Vibration therapy in multiple sclerosis: a pilot study exploring its effects on tone, muscle force, sensation and functional performance

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Objective: To examine the effectiveness of whole body vibration (WBV) on tone, muscle force, sensation and functional performance in people with multiple sclerosis.

Design: A randomized cross-over pilot study.

Setting: Revive MS Support Therapy Centre. Glasgow, UK.

Subjects: Sixteen people with multiple sclerosis were randomly allocated to one of two groups.

Intervention: Group 1 received four weeks of whole body vibration plus exercise three times per week, two weeks of no intervention and then four weeks of exercise alone three times per week. Group 2 were given the two treatment interventions in the reverse order to group 1.

Main measures: Ten-metre walk, Timed Up and Go Test, Modified Ashworth Scale, Multiple Sclerosis Spasticity Scale (MSSS-88), lower limb muscle force, Nottingham Sensory Assessment and Multiple Sclerosis Impact Scale (MSIS-29) were used before and after intervention.

Results: The exercise programme had positive effects on muscle force and well-being, but there was insufficient evidence that the addition of whole body vibration provided any further benefit. The Modified Ashworth Scale was generally unaffected by either intervention, although, for each group, results from the MSSS-88 showed whole body vibration and exercises reduced muscle spasms (P = 0.02). Although results for the 10-m walk and Timed Up and Go Test improved, this did not reach statistical significance (P = 0.56; P = 0.70, respectively). For most subjects sensation was unaffected by whole body vibration.

Conclusion: Exercise may be beneficial to those with multiple sclerosis, but there is limited evidence that the addition of whole body vibration provides any additional improvements. Further larger scale studies into the effects of whole body vibration in people with multiple sclerosis are essential.
Introduction

Exercise therapy is considered to be a key symptomatic and supportive treatment for people with multiple sclerosis, but the evidence to support its use is relatively poor. A recent Cochrane systematic review exploring the effects of exercise for people with multiple sclerosis showed that exercises have beneficial effects on strength, physical endurance, mobility-related activities (transfer, balance and walking) and on mood, without any evidence of detrimental effects. However, there was no evidence that any particular exercise programmes, included within the review, were more effective in improving or maintaining function.

Whole body vibration has been around for over 30 years and has been used by cosmonauts to delay muscle atrophy and loss of bone density. Research on whole body vibration training as a method of muscle strengthening has been investigated mainly on healthy subjects. Whole body vibration involves subjects performing static or dynamic movements on a vibrating platform. The vibrations generated by the engine of the platform are transmitted to the person standing, sitting or lying on the machine. Whole body vibration can be delivered in two main ways: by vertical displacements of the whole platform or by side alternating whole body vibration, which operates like a seesaw. Physiologically the vertical vibrations generate acceleration forces working on the body, causing the muscles to lengthen and thus triggering the stretch reflex. This effect on the neuromusculature (muscle spindles and the alpha-motoneurons) increases the synchronization of the motor units when combined with a voluntary muscle contraction. As a result, greater muscle strength can be achieved compared to conventional training. In the side alternating systems, the seesaw-like displacement of the platform is reported to mimic human gait, in which one foot moves upwards and the other downwards. These systems offer larger amplitudes of oscillations but a lower frequency range than platforms generating pure vertical oscillations.

The current research to support the use of whole body vibration in the rehabilitation of people with neurological conditions, although sparse, suggests optimism. Ahlborg et al. showed that an eight-week programme of whole body vibration training had positive effects on muscle tone and strength compared with resistance exercise in children with cerebral palsy. Proprioception of the affected lower limb improved in people with stroke after subjects stood on the vibrating platform. Schuhfried et al. studied the effect of whole body vibration at low frequency on 12 people with multiple sclerosis. In the intervention group, subjects received vibration (applied without any exercises) in five series of 1 minute each with 1-minute break in between. In the placebo group, subjects received transcutaneous electrical nerve stimulation (TENS) in a similar fashion. After one week of intervention, the results showed a significant improvement in balance, as measured by posturography and also in functional scores, as measured by a timed up and go test. These results suggest that whole body vibration had a positive influence on mobility and postural control.

