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Original Research Paper

The effects of a 12-week yoga intervention on body awareness in people with multiple sclerosis: A non-controlled pilot study

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ABSTRACT

Introduction and objective: Multiple sclerosis is a neurological autoimmune disease. Different disease-modifying treatments exist; however, they do not control the neurodegenerative processes and often result in adverse events. Therefore, many people with multiple sclerosis turn to complementary or integrative health (CIH) practices. Yoga is one of the more popular CIH practices among people with multiple sclerosis, and evidence points to an association between yoga and improved body awareness. The objective of this study was to investigate if a 12-week yoga course can improve body awareness in patients with multiple sclerosis as measured with the Multidimensional Assessment of Interoceptive Awareness (MAIA) questionnaire.

Material and methods: In this non-controlled pilot study, 22 patients participated in a 12-week yoga course. They attended weekly classes with the instructor and were encouraged to practice the exercises at home twice weekly. Before and after the course, all participants filled in the MAIA questionnaire, which consists of the eight dimensions: Noticing, Not-distracting, Not-Worrying, Attention regulation, Emotional awareness, Self-regulation, Body-listening and Trusting. Changes in mean scores were estimated with two-tailed paired t-tests.

Results: After the 12-week yoga course, participants' total mean scores for body awareness improved significantly. Significant improvements were detected within three of the eight subscales from the MAIA, Attention regulation, Emotional awareness and Trusting.

Conclusion: The results of this non-controlled pilot study suggest that yoga may have a positive effect on body awareness in patients with multiple sclerosis. Improvements were found in all subscales of body awareness although only improvements in three of the eight subscales were significant.

1. Introduction

Multiple Sclerosis (MS) is an autoimmune, demyelinating chronic disease in the central nervous system (CNS) [1]. MS entails perivenular inflammatory lesions, leading to demyelinating plaque. MS symptomatology results from a combination of location and size of lesions, and MS is characterized by progressive neurodegeneration which over time often leads to an increasing symptom burden [1]. People with MS (PwMS) experience a wide range of symptoms with varying severity [2]. Hence, many PwMS receive treatments and engage in activities to maintain functions and alleviate symptoms such as fatigue, poor sleep quality, walking disabilities, spasticity, and cognitive challenges [2].

Although different disease-modifying treatment options exist, they do not control the neurodegenerative processes and do not cure the disease [3] while often also resulting in adverse events [4]. Physical activity is increasingly recommended to PwMS as it is a beneficial rehabilitating approach addressing the multifaceted aspects of the disease [3]. Many PwMS also turn to complementary or integrative health (CIH) practices to supplement conventional treatment and rehabilitation, not least in the hope that such therapies can strengthen the body's ability to cope with MS [5]. Yoga is one of the more popular CIH practices among PwMS [6].

Yoga is an ancient Indian mind-body approach, and consists of eight principles including specific postures, breathing technics and meditation

Abbreviations: MS, Multiple Sclerosis; PwMS, People with multiple sclerosis; CIH, Complementary or integrative health; QoL, Quality of life; MAIA, Multidimensional Assessment of Interoceptive Awareness.

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with the aim of improving the individual's health and wellbeing. In the western world, the postures and breathing practices of Hatha yoga and meditation are most common [7]. Yoga seems to be a safe activity combining flexibility, strength, endurance mobility and balance and has been investigated as a compliment method to routine practice in many chronic diseases [8]. Several reviews and meta-analyses have suggested that yoga may have a positive impact on PwMS [6,9–11]. Positive effects from yoga include, but are not limited to, improvement in fatigue, mental status, muscle strength and function, sensory disturbances, balance, gait, bladder dysfunction, self-efficacy and quality of life (QoL) [6, 8–13].

Yoga has become increasingly popular in Western countries and is practiced for, among other reasons, its promotion of the mind-body connection [14]. Studies on the effects of yoga suggest that yoga may affect the brain, brain networks and the nervous system in such ways that yoga can improve sensory awareness and interoceptive awareness [14]. Interoceptive awareness may be defined as the information that arises within the body involving emotions, conscious awareness and behavior [15].

