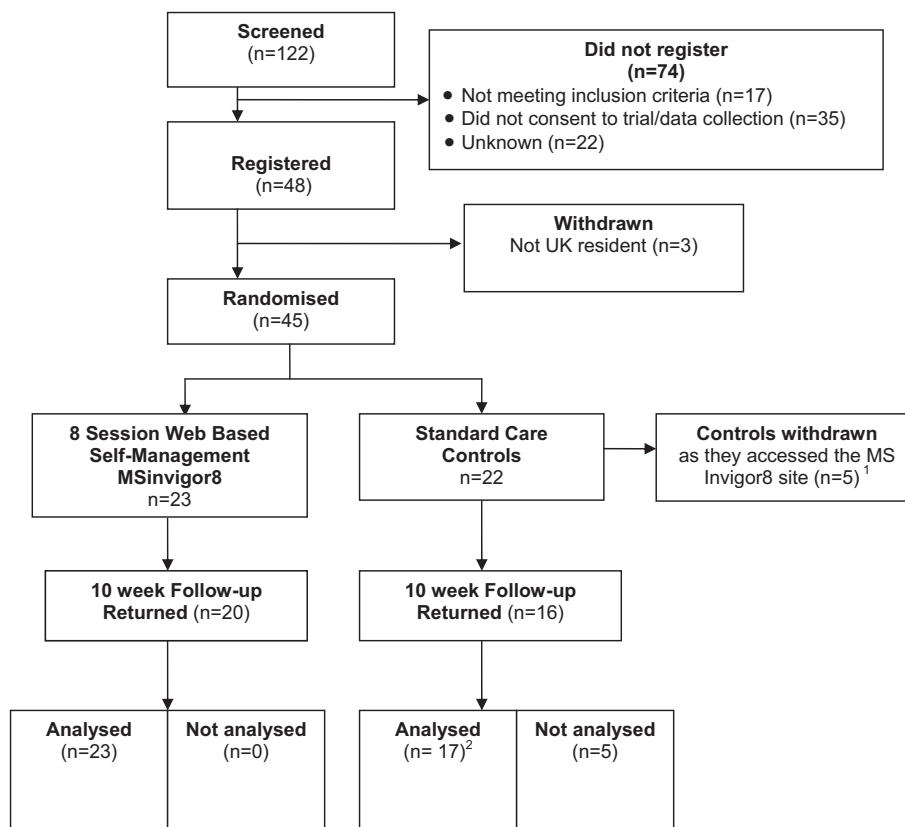


Fig. 1. Participant flow through the trial.

<sup>1</sup> An initial website fault meant that 5 participants allocated to the waiting list control were able to access the web site. These people were withdrawn from the trial.

<sup>2</sup> Baseline data missing for one control on three of the outcome measures. For these analyses only 16 controls are included but the primary data is analysed for 17.

randomly allocated to the MS Invigor8 group and 17 to the control group. Recruitment took a total of 61 days.

### Treatment

The treatment programme entitled 'MS Invigor8: Breaking the Cycle of Fatigue' was developed using Agile design (Cockburn & Highsmith, 2001). Agile design incorporates a co-design team who work closely together to produce software, whilst maintaining constant links with the end user. The design team included a software project manager (GW), software developers, health psychologists (RM, LY) and an expert paMS. The website was designed in a modular, iterative fashion. Six volunteers with MS fatigue (two men, four women, mean age 45, with different types and severity of MS, and differing computer skills) assisted the co-design team. They tested the modules in their own homes as they were developed. Immediately after completing each module, they were interviewed on the telephone using a variant of the 'think aloud' method (van den Haak, de Jong, & Schellens, 2007) which is used to understand the different perspectives of individual users. Feedback was elicited about their experience of the module, focussing on issues of usability, usefulness and acceptability of the information, and suggestions for improvements. Interviews were recorded, transcribed verbatim, and analysed. The feedback was used to modify session content and programme functionality.

The MS Invigor8 programme summarised in Table 1 consists of 8 weekly sessions. On average, sessions take between 25 and 50 min to complete. All sessions are interactive and include self-assessments which allow the programme to be tailored to the individual problems and progress of the paMS. Educational information can be printed. Sessions include homework tasks which are saved online in a Workbook, can be printed, and are reviewed in the subsequent session. Other features of the site include programme instructions, a 'take a break' button allowing people to rest during sessions, a time bar indicating progress through a session, and optional video/audio clips demonstrating relaxation techniques.

