Advantage of meditation over exercise in reducing cold and flu illness is related to improved function and quality of life

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Purpose To examine whether apparent advantages following training in meditation over exercise can be attributed to specific symptoms, functional impairments, or quality-of-life indicators assessed by the Wisconsin Upper Respiratory Symptom Survey (WURSS-24).

Methods Results from the randomized controlled trial "Meditation or Exercise for Preventing Acute Respiratory Illness" showed mean global severity and total days of illness were worse in control (358, 8·9) compared with exercise (248, 5·1) or meditation (144, 5·0). Global severity of illness was estimated using area under the curve from daily self-reported severity scores on the WURSS-24. For this project, we estimated within-group WURSS item-level severity and between-group effect sizes (Cohen's "d" statistic) relative to control. The item-level effect sizes were grouped into (i) symptom and (ii) function and quality of life domains.

Results Among the three groups, mediators showed the lowest severity estimates for 21 of 22 WURSS items. Item-level Cohen's "d" indicated most benefit was evident in WURSS items representing function and quality of life. Compared with exercise, meditation fostered larger reductions in illness severity, although due mostly to improved function and the quality of life domain ($d = -0.33$, $P < 0.001$) compared with symptom domain ($d = -0.22$, $P < 0.001$).

Conclusions The apparent advantage of training in meditation over exercise for reducing cold and flu illness is explained more by improved function and quality of life than by a reduction in symptom severity.

Keywords Acute respiratory infection, exercise, function and quality of life, meditation.

Introduction

Improved immune vigor attributable to exercise or reduced stress[1,2] may prevent or reduce the burden of acute respiratory infection (ARI) illness.[3] Acute respiratory infection illness includes both the common cold and influenza and is a major cause of morbidity and mortality in the United States and elsewhere.[4,5] It affects people of all ages with average incidence of 6–8 occurrences/year in children and 2–3 occurrences/year in adults.[6–8] The burden of non-influenza ARI illness in the United States has been estimated to average $40 billion per year with corresponding 189 million missed school days and 126 million missed work days.[9,10] With no current effective therapy, health-enhancing preventive strategies such as meditation and exercise may not only lessen disease burden, but may lead to substantial quality-of-life benefits and healthcare cost reductions (U.W. Madison, unpublished observation; Rakel *et al.,* 2012, submitted).

Mindfulness meditation has been reported to improve quality of life and psychological well-being.[11] Previous research has shown that exercise may play a role in the prevention of ARI illness, reducing both infection and duration of symptoms.[12,13] However, prior to ours, no study had evaluated potential differential effect between training in meditation and exercise. Our randomized controlled trial entitled Meditation or Exercise for Preventing Acute Respiratory Illness (MEPARI) examined the benefits of these two interventions for reducing ARI illness using the validated Wisconsin Upper Respiratory Symptom Survey

(WURSS).[3] Meditation or exercise for preventing acute respiratory illness findings not only showed that regular meditation and exercise can influence ARI outcomes but suggested an advantage of meditation compared with exercise. The duration (mean days) and global severity of illness (mean area under the curve) were least for meditation (5·0, 144) compared with exercise (5·1, 248) and control (8·9, 358).

Methods used to develop and validate the WURSS instrument have been described previously.[14,15] Briefly, the WURSS instrument is a self-reporting survey that not only measures both ARI symptoms and impact on daily life activities, but also reflects overall changes in illness severity with time. It was designed and validated as a patient-oriented self-report evaluative outcome instrument for use in clinical trials. The instrument was developed using iterative mixed methods, semi-structured interviews, and focus groups.[14] Utilizing importance to patients and responsiveness as major standards, the WURSS-21 was derived from the WURSS-44 and then independently validated.[15] The WURSS-21 contains one item rating global illness severity ("how sick do you feel today?"), 10 items rating specific symptoms (including runny nose and sneezing), nine items rating function and quality of life (including interference with ability to think clearly and interact with others), and one item rating daily change ("compared to yesterday, I think my cold is…"). Items assessing influenza-like symptoms (fever, headache, and muscle aches) taken from the WURSS-44 were added to the WURSS-21 to create the WURSS-24, which was used in the MEPARI study.

The objective of this analysis was to investigate the differences in ARI global severity ratings following training in exercise versus meditation, as compared to results for matched control participants. Our main results of primary outcome paper looked at global severity based on summing scores of WURSS items each day and then calculating area under the curve over the entire illness. The specific aim of this study was to identify specific WURSS items or domain levels that accounted for the differences in symptom severity or function and quality-of-life estimates between moderate-intensity exercise and mindfulness meditation. This would not only help describe the apparent advantage of meditation over exercise but may help identify WURSS items with the greatest impact during ARI illness.