The connection between yoga and body awareness has been investigated in a number of studies. A narrative review, focusing primarily on studies comparing trained meditators to healthy matched non-meditators, concludes that yoga seems to increase sensory awareness and interoception [14]. Among primary care patients with low back pain, a US study. found a positive association between yoga and body awareness [15,16]. Patients having experience with meditation and yoga scored significantly higher on a body awareness scale, compared to mind-body inexperienced patients [16]. A German study found similar associations in a study among women with abdominal obesity [17] and significant improvements in interoceptive bodily awareness were detected among veterans with PTSD performing yoga [18]. A US study suggests increase of interoceptive awareness to be one of the main aspects explaining the effect of yoga as stress-reducing [19]. Among healthcare providers a meditation program, grounded in the system of yoga, significantly improved the interoceptive awareness [20].

Qualitative studies indicate that yoga may assist in enhancing body awareness – e.g. among patients with paroxysmal atrial fibrillation [21], systemic lupus erythematosus [22], obstructive pulmonary diseases [23], PTSD [24], cancer [25–27], Chronic neck pain [28] and back pain [29].

Within the MS field, the connection between yoga and body awareness has only been investigated by a small qualitative case study (n = 2), where its was found that PwMS who practice yoga experienced an ongoing development of body awareness [30].

The concept of interoception in relation to MS has been described in several publications; alterations in the sensing of bodily signals is prevalent among PwMS, indicating distinctively impaired interoceptive processes within this patient group [31–34]. Alterations related to sensing of bodily signals also characterizes related disorders such as Parkinson's disease [35–39], Tourette Syndrome [40] and Alzheimer's [41].

As the sensing of bodily signals is important as a tool to continuously assess possible effects and adverse effects of treatments, impaired interoceptive processes may constitute a barrier to finding optimal treatment strategies – in dialog with HCPs as well as self-initiated in daily life - among PwMS. Interventions that may strengthen the interoceptive processes may therefore be highly relevant for PwMS. Within the field of Parkinson's Disease, a US study [39] underlines the relevance of further research regarding the efficacy of mind-body techniques, specifically yoga, to improve body awareness.

Limited qualitative data points to a possible association between yoga and improved body awareness. However, possible benefits from yoga regarding body awareness among PwMS have not been sufficiently investigated and not using a validated instrument for assessing the interoceptive awareness. Thus, this pilot study aims to investigate if a 12-week yoga course can improve interoceptive awareness in PwMS as measured with the Multidimensional Assessment of Interoceptive Awareness (MAIA), a validated self-report instrument.

2. Materials and methods

This was a pilot study, conducted as a single-group intervention study with a pre- and post-test research design, aimed to perform a preliminary investigation of the effects of yoga on interoceptive awareness in PwMS.

2.1. Yoga course

A Hatha yoga instructor with certification E-RYT 200 from Yoga Alliance, who was also a trained MS nurse (affiliated with an MS clinic for 10 years as well as supplementary education), designed a 12-week yoga course. The yoga course served as an add-on to conventional MS treatment. The yoga intervention consisted of one weekly 75 min practice (40 min postures, 10 min breathing and lastly 15 min body-scan) with the certified instructor and MS nurse and was performed at the MS clinic at Rigshospitalet Glostrup, Denmark. Optional online yoga lessons (10–15 min) were available as a guide for at home practices. Since PwMS have varying levels of energy, the amount of at home practices was not standardized. The majority of participants had performed yoga at home to varying degrees and intensities during the course.