During the trial, the MS Invigor8 group received automated emails encouraging the completion of one session per week over 8–10 weeks. Participants also received three telephone support sessions of between 30–60 min, while they worked through the programme. The first was scheduled after the completion of the initial session and focused on talking through the personal five part model (see Table 1, session 1). The second took place in week three and focused on clarifying goal setting and progress with goals. The final session in week six focused on identifying and challenging unhelpful thoughts. Sessions were provided by an assistant psychologist who received 5 h of basic training in the interventions and fortnightly supervision from a registered psychologist (RMM). All sessions were audiotaped and fidelity to the treatment procedures was cross-checked throughout the trial.

### Assessments

Participants provided demographic data, and information on their MS type and duration. Questions to quantify MS type were drawn from previous research (Skerrett & Moss-Morris, 2006). Ambulation ability was measured using the ambulation questions from the self-report Expanded Disability Status Scale (Bowen, Gibbons, Gianas, & Kraft, 2001).

The primary outcomes were:

- 1) Fatigue severity, measured by the ordinal version of the Fatigue Scale (Chalder et al., 1993). This questionnaire measures physical and mental fatigue severity, was used in the CBT therapist trial for MS fatigue (van Kessel et al., 2008) and has

**Table 1**  
Outline of MSInvigor8 sessions.

Session	Content
1	<b>Title: Understanding MS fatigue</b> Overview of MS fatigue. Self-assessment of biological, behavioural, cognitive, emotional and environmental factors which may be contributing to fatigue. Computer generated 5-part personal cognitive behavioural (CB) model of MS fatigue based on self-assessment data.
2	<b>Title: Fatigue Diary</b> Introduction to self-management based on CBT principles including the role of homework. Interactive tasks include the steps of keeping daily diaries of activity, rest and fatigue levels. Homework: Daily fatigue diary
3	<b>Title: Rest and Activity Patterns.</b> Review of diary. Education on how erratic patterns of rest and activity or over-activity affect fatigue. Importance of consistency is outlined, and benefits of moderate physical exercise discussed. Interactive tasks include the steps of goal setting (what, when, where). Homework: Set and monitor rest and activity goals and exercise goals
4	<b>Title: Improving Sleep</b> Self-assessment of sleep patterns. Education on behavioural techniques (basic sleep hygiene) to improve sleep are discussed, e.g. having set 'worry times', getting up if lying awake in bed for longer than 20 minutes. Homework: Set and monitor goals for improving sleep.
5	<b>Title: Understanding MS Symptoms</b> Education on normal symptom fluctuations versus signs of relapse and disease progression. The effect on fatigue of symptom focussing and attributing all symptoms to MS is introduced. Interactive task to generate possible alternative attributions for somatic symptoms e.g. stress, medication side effects. Homework: Recording somatic symptoms and generating alternative attributions.
6	<b>Title: Recording Thoughts</b> The concept of unhelpful thoughts is introduced, and how these impact on fatigue and mood. Interactive tasks include identifying cognitive errors and generating alternate thoughts. Homework: Daily thought records of unhelpful thoughts and possible alternatives.
7	<b>Title: Managing Stress</b> Basic stress management is discussed. Interactive tasks include identifying stressors which are controllable and those which are not, and matching these to appropriate stress management strategies. Homework: Goals for stress management
8	<b>Title: Emotions, Support and the Future</b> The importance of social support is discussed, and how to access better social support. Interactive tasks include identifying possible sources of support for different types of support needed. Managing difficult emotions and relapse are reviewed. Homework: Building tool set for long term fatigue management and possible relapse.

good psychometric properties. Cronbach's  $\alpha$  in this sample was excellent (0.83)

- 2) Fatigue impact, assessed by Modified Fatigue Impact Scale (Fatigue guidelines development panel of the multiple sclerosis council for clinical practice guidelines, 1998), a shortened version of the Fatigue Impact Scale (Fisk et al., 1994). This scale taps perceived limitations in cognitive, physical and psychosocial functioning as a result of fatigue. The scale has been validated in people with MS (Fisk et al., 1994). Cronbach's  $\alpha$  in this sample was excellent (0.81)

The secondary outcomes were anxiety and depression, measured by the Hospital Anxiety and Depression scale (HADS) which was specifically designed to measure mood disturbance in people with physical illness (Zigmond & Snaith, 1983). Cronbach's  $\alpha$  was 0.84 for anxiety and 0.72 for depression.