Thus overall there is limited evidence to support the use of whole body vibration for people with neurological conditions, in particular multiple sclerosis. However, people with multiple sclerosis are increasingly buying relatively expensive vibration machines despite the lack of evidence.

The aim of this pilot study, therefore, was to establish whether whole body vibration training combined with exercises was more beneficial to people with multiple sclerosis than exercise alone.

Methods

Design

An experimental within-subject, counterbalanced design was used for a sample of 16 people with multiple sclerosis randomly allocated to one of two groups (group 1 or group 2). Subjects were randomized by the physiotherapist involved with the treatments drawing a number from an envelope to allocate each subject to a group: number 1 for group 1 and number 2 for group 2. Each group then consisted of eight subjects.

For group 1, the protocol consisted of four weeks of a set exercise programme performed
with whole body vibration, three times per week, followed by a rest period of two weeks. Thereafter, subjects received a further four-week period of the same exercises but without whole body vibration, three times per week. The subjects in group 2 had exercise without whole body vibration for four weeks first, and then rest for two weeks and then four weeks of exercise and whole body vibration (Figure 1). Selected outcome measures were taken before and after each four-week period of exercise and each two-week rest period.

Subjects
Subjects were recruited via flyers within Revive MS Support and at local community leisure centres around Glasgow. To establish eligibility, recruited subjects undertook a screening process to ascertain that they had a confirmed diagnosis of multiple sclerosis, a disability level between 1 and 6 on the Hauser Ambulation Index\textsuperscript{15} and had at least one of the following symptoms based on previous clinical assessment: abnormal muscle tone, lower limb weakness, altered sensation and/or proprioception. In group 1, there were

![Flowchart of the experimental protocol.](image-url)
five females and three males, with five subjects having bilateral leg symptoms. In group 2, there were seven females and one male and four subjects had bilateral symptoms. The mean age was 45.8 years (SD 8.4) and 49.5 years (SD 6.14) for groups 1 and 2 respectively. The duration of multiple sclerosis from diagnosis varied from 10 months to 23 years (mean 6.7 years) in group 1 and 3.5 to 18 years in group 2 (mean 11.8 years).

Participants were asked to stabilize their medications, especially antispasmodic drugs, for the duration of the study. Subjects were excluded from the study if they were receiving ongoing physiotherapy or were keen to continue attending other types of exercise class, were receiving complementary therapy (e.g. acupuncture, reflexology, and aromatherapy), had previous or current use of whole body vibration, or presented with any contraindications of whole body vibration such as tumour, pacemaker, pregnancy, epilepsy, severe pain, active infection or dizziness.

Measurements
The outcome measures were taken before and after each four-week exercise period and rest period (Figure 1). All measures were performed by a physiotherapist who was not involved in the training procedure and who was blind to the group allocation.

Abnormal tone
Tone was assessed with the Modified Ashworth Scale.\textsuperscript{16} The four muscle groups most commonly affected by multiple sclerosis were measured: hip adductors, quadriceps, hamstrings and gastrocnemius. Only the affected lower limb(s) were considered.

The Multiple Sclerosis Spasticity Scale 88 (MSSS-88)\textsuperscript{17} was used to measure the subjects’ perception of the impact of abnormal tone on their multiple sclerosis. The MSSS-88 is a questionnaire that quantifies the impact of spasticity in six clinically relevant areas: three spasticity-specific symptoms (muscle stiffness, pain and muscle spasms) and three areas of physical functioning (ADL, walking, body movements), emotional health and social functioning.

Muscle force
The isometric force output of seven muscle groups was tested with a hand-held dynamometer: hip flexors, hip extensors, hip abductors, hip adductors, quadriceps, hamstrings and ankle dorsiflexors. The hand-held dynamometer was used to record the peak force exerted during maximum voluntary isometric contraction using the ‘make test’.\textsuperscript{18} Where patients exhibit clinically weak muscles, such as patients with neuromuscular disorders, the hand-held dynamometer provides a reliable and accurate means of assessing muscle strength.\textsuperscript{19} An average of two measures for each muscle group of the affected lower limb(s) was recorded.