The yoga course was primarily inspired by slow Hatha yoga. Prior to the pilot study, the yoga course was tested on a small sample of MS patients over an 8-week period to ensure the intervention accounted for MS-specific challenges. The yoga course was not designed as a standardized yoga program as the choice of positions depending on the participants' capacities and challenges at each session. However, a focus area for each session had been decided by the yoga instructor and MS nurse. Throughout the 12-week yoga course 10 different focus areas were covered in the sessions; strength (standing exercises), flexibility (arms and legs), breathing, balance (leg and stomach), digestion (twists), spasms (hamstring stretches), sleep (calming, restorative yin exercises), hip, knee, ankle and feet (balance), meditation (cognitive and breathing yin exercises). Sessions were always initiated with breathing exercises, and they were always finalized with a 10–15 min body scan exercise resting on the ground to establish a certain calmness. Additionally, mobility of shoulder hip and back were covered in each session. Thirty different yoga positions were applied during the 12-week course. Eight positions were applied at every session. These were: Breathing exercises in crossed-leg position, Cat/cow, Mountain Pose, Tree Pose, Warrior II, Bridge Pose, Child's Pose, Head-to-knee Pose, Cobra Pose, Reclined Big Toe Pose, Seated Twists Tose, Corpse Pose. The yoga teaching included visual demonstration, verbal guidance and/or hands on assistance.

The participants were divided into two groups so the yoga instructor and MS nurse could guide every participant through the different poses to ensure that participants got into the pose correctly and to establish a continued focus on participants breathing throughout the session. Participants were asked to inform the instructor of any pain upon which poses would be modified. In the same way, the instructor adjusted poses according to participants' balance or ability to stand on just one leg.

2.2. Recruitment strategy

Participants were recruited among MS patients receiving their MS care at Rigshospitalet Glostrup, Denmark. Recruitment folders about the yoga course were placed in the waiting room and in doctors' and nurses' offices. Participants signed up for the yoga course by e-mail. Inclusion criteria constituted by the ability to sit on a yoga mat and the ability to enter a sitting position and to get up from the floor without help from others. The inclusion criteria were based on a wish for a homogeneous group with a similar level of ability. Only one participant failed the

screening due to this inclusion criteria. All participants received conventional MS treatment.

2.3. The MAIA questionnaire

Changes in body awareness over time were measured with the self-report instrument MAIA. MAIA has been developed to capture changes in interoception associated with mind-body interventions. The MAIA survey consists of 32 items comprising eight separately scored scales: Noticing, Not-Distracting, Not-Worrying, Attention Regulation, Emotional Awareness, Self-Regulation, Body Listening and Trusting. The scales measure different modes of attention to bodily sensations, allowing for a differentiated assessment of interoceptive processing and the ability to distinguish between beneficial and maladaptive aspects of body awareness [42]. The instrument assesses interoceptive awareness on 6-point Likert-type scales ranging from 0 (Never) to 5 (Always) [42].

MAIA was developed with a mixed methods approach and validated using multiple validation methods. Validation methods supported construct validity and found adequate to excellent internal-consistency reliability of the eight scales [42].

The Noticing scale assesses the participant's awareness to different signals from the body. The Not-Distracting scale refers to the tendency not to distract one-self from, or ignore, pain and uncomfortable body sensations. Not-Worrying evaluates the participant's ability not to worry or experience emotional distress due to uncomfortable body sensations such as pain. Attention Regulation is the ability to maintain and regulate attention to signals from the body. Emotional awareness refers to the consciousness of the interrelation of emotions and body sensations. Self-Regulation assesses the ability to control distress and discomfort through bodily awareness. Body Listening includes actively listening to body sensations for insights and Trusting refers to experiencing one's body as safe and trustworthy [15].

MAIA was administered to participants upon entry into the study before participation in the yoga course and at follow-up after the 12-week yoga course. The instrument was used at its complete length and participants were asked to complete all 32 questions. Participants completed the questionnaire anonymously and alone without any influence from others.

2.4. Statistical analysis

Total MAIA scores were calculated for each individual and population pre and post mean scores were estimated [43]. Higher scores indicated a higher level of positive awareness [43]. To evaluate the effect of yoga on interoceptive awareness a two-tailed paired t-test was performed as suggested by Cranmer to account for between-person variances [44]. Changes were considered significant at $p < 0.05$.