For the economic evaluation, participants completed the Euro-Qol (eq-5d) (Curtis & Netten, 2006) as a measure of quality-

adjusted life years (QALYs), and service use during the 10-week follow-up period was measured with an adapted version of the Client Service Receipt Inventory (CSRI) (Beecham & Knapp, 2001).

Fifteen of the 23 MS Invigor8 participants agreed to be interviewed about their experiences of the intervention. A health psychology researcher independent of the trial team conducted semi-structured interviews based around experiences of fatigue, treatment expectations and how the participant was feeling following the intervention. Participants were also asked about experiences of using MS Invigor8 and the telephone support and specific elements they had found helpful and unhelpful. Data-driven thematic analysis was used to identify common and salient themes (Boyatzis, 1998; Braun & Clarke, 2006).

### Statistical analysis

Analyses were performed using IBM SPSS for Windows (Version 19). As this is a pilot study, data were presented descriptively. We also conducted preliminary treatment effect analyses by intention-to-treat using linear models with group as the fixed factor and baseline level of the outcome variable as the covariate. All participants were included in the analyses except for the five control participants who had erroneously accessed MS Invigor8. They only provided baseline data and were removed entirely from all analyses as they were deemed to no longer be true controls. As they did not provide follow-up data, their inclusion would have seriously biased the results in favour of the treatment group.

### Economic analysis

Service costs were calculated by combining the service use data with appropriate unit costs (Curtis, 2008). QALYs were calculated by adding the baseline and follow-up EQ-5D scores and dividing by 2, assuming a linear (change over time) and multiplying by 10/52

**Table 2**  
Baseline demographic characteristics of MS participants in the CBT and control groups.

	MS Invigor8 group (n = 23)	Control group (n = 17)
Age (M, SD)	40.14 (17.76)	41.81 (11.43)
Time since diagnosis in years (M, SD)	21 (9.05)	16 (7.88)
Gender (n) % female	(16) 69.6%	(16) 94.1%
Years of education	13.95 (4.83)	11.85 (5.01)
Marital status (n) %		
Single	(4) 17.4%	(4) 26.7%
Living with partner	(14) 60.9%	(8) 53.3%
Divorced/widowed	(5) 21.7%	(3) 17.6%
Missing data	—	(2) 11.8%
Ambulation status (n) %		
Able to walk 500 m or more without aid or rest	(9) 39.1%	(10) 58.8%
Able to walk 100 m without aid or rest	(4) 17.4%	(2) 11.8%
Require unilateral or bilateral aid to walk 20–100 m	(9) 39.1%	(4) 23.5%
Missing data	(1) 4.4%	(1) 5.9%
MS type (n) %		
Relapsing remitting	(10) 43.5%	(12) 70.6%
Secondary progressive	(7) 30.4%	(2) 11.8%
Primary progressive	(2) 8.7%	—
Unsure	(4) 17.4%	(3) 17.6%
Employment related to MS		
Working less or off sick	(2) 9.0%	(1) 5.8%
Unemployed	(7) 31.8%	(4) 23.5%

Note. M = mean; SD = standard deviation.

(which is the maximum QALY gain attainable in the follow-up period).

## Results

### Participants

Table 2 shows characteristics of the participants. The mean age was early forties, most participants were female, and 30% were unemployed or working less because of their MS. The groups were well matched for age and time since diagnosis. However, the intervention group had a slightly lower percentage of females, a greater percentage of people with progressive disease, and greater levels of ambulatory difficulties than the control group.

Two of the 23 treatment participants failed to complete follow-up assessments and one did not complete the fatigue scale. They were the lowest users of the site, with one not completing any sessions. One of the controls did not complete follow-up assessment but no reason was given.