Sensation and proprioception
As there is no specific scale to measure sensory impairment in multiple sclerosis the Nottingham Sensory Assessment,\textsuperscript{20} a scale for assessing sensory impairment in stroke patients, was used. The subjects’ tactile sensation to light touch, pinprick, pressure, temperature and proprioception was assessed at the knee, ankle and foot of the affected lower limb(s).

Functional measures
Walking performance was tested using the 10-m walk test.\textsuperscript{21} This is simple, quick and inexpensive, relatively reliable and responsive and has established face validity.\textsuperscript{22} The subjects were instructed to walk a standardized 10 m distance at their ‘own pace’, using their walking aid if necessary. The 10-m walk was undertaken twice and the average of the two times was recorded.

Balance in basic mobility movements was evaluated with the Timed Up and Go Test,\textsuperscript{23} a reliable and valid test for quantifying functional mobility.\textsuperscript{23–25} Participants sat on a standard chair with arms and were instructed to get up and walk at a comfortable and safe pace to a line on the floor 3 m away, turn around, return to the chair and sit down again. The time required to complete this task was recorded.

Well-being
The Multiple Sclerosis Impact Scale (MSIS-29)\textsuperscript{26} was used to measure the participants’
health-related quality of life. The MSIS-29 is a measure of the physical and psychological impact of multiple sclerosis from the patients’ perspective and consists of a 29-item questionnaire (20 items for physical construct and 9 items for psychological construct). It shows good variability, small floor and ceiling effects, high internal consistency and high test–retest reliability.26

Subjective comments
On a weekly basis, for both groups, the participants were asked to report any effect on their symptoms. The purpose of this was to highlight potential subjective changes which may not have been picked up by the chosen outcome measures.

Intervention
The whole body vibration was delivered via a vibrating platform (VibroGym International BV, The Netherlands). On this device vertical vibrations can be delivered at a frequency of 30, 40 or 50 Hz and the amplitude of the vibrations can be chosen between low (2 mm) and high (4 mm). As the literature base was limited the frequency and amplitude of the vibrations, as well as the duration of exercises, were chosen according to the manufacturers’ recommendations for stretching and strengthening exercise (i.e. 40 Hz, low amplitude (2 mm) and for 30 seconds).

In group 1, the subjects performed a series of exercises with vibrations three times a week for four weeks. Each session consisted of a warm-up massage of the quadriceps, hamstrings and gastrocnemius muscles delivered by the vibrating plate. Each muscle group was treated for 60 seconds at 50 Hz. Following the warm-up, subjects performed 10 different strengthening and stretching exercises for the lower limbs with vibration frequency of 40 Hz, and for 30 seconds. Each session ended with a cool-down massage similar to the warm-up. After a two-week rest period, the same protocol of exercises, this time without the vibration, was performed three times weekly for another four weeks. In this case, the warm-up and cool-down consisted of 3 minutes of slow passive movements on a motorized cycling machine. This again was followed by a two-week rest period. For group 2, the order of treatment was reversed (i.e. four weeks of exercise alone, two weeks rest and then four weeks of exercise with whole body vibration) (Figure 1).

Ethics
Prior to starting the study ethical approval was granted by the Research Committee of Glasgow Caledonian University and by Revive MS Support. A courtesy letter was sent to all subjects’ GPs. All subjects received written information about the study and were made aware that they could withdraw from the study at any time without consequence.