Moreover, mean scores were calculated for every subscale as described in the scoring instructions [42] after which population means for each subscale pre and post yoga intervention were calculated. Differences in mean pre-and post-tests for the subscales were estimated with two-tailed paired t-tests (significance level $p < 0.05$).

All statistical analyses were performed with Microsoft Excel, Office 16.

2.5. Ethics

Written informed consent was obtained from all participants after reading the participant information. The study adhered to the EU general Data Protection Regulation.

The study was reported to the administration of the Danish National Committee on Health Research Ethics who decided that a formal review and approval were not necessary for this study as the intervention was mild and non-invasive. The study adhered to the EU General Data Protection Regulation.

3. Results

Twenty-two participants were recruited to this pilot study. Two participants did not complete the second MAIA questionnaire and one participant only took part in four of the 12 yoga sessions. These three participants were excluded from the analysis. This resulted in a population of 19 participants of which 15 (79%) were female. All participants were between 20 and 50 years old and had MS between 0 and 10 years. All participants received disease modifying treatment. Their EDSS score ranged from 0 to 5.5.

At baseline, participants' total MAIA scores ranged from 25 to 116 and total MAIA scores at follow-up ranged from 66 to 137. Participants' changes in MAIA score are depicted in Fig. 1.

The total MAIA mean score increased significantly ($p = 0.015$) from baseline (88) to follow up (101) (Table 1), indicating improved body awareness among participants.

Mean scores within each of the eight MAIA subscales increased (improved) from baseline to follow-up as presented in Table 2. Noticing improved from 2.96 to 3.34, Not-distracting improved from 1.88 to 2.07, Not-worrying improved from 2.72 to 2.74, Attention regulation improved from 2.63 to 3.30, Emotional awareness improved from 3.11 to 3.61, Self-regulation improved from 2.54 to 3.21, Body listening improved from 2.68 to 2.77 and trusting improved from 3.12 to 3.54.

Statistically significant improvements in mean scores from baseline to follow-up were found in the participants' attention regulation ($p = 0.002$), emotional awareness ($p = 0.026$) and trusting ($p = 0.016$). Changes in the subscales Noticing, Not-Distracting, Not-Worrying, Self-Regulation and Body Listening was not significant although changes in Self-Regulation were borderline significant. Changes in mean scores from baseline to follow-up are depicted in Table 2 together with the respective p-values from the Student t-test.

Due to the limited number of participants we chose to further explore patterns in individual participant changes in total MAIA scores and changes in subscale scores for significant subscales. Changes in total MAIA scores and changes in the subscales found significant with the student t-test were portrayed graphically to examine whether any participants stood out in particular which could possibly explain the significant results. Potential outliers were determined by using the interquartile range to which ID10 can be determined as a weak outlier. Removing the outlier (ID10) did not change the significance of the results of the total score and did only alter the results of the subscale slightly as 'Self-regulation' was no longer borderline significant ($p = 0.097$) and 'Emotional Awareness' was now borderline significant ($p = 0.051$).

4. Discussion

In this pilot study we examined the effects of a 12-week yoga course, designed for PwMS, on body awareness as measured with the MAIA questionnaire. To our knowledge, this is the first study that investigates the effects of yoga on body awareness among PwMS, using a validated outcome measure. This preliminary study shows that the MAIA score improved significantly from baseline to follow-up in the 12-week period where the group participated in the yoga sessions, suggesting that yoga may have a positive effect on body awareness in this patient group. Improvements were found in all subdimensions of body awareness although only improvements in participants' attention regulation, emotional awareness (borderline significant if ID 10 is removed from the analyses) and trusting were statistically significant. These findings support previous case study qualitative findings which found that PwMS performing yoga reported an experience of ongoing improvements in body awareness [30].