### Adherence to intervention

At the 10 week assessment point the mean number of sessions completed was 4.91 (SD 2.10). Only one (4.3%) participant finished all 8 sessions and three (13%) finished 7 sessions. Overall 15 (60.8%) patients finished more than half the sessions (>5) with only one (4.3%) patient not completing any sessions.

Participants still had access to the website after the end of the assessment period and continued to complete sessions as captured by the automated record of sessions completed. The mean number of sessions completed one month post the assessment period was 6.1 (SD 2.45) with 11 people having completed all 8 sessions (47.8%) and 19 (82.5%) having completed more than half the sessions.

21 (91%) participants completed the initial telephone support session (mean length 52.43 min, SD 15.35). 19 (82%) participants completed the second session (mean length 30.21 min, SD 7.8) and 15 (65%) completed the final session (mean length 45.6 min, SD 14.18). Reasons for cancellations included work commitments or other appointments, illness, not having completed the MS Invigor8 session and non-response. No adverse events were reported.

### Descriptive outcome data

The means and standard deviations for the outcome data across groups are presented in Table 3. The groups appear well matched

**Table 3**  
Means and standard deviations for the primary and secondary outcome measures across groups at baseline and 10 weeks follow-up.

Group	N	Pre-treatment (baseline)	N	Post treatment (10 weeks)
<b>Fatigue scale, mean (SD)</b>				
MS Invigor8	23	21.39 (4.30)	20	12.39 (6.84)
Control group	17	21.53 (3.62)	16	19.57 (5.20)
<b>Modified fatigue impact scale, mean (SD)</b>				
MS Invigor8	23	13.17 (3.81)	21	9.00 (3.75)
Control group	17	12.69 (3.89)	16	12.88 (3.89)
<b>HADS anxiety, mean (SD)</b>				
MS Invigor8	23	8.26 (4.31)	21	6.44 (3.91)
Control group	17	9.56 (4.50)	16	11.65 (5.26)
<b>HADS depression, mean (SD)</b>				
MS Invigor8	23	7.96 (3.64)	21	5.18 (3.38)
Control group	17	6.75 (2.72)	16	8.73 (3.62)

on baseline levels of fatigue and mood. The control group appears to show little change over the 10 weeks in all four outcomes, whilst the treatment group shows decreases on both fatigue measures as well as anxiety and depression.

#### Analysis of primary outcomes

Linear models demonstrated that the MS Invigor8 group when compared to the control group had significantly lower scores on the Fatigue Scale ( $F(1,36) = 169.88, p < 0.001$ ) and the Modified Fatigue Impact Scale ( $F(1,36) = 214.64, p < 0.001$ ) at the end of treatment. The between group effect size for the fatigue scale was  $d = 1.19$  [95% CI -1.28–3.98] and for the Modified Fatigue Impact Scale,  $d = 1.22$  [95% CI -0.62–2.31].

#### Analysis of secondary outcomes

There were also significant group differences on anxiety ( $F(1,36) = 88.99, p < 0.001$ ) and depression ( $F(1,36) = 119.79, p < 0.001$ ), with the MS Invigor8 group showing significantly greater reductions on both scales.

We re-ran the outcome analysis controlling for gender and ambulation status and a completer only analysis (those who returned follow-up), and the results retained their significance levels for all outcomes.

#### Cost-effectiveness

During the follow-up period the most commonly used services were neurologists and general practitioners (Table 4). Mean costs were very similar in the intervention (£211) and control (£214) groups. There is therefore no evidence that during the treatment period the intervention had any impact on the use and cost of other services. Medication costs were not included, although it is unlikely these would differ between groups. Two participants in the control group did start to receive a disease modifying agent during the follow-up period but it is difficult to assess whether this would be due to lack of the intervention.

The mean (SD) EQ-5D scores at baseline were 0.56 (0.26) in the intervention group and 0.64 (0.28) in the control group. By follow-up the scores were 0.71 (0.28) in the intervention group and 0.62 (0.27) in the control group. The mean score at follow-up, adjusted for baseline, was 0.15 higher for the intervention group ( $p = 0.038$ ).

The mean (SD) QALY gain for the intervention group was 0.1212 and 0.1243 in the control group. However, due to the quality of life difference at baseline the QALY gain was 0.015 higher in the intervention group ( $p = 0.038$ ).