Statistical analysis
Repeated-measures ANOVA with two factors (group and assessment number) and their interaction was performed on the continuous response variables (muscle force, MSSS-88, MSIS-29, 10-m walk and Timed Up and Go Test). This allowed comparison of the data for both groups and investigated whether the order of interventions had any effect, and if there was any carryover effect from each intervention respectively. Provided there was no evidence of carryover or order effects the data were combined and a Wilcoxon signed ranks test was carried out on the difference between change following whole body vibration and exercise and change following exercise alone. Medians and non-parametric tests were considered as a result of the small sample size and where interactions were identified differences were considered separately for each group. Categorical tests such as McNemar’s test were considered for the variables Modified Ashworth Scale and Nottingham Sensory Assessment. However, the sample sizes were too small to obtain meaningful results with even exact versions of the test and hence descriptive analyses are presented here to illustrate the frequency and percentage of subjects with a decrease in score, no change in score and an increase in score following each intervention.
Results

Of the 16 subjects who were recruited and agreed to participate nine had multiple sclerosis affecting both lower limbs whereas seven subjects had a more unilateral presentation. Of the 16 subjects, four failed to complete the study; for one subject the whole body vibration aggravated a pre-existing knee condition and the other three subjects withdrew as they found coming to the therapy centre three times a week unfeasible. Thus 12 subjects completed the study.

Although the study was of a cross-over design, statistical analysis revealed that there was little evidence of a group or interaction effect for any of the outcome measures (except MSSS-88). Therefore, while appreciating that this may be a result of the small sample size in some cases, the effect of whole body vibration and exercise was compared with that of exercise alone regardless of the order the interventions occurred. In addition, statistical results are presented for right and left affected limbs separately. However, descriptive results for Modified Ashworth Scale and Nottingham Sensory Assessment are presented for all limbs affected by multiple sclerosis as a result of small sample sizes for categorical data analysis. Thus, although there were 12 subjects, due to the bilateral presentation of some subjects data for 18 limbs from group 1 and 21 limbs from group 2 are included.

Muscle force production

The results for maximum muscle force produced for each of the seven muscle groups tested suggest that there was a trend towards an improved ability to generate muscle force especially following whole body vibration and exercise (Table 1). Although there appeared to be a trend, this difference did not reach statistical significance.

Abnormal tone

Although the results were variable, for most subjects the Modified Ashworth Scale score remained unchanged following each of the interventions (Table 2). Tone tended to increase more for exercise alone compared with whole body vibration and exercise.

Each of the eight components of the MSSS-88 was analysed. For MSSS-88 pain, there was a borderline interaction between group and assessment number, thus each group was considered separately. For group 1, there was a statistically significant difference between the results before and after whole body vibration ($P=0.036$). However, for group 2, there was no significant difference. For MSSS-88 spasm, there was no evidence of order or carryover effects and hence the data from groups 1 and 2 were combined and analysed using a Wilcoxon signed ranks test. This produced a $P$-value of 0.02 with a 95% confidence interval (CI) of 2.00, 14.50, which highlights that a greater reduction in score was achieved using whole body vibration and exercise compared to exercise alone.

For the remainder of the MSSS-88 components (ADL, social functioning, stiffness, gait, body movement and emotional health) no statistically significant results were obtained.

Functional measures

From Table 3 it appears that both interventions increased the subjects’ walking speed as evidenced by a faster 10-m walk time, however the difference between performance with vibration and exercise, and exercise alone was not statistically significant ($P=0.561$). A similar pattern was observed with the results of the Timed Up and Go Test ($P=0.720$). There was insufficient evidence that including whole body vibration within the exercise programme improved these functional outcomes for people with multiple sclerosis over that of exercise alone. The confidence intervals for the results of both outcome measures are relatively wide mainly due to two subjects with a higher level of disability (i.e. score of 6 on the Hauser Index) and thus a relatively poor functional ability compared to the remainder of the subjects.

Sensation

For most subjects, sensation was unaffected by either intervention in that there was no change in the scores recorded (Table 4). For each of the five
sensations assessed the number of subjects with increased scores (i.e. improved sensation) was higher for exercise alone than for exercise combined with whole body vibration.