The results from the present study are in line with existing evidence regarding possible associations between yoga and body awareness in other patient groups. Positive effects from yoga on body awareness, measured similarly by questionnaires, have been found within the fields

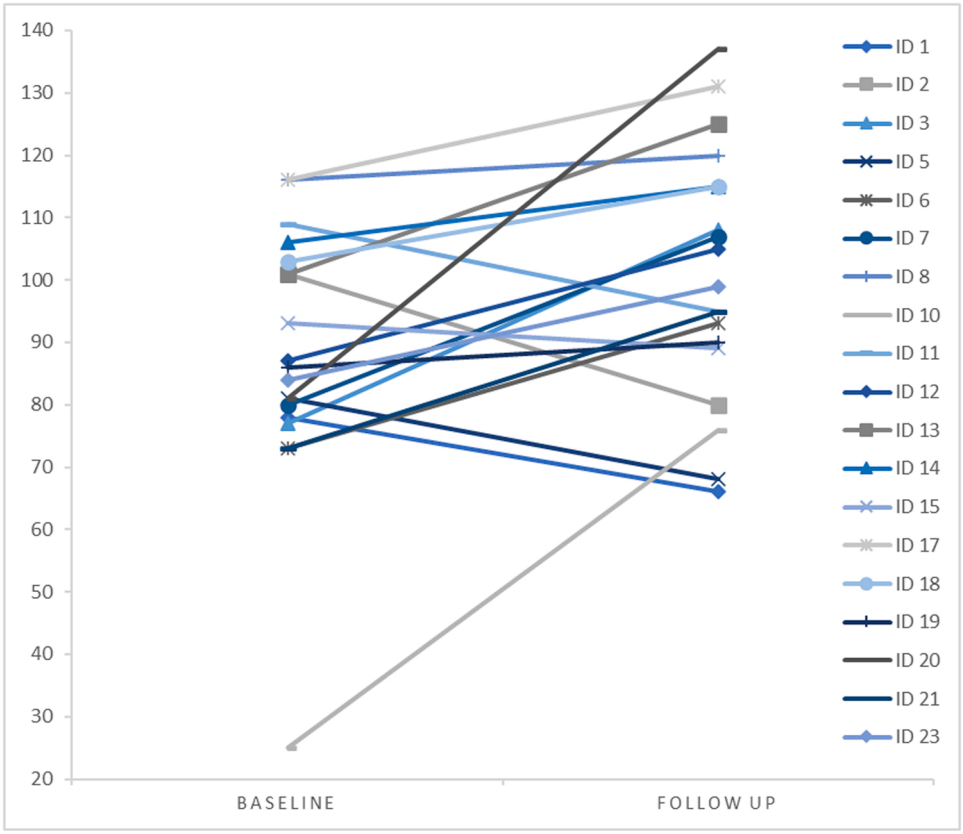

Fig. 1. Participants' changes in MAIA scores.

Table 1
Mean scores for baseline and follow-up.

Baseline	Follow up	Student t-test
87.89	100.74	0.015*

Table 2
Mean scores and analysis of variance within the eight subscales.

	Baseline	Follow-up	Student t-test
Noticing	2,96	3,34	0.20
Not-Distracting	1,88	2,07	0.276
Not-Worrying	2,72	2,74	0.942
Attention Regulation	2,63	3,30	0.002*
Emotional Awareness	3,11	3,61	0.026*
Self-Regulation	2,54	3,21	0.051(*)
Body Listening	2,68	2,77	0.756
Trusting	3,12	3,54	0.016*

of low back pain [15,16], women with obesity [17], veterans with PTSD [18] and stress [19] as well as among healthcare providers [20].

Qualitative studies regarding the effect of yoga on body awareness have suggested positive associations within several patient groups [21–25,27–29,45].

The explanation of the link between yoga and body awareness within the field of MS is not evident as the mechanistic processes involved are not fully identified. A recent review on the effects of yoga underlined that increase in body awareness is associated with a wide variety of changes in terms of brain activity and structure, but that further studies are needed to reveal its precise mechanism of action [14].

We know that several alterations related to the sensing of bodily signals are entailed by MS [31–34], and an Argentinian study showed that MS patients are characterized by atypical multimodal brain signatures of interoception [32]. Researchers have also suggested that such aberrant integration and control of interoceptive signals can perturb the whole system [34] and it may be relevant to regard the possible link between yoga and body awareness among PwMS in a broad, whole-body perspective.