Methods

The MEPARI trial took place in University of Wisconsin facilities from September 2009 to May 2010, randomizing 154 participants into meditation, exercise, or wait-list observational control groups. Recruitment targeted healthy community residents in Madison, WI, and the surrounding area who were ≥50 years of age and reported at least one cold per year. Previous meditation training, engagement in moderate exercise (more than twice per week), and histories of autoimmune or immunodeficiency diseases were reasons for exclusion. Eligible participants were screened by telephone interviews, met personally for informed consent, and enrolled in a 2-week run-in trial to assess adherence. The run-in trial involved providing contact information and completion of baseline and data collection questionnaires.

Participants were randomized on successful completion of the run-in trial in two cohorts ($n = 94$ in cohort 1 and $n = 60$ in cohort 2). Cohort 1 began the interventions in September 2009, while cohort 2 began in January 2010. Both cohorts were monitored until May 2010. Five participants dropped out before any study data could be gathered. Reasons for withdrawal were as follows: health needs following unrelated diagnosis of uterine cancer, displeasure at control group assignment, need to take care of elderly parents, refusal to get the protocol-required influenza vaccine, and conflict with changed work schedule. Participants in the intervention groups received 8 weeks of training in either mindfulness meditation or moderate-intensity sustained exercise. Meditation training followed the Mindfulness-Based Stress Reduction (MBSR) program developed by Jon Kabat-Zinn *et al.* at the University of Massachusetts Medical Center. The exercise program was matched to the MBSR program in terms of attention, location, and duration of class time and home practice. Exercise intensity was assessed using Borg's Rating of Perceived Exertion[16] and included jogging and walking. Both meditation and exercise were matched based on weekly two-and-half-hour group sessions and daily 45-minute home practices and assessed using Mindfulness Attention Awareness Scale[17] and International Physical Activity Questionnaire,[18] respectively.

Biweekly telephone and bimonthly in-person interviews were used for monitoring study participants including control group. Participants who reported a new ARI were encouraged to complete the WURSS instrument once daily from the first symptom until at least a day or 2 after the illness had resolved. The start and finish of a cold were marked, respectively, following two consecutive daily answers of "Yes" to either "Do you think you are coming down with a cold?" or "Do you think you have a cold?" and "No" to "Do you think that you are still sick with this infection?" Each illness required a score of ≥2 on the Jackson scale, including sneezing, sore throat, nasal discharge, or obstruction. WURSS-24 was used for self-reporting daily symptoms including fever on a scale ranging from "0" – do not have this symptom to "7" – severe. The protocol did not include thermometer measurement of body temperature. Additionally, multiplex PCR was used to identify specific viruses. Meditation or exercise for preventing acute respiratory illness was funded by the National

Center for Complementary and Alternative Medicine (NCCAM) and was approved and monitored by the U.W. Institutional Review Board (IRB).

The primary outcomes of the MEPARI study were incidence, duration, and global severity of ARI illness. Duration was assessed as total days of ARI illness. Date and time were assessed at beginning and end of illness. Global severity was calculated using area-under-the-curve (AUC) trapezoidal approximations, with WURSS-24 severity as the *y*-axis and duration as the *x*-axis, such that low AUC indicates lesser overall (global) severity.

A total of 149 participants completed the trial (82% women, 94% white, mean age $59.3 \pm$ SD 6.6 years) (Table 1). Fifty-five percent ($n = 28$) of the control group reported a total of 40 ARI episodes, while 36% ($n = 17$) of the exercise and 41% ($n = 21$) of the meditation groups reported 26 and 27 ARI episodes, respectively. The control group also reported the worst global illness severity (average score, 358) and a longer duration of illness (mean days = 8.9). Although exercise and meditation groups reported similar illness durations (average 5.1 and 5.0 days, respectively), their global illness severities differed with exercise reporting more severe colds (mean = 248) than meditation group (mean = 144; Figure 1).

On the basis of these differential effects, we thought it of value to analyze the individual WURSS items to better understand which items accounted for the apparent advantage of training in meditation over exercise.

Statistical analysis

For this study, global severity AUC estimates were calculated by first summing severity scores over time from 22 WURSS items and then applying trapezoidal approximation. These estimates also formed the primary outcome of the MEPARI trial. The first and last WURSS-24 items were not included in the daily summary scores because they referred to different time frames and were analyzed separately. Following intention-to-treat principles, we averaged ARI severity scores across all randomized participants for whom we had follow-up data.

To explore the potential differences in global illness severities, we conducted an item-level analysis. The WURSS items were grouped into two domains: (i) symptom severity and (ii) impact on function and quality of life. Cohen's "*d*" statistics[19] were used for all individual item and domain effect size estimations. SAS® version 9.2 and NCSS®2007 statistical programs[20,21] were used for analyses.