#### Qualitative feedback from people in the treatment group

The interviews ( $n = 15$ ) revealed that most participants perceived an improvement in their fatigue, felt they understood their fatigue better, were more in control of it and were trying to implement lifestyle changes suggested by the programme.

"It's like somebody offering a helping hand, and that psychologically has been a huge boost to me. That there is this therapy out there that can make a difference. It's not going to cure my MS, but it will help me handle it." (female, 60 years)

"I wasn't aware of how much certain things did have an impact on my fatigue, and how I could go around and help myself by sort of training my brain to think differently almost, um, or to deal with things differently," (females, 36 years)

"I don't have any fatigue at the moment um compared to when I started I feel more have more higher energy levels" (male, 32 years)

The telephone support was perceived as augmenting the Internet-based sessions by nearly all participants.

"It was actually really good to talk to her because I was able to relate what I was learning ... in the sessions, to my personal circumstances." (female, 35 years)

"The programme on its own, without the therapy sessions, would be ... 50 percent as effective. The talking ... sessions, certainly for me, have been vital." (female, 60 years)

The structure of the programme was generally well accepted but occasional technical difficulties with the programme were detrimental to many users' experiences, especially those using certain Internet browsers. Participants also offered suggestions for modifications to website layout and operation. Further customisation was seen as necessary by some, including a few people with progressive forms of MS suggesting that the programme may be more relevant to those with relapsing remitting MS.

#### Discussion

This study developed a novel Internet-based intervention, MS Invigor8, which has the potential to make CBT-based self-management for fatigue more widely available to paMS. Strengths

**Table 4**  
Service use and costs (2007/8 £s) at follow-up.

Service	MS Invigor8			Control		
	N (%) using service	Mean (SD) contacts <sup>a</sup>	Mean (SD) cost <sup>b</sup>	N (%) using service	Mean (SD) contacts <sup>a</sup>	Mean (SD) cost <sup>b</sup>
Neurology outpatient	3 (15)	1.7 (1.2)	32 (92)	6 (38)	1.2 (0.4)	56 (81)
Other outpatient	3 (15)	1.0 (0.0)	15 (36)	3 (19)	1.7 (1.2)	31 (79)
Neurology day-patient	1 (5)	1.0 (-)	6 (26)	0 (0)	-	0 (0)
Residential care	0 (0)	-	0 (0)	0 (0)	-	0 (0)
Urology inpatient <sup>c</sup>	0 (0)	-	0 (0)	0 (0)	-	0 (0)
Intensive care unit <sup>c</sup>	0 (0)	-	0 (0)	0 (0)	-	0 (0)
Other inpatient	2 (10)	1.0 (0.0)	49 (152)	1 (6)	1.0 (-)	31 (123)
General practitioner	11 (55)	1.3 (0.5)	24 (29)	11 (69)	3.9 (8.3)	28 (25)
Neurologist (non-outpatient)	4 (20)	1.0 (0.0)	17 (36)	6 (38)	1.0 (0.0)	23 (35)
Other specialist	0 (0)	-	0 (0)	0 (0)	-	0 (0)
Physiotherapist	3 (15)	1.7 (0.6)	7 (21)	4 (25)	2.3 (1.0)	17 (35)
Social worker	2 (10)	4.0 (2.8)	43 (185)	0 (0)	-	0 (0)
Nurse	3 (15)	1.0 (0.0)	3 (7)	5 (31)	3.4 (3.9)	20 (56)
Home help	1 (5)	4.0 (-)	13 (57)	0 (0)	-	0 (0)
Other	3 (15)	2.0 (1.0)	2 (7)	2 (13)	1.0 (0.0)	2 (4)
<b>Total</b>			<b>211 (299)</b>			<b>214 (239)</b>

<sup>a</sup> Contacts are for those using services only.

<sup>b</sup> Costs are for all participants.

<sup>c</sup> Inpatient contacts refer to number of days.

of the programme included its iterative development process with input from paMS and its basis on a theoretical and evidenced-based approach for treating MS fatigue (van Kessel & Moss-Morris, 2006; van Kessel et al., 2008). The pilot data suggest that MS Invigor8 has the potential to effectively reduce both severity of fatigue and its impact on daily living. The between group effect sizes for the fatigue measures at the end of treatment were well above the 0.80 cut-off for a large treatment effect (Cohen, 1988). MS Invigor8 also had a significant positive effect on both anxiety and depression. These data add to a growing body of literature showing that Internet-delivered self-help CBT with minimal therapist support is an effective treatment option for a range of symptom based problems such as tinnitus, headache, chronic pain, insomnia and irritable bowel syndrome (Andersson, 2009; Ljotsson et al., 2010).