Well-being

Both interventions appeared to improve the subjects’ well-being as evidenced by a reduction in scores for both physical and

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### Table 1 Maximum muscle force produced for each of the seven muscle groups

<table>
<thead>
<tr>
<th>Muscle group</th>
<th>WBV and exercise (Pre–post)</th>
<th>Exercise alone (Pre–post)</th>
<th>P-value (CI) for difference between interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip flexors (L)</td>
<td>−6.13 [−13.12 to 5.03]</td>
<td>−3.43 [−14.22 to 1.96]</td>
<td>0.074 [−23.05, 28.69]</td>
</tr>
<tr>
<td>Hip flexors (R)</td>
<td>−5.15 [−22.20 to 15.33]</td>
<td>4.17 [−3.19 to 12.75]</td>
<td>0.492 [−23.79, 13.00]</td>
</tr>
<tr>
<td>Hip extensors (L)</td>
<td>−30.66 [−40.22 to −14.22]</td>
<td>−1.47 [−32.37 to 5.40]</td>
<td>0.363 [−40.22, 22.32]</td>
</tr>
<tr>
<td>Hip extensors (R)</td>
<td>−3.19 [−6.25 to 0.49]</td>
<td>−4.41 [−60.94 to 4.42]</td>
<td>0.375 [−16.68, 48.07]</td>
</tr>
<tr>
<td>Hip adductors (L)</td>
<td>−22.07 [−28.45 to −11.77]</td>
<td>−11.77 [−37.77 to −0.49]</td>
<td>0.844 [−44.15, 30.41]</td>
</tr>
<tr>
<td>Hip adductors (R)</td>
<td>0.00 [−13.73 to 20.23]</td>
<td>19.87 [−35.68 to 6.13]</td>
<td>0.193 [−12.26, 37.77]</td>
</tr>
<tr>
<td>Quadriceps (L)</td>
<td>−13.98 [−54.32 to −1.35]</td>
<td>−14.22 [−51.99 to 17.66]</td>
<td>0.740 [−60.82, 48.56]</td>
</tr>
<tr>
<td>Quadriceps (R)</td>
<td>−19.13 [−47.82 to −14.47]</td>
<td>−22.07 [−44.51 to 9.81]</td>
<td>0.846 [−42.43, 23.30]</td>
</tr>
<tr>
<td>Hamstrings (L)</td>
<td>−18.64 [−23.79 to −9.20]</td>
<td>−12.75 [−15.70 to −5.40]</td>
<td>0.844 [−19.13, 23.05]</td>
</tr>
<tr>
<td>Hamstrings (R)</td>
<td>−7.11 [−34.70 to 7.60]</td>
<td>−14.47 [−24.40 to 3.56]</td>
<td>1.000 [−27.71, 23.05]</td>
</tr>
<tr>
<td>Ankle DF (L)</td>
<td>−3.68 [−10.55 to 0.736]</td>
<td>2.45 [−7.85 to 3.43]</td>
<td>0.461 [−19.62, 12.51]</td>
</tr>
<tr>
<td>Ankle DF (R)</td>
<td>1.96 [−13.12 to 9.81]</td>
<td>0.00 [−6.38 to 5.76]</td>
<td>0.770 [−15.94, 12.51]</td>
</tr>
</tbody>
</table>

Values are median difference (before minus after) [interquartile range of difference] for each intervention. P-values and 95% confidence intervals (CI) for the difference between change (before minus after) in muscle force (N) following whole body vibration and exercise and change in muscle force following exercises were computed using a Wilcoxon signed ranks test. Left n=8, right n=10.

WBV, whole body vibration.

### Table 2 Frequency and percentage of subjects with a decrease, no change or increase in Modified Ashworth Score following each intervention

<table>
<thead>
<tr>
<th>Muscle group</th>
<th>WBV and exercise (n=18)</th>
<th>Exercise alone (n=21)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Decrease in score</td>
<td>No change in score</td>
</tr>
<tr>
<td>Quadriceps</td>
<td>9 (50.0%)</td>
<td>5 (27.8%)</td>
</tr>
<tr>
<td>Hamstrings</td>
<td>2 (11.1%)</td>
<td>15 (83.3%)</td>
</tr>
<tr>
<td>Hip adductors</td>
<td>5 (27.8%)</td>
<td>13 (72.2%)</td>
</tr>
<tr>
<td>Gastrocnemius</td>
<td>1 (5.6%)</td>
<td>13 (72.2%)</td>
</tr>
</tbody>
</table>