Results

For 21 of the 22 WURSS items, mean AUC global severity scores were lowest for the meditation condition, next lowest for exercise, and highest for control (Table 2 and Figure 2). Among the 22 items, only fever did not follow this pattern, as the fever reports were slightly higher in exercisers, as compared to control. Mean fever scores were lowest among all items, while the highest severity estimates were feeling tired (for exercise and control) and plugged nose (for meditation).

Using Cohen's *d* statistic to estimate overall effect size differences in illness severity between meditation and control groups (based on AUC scores), meditation appeared to significantly reduce severity by 0.4 standard deviation units ($d = -0.4$, $P < 0.001$). Exercise showed a lower magnitude of reduction in severity by 0.2 standard deviation units, although still statistically significant ($d = 0.2$, $P < 0.001$) when compared with control (Table 3).

Grouping the WURSS items into symptom severity versus impact on function and quality of life suggested a disparity between these two domains. Compared with

Table 1. Demographic characteristics of meditation or exercise for preventing acute respiratory illness study population

Randomized groups	Exercise (*n* = 47)	Meditation (*n* = 51)	Control (*n* = 51)
Demographics			
Age (years), Mean (SD)	59·0 (6·6)	60·0 (6·5)	58·8 (6·8)
Female, *n* (%)	39 (83·0)	42 (82·4)	41 (80·4)
Non-smokers, *n* (%)	43 (91·5)	48 (94·1)	48 (94·1)
Race white, *n* (%)	43 (91·5)	49 (92·5)	48 (94·1)
Ethnicity non-hispanic, *n* (%)	47 (100)	51 (100)	49 (96·1)
BMI mean (SD)	29·0 (6·9)	29·0 (6·0)	29·8 (6·8)
College graduate or higher, *n* (%)	27 (57·4)	36 (70·6)	35 (68·6)
Income > $50 000, *n* (%)*	25 (53·2)	31 (60·8)	29 (56·9)

BMI, Body mass index (weight/height^2).
*Missing information on income from meditation group (*n* = 2).

Figure 1. Mean global severity and duration of illness from meditation or exercise for preventing acute respiratory illness (MEPARI) study. AUC = Area under the curve severity estimates calculated as trapezoidal approximations using daily scores on Wisconsin Respiratory Symptom Survey and duration of illness. Duration of illness calculated in hours and minutes and then converted to decimalized days of reported illness.
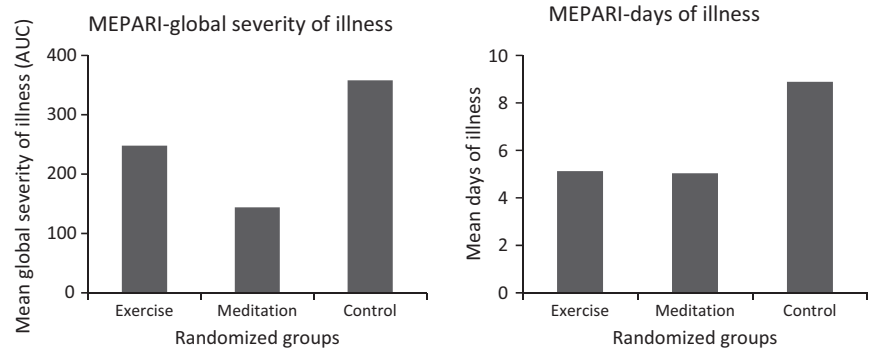
Table 2. WURSS* item-level mean severity estimates (within groups)