In terms of economics, we measured other service costs rather than direct cost of the intervention because the latter would depend on how many people in routine practice made use of it. Service costs were very similar between the groups over the 10 week period. However, this period may be too short to show much change in service use costs. The intervention produced more QALYs. To achieve a cost per QALY of £20,000 (below which interventions in England are usually recommended) the intervention costs would need to be no more than £300 per person (£20,000 divided by 0.015 QALYs), or approximately £50 per session. If the intervention were never used beyond the 23 in the intervention group then this would only cover £6900 development costs. However, if the intervention is effective it is likely to be used by many more. If 300 people used it then this would cover a £90,000 development cost which is above the actual costs that were accrued. More widespread use would clearly offset these costs to greater extent, as would maintaining the QALY gain beyond 10 weeks.

Internet delivery of the intervention appeared to be acceptable to most participants. paMS self-referred into this study. Recruitment targets were met quickly suggesting that paMS are self-motivated to receive such treatments. There were also few drop outs. In depth interview feedback was largely positive, with many participants finding MS Invigor8 more helpful than other treatments they had tried. The telephone support was also seen by most as a key component of the treatment. Negative feedback centred on problems with website bugs rather than the nature of the treatment. Additional feedback was given to improve on minor aspects of the intervention structure and content. These revisions and bug fixing will improve the programme for future users.

The adherence data suggests that patients struggled to complete the programme within ten weeks. Interestingly a number of people continued with the website treatment after the study was finished. Thus, a longer treatment period may be required, possibly with more structured support by email or telephone to assist with progress.

In the original therapist trial of CBT for MS fatigue, all paMS in the CBT group completed the 8 sessions (van Kessel et al., 2008). The average change on the Fatigue Scale in the original trial was 13.04 points compared to 9 points in the current study. The eligibility criteria for both trials were the same and the baseline fatigue scores were similar. It would therefore be interesting to investigate the relative clinical and cost-effectiveness of these two approaches in a future trial. Further research comparing different doses of therapist time alongside the website would help ascertain optimal contact time. Therapist skill may also influence treatment effects; therapy support in this study was provided by a psychology assistant with minimal CBT experience, whereas the therapy trial included an experienced clinical psychologist

This study suffered certain limitations linked to the Internet technology. The development of the website proved extremely time-consuming. This part of the project overran leaving insufficient time to adequately test the website before we went to trial.

This meant that many participants encountered bugs in the programme. Most could work around these, but the qualitative data suggested that the problems negatively affected participants' treatment experiences. Problems also occurred with using the website for trial procedures such as screening and self-entry into the trial. It had been hoped that incorporating these into the website would be a feasible means of reducing trial research costs and widening the recruitment base. However, our experiences suggest that handling these trial procedures independently will provide better control over recruitment and eligibility.

The current study was a small pilot/feasibility trial of volunteers recruited over the internet and there was no long term follow-up data. A larger more definitive RCT is now needed with longer term follow-up to examine maintenance of treatment gains.

## Conclusion

Internet CBT-based self-management appears to be a promising, acceptable and cost-effective approach for treating MS fatigue and improving broader outcomes such as distress. If future research replicates these findings MS Invigor8 may be a feasible means of delivering a CBT-based intervention to a large pool of paMS who experience troubling and disabling fatigue.

## Role of the funding source

This study was funded by a grant from the UK MS Society. The society played no role in the design, conduct or write up of the study.

## Acknowledgements

We would like to acknowledge the substantial input into this project of our design team including the trial coordinator, Louise Bell, programmers – Prins Adeel Butt, Lisha Chen-Wilson, and Stephanie Cobb, and Lawrence Gilbert. We would also like to thank Caroline Blakemore who conducted the think aloud interviews for the development of the website and Carolyn Powell who conducted and analysed the qualitative interviews for the pilot trial.

There were no competing interests.

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