### Table 3 Results for 10-m walk and Timed Up and Go Test

<table>
<thead>
<tr>
<th></th>
<th>WBV and exercise (Pre–post)</th>
<th>Exercise alone (Pre–post)</th>
<th>P-value (CI) for difference between interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-m walk (s)</td>
<td>1.00 [0.50 to 2.13]</td>
<td>0.50 [−0.50 to 2.38]</td>
<td>0.561 [−6.50, 2.25]</td>
</tr>
<tr>
<td>TUGs</td>
<td>1.25 [−0.50 to 2.25]</td>
<td>1.50 [0.13 to 2.38]</td>
<td>0.720 [−25.75, 9.25]</td>
</tr>
</tbody>
</table>

Values are median difference (before minus after) [interquartile range of difference] for each intervention. P-values and 95% confidence intervals (CI) for the difference between change (before minus after) in functional measures following WBV and exercise and change in functional measures following exercise were computed using a Wilcoxon signed ranks test (n=12).

WBV, whole body vibration; TUG, Timed Up and Go Test.
psychological constructs within the MSIS-29 questionnaire (Table 5). However the difference between scores with whole body vibration and exercise and exercise alone was not statistically significant in either case (psychological or physical), suggesting that whole body vibration had no added value in terms of the results.

Subjective comments

Subjective comments given by participants were supportive of both vibration and exercise, and exercise alone. The comments made by subjects while receiving exercise alone included the following: improved sleeping, more energy during the day, and improved and brighter mood. These comments were also noted by subjects while receiving whole body vibration with exercise with the addition of the following statements: reduction in foot cramps at night, improved ability to feel the ground immediately after the session and improved ability to negotiate stairs.

Discussion

The results of this study suggest that exercise performed three times a week for four weeks improved muscle force output, functional ability and general well-being in people with multiple sclerosis. The addition of whole body vibration to the exercise programme provided some added benefit to exercise alone in terms of reducing muscle spasm. In addition there was a trend towards a greater increase in muscle force generation with the addition of whole body vibration. Exercise, with or without whole body vibration, appeared to have had no effect on sensation or muscle tone.

The MSSS-88 yielded several interesting findings. It appeared that whole body vibration and
exercise decreased muscle spasms as well as the pain associated with those spasms to a greater extent than exercise alone. Potential physiological explanations for these findings have not been explored as previous studies have concentrated on the effects of whole body vibration on muscle strength.

An increase in the maximum force generated from each of the seven muscle groups tested was observed for both interventions (whole body vibration and exercise and exercise alone). Although the results failed to reach statistical significance, they revealed a trend for greater improvement in muscle force production following whole body vibration and exercise compared to exercise alone. Although there is some literature on the effect of whole body vibration in healthy subjects, only one study has investigated the effects of whole body vibration on muscle strength in those with neurological problems. Ahlborg et al. showed an increase in quadriceps strength following whole body vibration in subjects with cerebral palsy. The present study is the first to consider the effect of whole body vibration on muscle force in people with multiple sclerosis. In healthy subjects, numerous studies have demonstrated the potential of whole body vibration training to induce strength gains in the knee extensor muscles and jump performance. In a recent systematic review on strength training effects of whole body vibration, the five studies with strong experimental designs found that whole body vibration did not have additional value to the effect of the concomitant exercises performed on the vibrating platform. The review also highlighted a significant methodological flaw in some studies where the control group did not perform similar training exercises to the whole body vibration group. The exercises were the same for both interventions in the present study and the result was a trend towards a greater increase in muscle force with whole body vibration and exercise.