Previous research within MS and CIH has indicated that treatment of PwMS may be regarded fundamentally as a question of processes being initiated and maintained, with the purpose of strengthening the patients' resources and competences on a physical, an emotional and a cognitive level [46]. In this perspective, alleviation of a given symptom may be the result of a multi-pronged process where different symptoms and functions affect each other in a complex course of treatment.

In a German study on patients with chronic neck pain, it was argued that body awareness appears to constitute a key mechanism in changes detected within a broad range of outcomes [28].

As PwMS often have reduced sensibility due to damaged myelin in the nerve cells [47], e.g. with regards to reduced sweating response [48] and reduced temperature sensitivity [49], interventions that strengthen the patients' body awareness could be seen as essential with regard to enhancing the patients' continuous optimal adjustment of interventions and activities, e.g. the amount of physical exercise.

Body awareness is seldom investigated as an outcome measure in CIH research. From a whole-body perspective, it may be argued that increased body awareness could constitute an important outcome measure and should be integrated as such. This argument has also been brought forth by US studies [29].

This was a pilot study with a small sample size and no control group was included. For these reasons the results should be interpreted with care. In extension to this, the present study did not include a run-in or follow-up period why the analyses do not account for changes in MAIA overtime before or after the intervention period. Future studies should more thoroughly investigate the potential of yoga as an intervention to improve body awareness in PwMS by including a control group and

extended follow-up time. An investigation of non-responders would also be of relevance in future studies. The lack of control group implies that improvements observed in the study could be affected by non-specific factors and might not be attributed solely to the yoga intervention. Further, the rather simple design entails a risk for non-spuriousness, as analyses were not controlled for confounding variables, which can threat the internal validity. Future larger studies on the association between yoga and body awareness among PwMS could preferably be designed with a control group, based on random allocation. The pre-post design entails a risk of improvements being allocated to test as well as to effects of the intervention – meaning that the MAIA questionnaire might have brought increased attention to, or new knowledge about, body awareness to participants which might have affected participants post-scores [50]. The psychometric properties of the MAIA questionnaire have been validated with positive results [42], however the questionnaire has not been validated within an MS-population specifically.

It has been argued that many CIH interventions, such as yoga, should be examined by use of research designs that take non-specific factors into consideration [51]. Although randomization is the best way to secure homogeneity between an intervention group and a control group, is should be considered that non-specific factors, such as motivation, may play an important role in real-world settings, as indicated by previous Danish research [46].

In several previous studies yoga was combined with other interventions – such as other mind-body interventions or exercise interventions – making it difficult to assess the effects of yoga specifically [12]. In this study, the yoga intervention was an add-on to conventional treatment, but was not combined with any other CIH intervention, which is considered as a strength.

5. Conclusion

The results of the present pilot study indicate that a course of yoga may improve body awareness among PwMS. Possible benefits from an improved body awareness among PwMS related to an enhancement of the patients' ability to adjust various activities is a relevant area for future investigation.

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Ethical statement

Written informed consent was obtained from all participants after reading the participant information. The study adhered to the EU general Data Protection Regulation.

The study was reported to the administration of the Danish National Committee on Health Research Ethics who decided that a formal review and approval were not necessary for this study as the intervention was mild and non-invasive. The study adhered to the EU General Data Protection Regulation.

CRediT authorship contribution statement

Signe Reitzel Gunnersen: Drafting/revising the manuscript, analysis or interpretation of data, accepts responsibility for conduct of research and final approval, statistical analysis. Kirsten Hanehøj: Revising the manuscript, study concept or design, analysis or interpretation of data, accepts responsibility for conduct of research and final approval, statistical analysis. Signe Gro and Clara Mosborg Petersen: Revising the manuscript, analysis or interpretation of data, accepts responsibility for conduct of research and final approval. Lasse Skovgaard: Revising the manuscript, study concept or design, analysis or interpretation of data, accepts responsibility for conduct of research and final approval, study supervision.

Declaration of conflicting interests

None.

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