Both interventions – whole body vibration and exercise and exercise alone – improved function as measured by the 10-m walk and the Timed Up and Go Test. However, there was insufficient evidence that whole body vibration had added benefit over exercise alone. In both interventions, the exercises performed were static and it is possible that more dynamic movements may have had a greater impact on subjects’ functional level. In a previous study on cerebral palsy, the 6-minute walk test and the Timed Up and Go Test did not change significantly following either whole body vibration or resistance training. However in that study, subjects did not exercise on the vibrating platform and thus it appears that for functional improvement vibration alone may not be sufficient. In the study of whole body vibration for people with multiple sclerosis, the results of the Timed Up and Go Test were better for the whole body vibration group compared with the placebo immediately after the intervention, and this was maintained one week later. However, Schuhfried et al. used different treatment parameters to the ones used in the present study: they used a low frequency (1 Hz), which was increased as tolerated, and 3 mm amplitude compared to the parameters in the present study of 40 Hz and amplitude of 2 mm. In addition, no exercises were performed concurrently with the whole body vibration and their control group did not receive whole body vibration. In summary, although for some outcome measures whole body vibration appears to provide little added benefit over exercise alone, it may be that the use of whole body vibration has benefits compared to no intervention at all for people with multiple sclerosis.

Although subjective comments suggested that sensation was improved following whole body vibration, the results of the Nottingham Sensory Assessment found that for the majority of subjects sensation was unaffected by either intervention. It is reported that vibration stimuli can have the following effects: stimulation of the pressure receptors on the sole of the foot, stimulation of the proprioceptors, increased blood flow and trigger of reflexes. Although outwith the scope of the present study a more sensitive outcome measure such as Quantitative Sensory Testing (QST) would provide objective results to examine the potential effect of whole body vibration on the sensory system in people with multiple sclerosis.

Finally, well-being improved after both interventions, but there was insufficient evidence of added benefit from the whole body vibration. This corroborates results of a systematic review on exercises and multiple sclerosis that reported that exercise, regardless of the type, has a strong
positive effect on the physical and psychological impact of multiple sclerosis.

One subject was unable to complete the study as the whole body vibration appeared to exacerbate a pre-existing knee condition, unrelated to her multiple sclerosis. The three other subjects who withdrew from the study did so because they found attending the centre three days a week impossible. Throughout the course of the study, none of the subjects reported any significant deterioration in symptoms. Thus although the effects of whole body vibration in multiple sclerosis have not been completely elucidated in this study, it does seem that whole body vibration caused few adverse effects in this sample of people with multiple sclerosis.

This study was designed as a pilot study and therefore the main limitation was obviously the small sample size thus trends and minor differences observed may have been due to chance. A larger sample would increase statistical power and allow more formal statistical procedures to be applied in the case of categorical data. Further research to determine the optimum parameters for the application of whole body vibration for people with neurological conditions is required. A recent review on the use of vibration training to enhance muscle strength and power28 highlighted that the differences in vibration training methodologies affect the short- and long-term effect on neuromuscular performance. The vibration characteristics (vibration amplitude, frequency and vertical versus side-alternating) as well as the exercise protocols (type of exercises, intensity, and dosage) are complex methodological aspects to consider as they may greatly influence the potential benefits obtained with vibration training. Further larger scale studies into the effects of whole body vibration in people with multiple sclerosis, and indeed other neurological conditions, are essential.

Exercise may be beneficial to those with multiple sclerosis, but there is limited evidence that including whole body vibration provides any additional improvements. Whole body vibration, using the parameters used in this study, did not appear to have a detrimental effect on symptoms of multiple sclerosis and, as such, may be considered as part of a therapeutic programme for people with multiple sclerosis.

Clinical messages

- With the exception of a reduction in muscle spasms, there was insufficient evidence that the addition of whole body vibration to the exercise programme provided any added benefit.
- Whole body vibration did not appear to have a detrimental effect on multiple sclerosis.
- Further, larger trials are warranted.

Competing interests

None.

Contributors

FS and EN initiated the study. FS, EN and LP acquired funding. FS managed the project, FS and KF undertook the recruitment and treatment/assessment. CF provided statistical support and undertook statistical analysis. FS and LP wrote the draft manuscript. FS, LP and CF revised the manuscript and with KF and EN gave approval of the final version submitted. FS takes responsibility for the accuracy and honesty of the report and the morality of the study.

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