WURSS items	Meditation (n = 51) Mean AUC** (95% CI***)	Exercise (n = 47) Mean AUC** (95% CI***)	Control (n = 51) Mean AUC** (95% CI***)
Runny nose	9·029 (3·14, 14·92)	11·19 (2·87, 19·52)	20·75 (10·32, 31·19)
Plugged nose	10·16 (4·60, 15·71)	11·87 (2·57, 21·18)	18·24 (10·50, 25·97)
Sneezing	7·24 (2·47, 12·00)	9·54 (1·42, 17·66)	10·84 (5·91, 15·77)
Sore throat	5·16 (1·065, 9·25)	9·60 (2·081, 17·11)	10·43 (5·54, 15·32)
Scratchy throat	4·90 (0·95, 8·85)	9·14 (1·79, 16·48)	12·79 (6·79, 18·80)
Cough	7·65 (2·39, 12·90)	15·65 (6·18, 25·12)	20·10 (11·46, 28·73)
Hoarseness	8·41 (2·56, 14·26)	9·36 (2·072, 16·65)	13·29 (5·94, 20·65)
Head congestion	9·25 (4·059, 14·45)	11·96 (2·62, 21·29)	19·34 (11·023, 27·66)
Chest congestion	6·23 (1·76, 10·69)	11·50 (2·27, 20·73)	13·50 (6·24, 20·76)
Headache	5·54 (1·97, 9·11)	8·73 (1·84, 15·63)	12·22 (7·13, 17·30)
Body ache	4·59 (1·55, 7·63)	10·16 (2·22, 18·10)	11·36 (6·39, 16·34)
Fever	1·84 (−0·090, 3·78)	3·87 (−0·15, 7·89)	2·48 (0·67, 4·29)
Feeling tired	9·059 (4·090, 14·03)	17·19 (6·54, 27·84)	24·99 (15·69, 34·29)
Think clearly	4·80 (2·053, 7·55)	9·41 (2·46, 16·37)	15·44 (8·52, 22·37)
Sleep well	6·049 (2·47, 9·63)	14·00 (5·39, 22·61)	20·12 (11·73, 28·51)
Breathe easily	8·059 (3·75, 12·37)	13·22 (4·60, 21·85)	21·25 (12·88, 29·61)
Exercise, walk, or climb stairs	6·90 (2·94, 10·87)	14·11 (4·74, 23·47)	19·51 (10·54, 28·48)
Accomplish daily activities	6·49 (2·59, 10·39)	12·87 (4·31, 21·44)	19·60 (11·25, 27·94)
Work outside the home	4·77 (1·48, 8·067)	10·91 (3·00, 18·83)	14·86 (7·90, 21·83)
Work inside the home	6·21 (2·35, 10·064)	12·49 (4·049, 20·93)	19·020 (10·74, 27·30)
Interact with others	5·52 (2·20, 8·84)	10·38 (2·51, 18·25)	18·68 (10·32, 27·034)
Live your personal life	5·76 (2·22, 9·31)	11·22 (3·35, 19·10)	19·078 (10·62, 27·53)

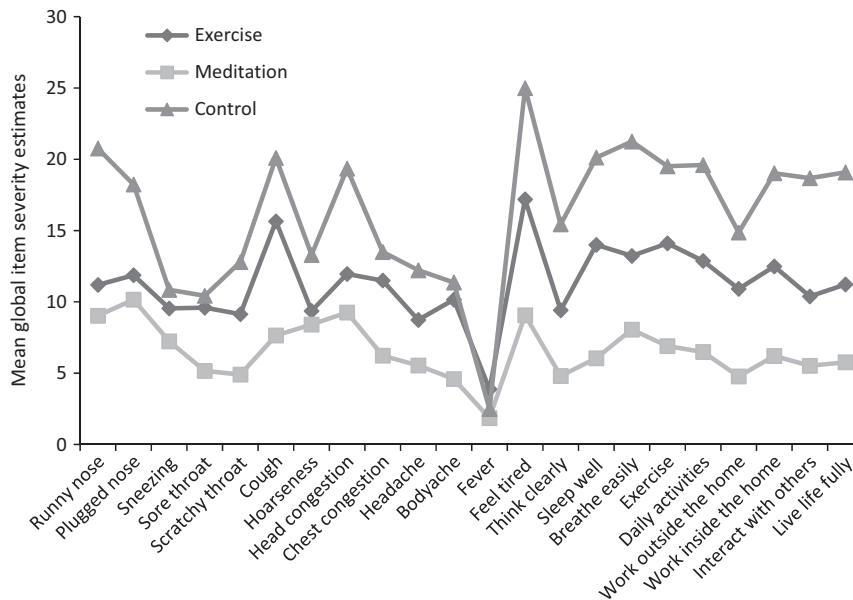*Wisconsin Upper Respiratory Symptom Survey data from participants with acute respiratory infection illness.
**Area under the curve.
***95% confidence interval.

controls, meditation significantly reduced severity of ARI illness by 0·3 standard deviation units ($d = −0·3$, $P < 0·001$) within the symptom severity domain and showed improved reduction by 0·6 standard deviation units ($d = −0·6$, $P < 0·001$) in the function and quality of life domain. Within the function and quality of life domain, exercise reduced the severity of illness relative to controls by 0·2 standard deviation units ($d = −0·2$, $P < 0·001$). This trend was also reflected in the symptom severity domain,

but the magnitude was more marginal ($d = −0·1$, $P = 0.04$).

Comparing the effects of the interventions with all items included, meditation elicited significantly better overall reduction in illness severity ($d = −0·3$, $P < 0·001$), as compared to exercise. Similar trends were also observed among the other clustered domains. The function and quality of life impairment domain ($d = −0·3$, $P < 0·001$) was responsible for more of the benefit from the interventions

Figure 2. Graphical display of mean WURSS [†]item severity estimates [Wisconsin Upper Respiratory Symptom Survey data from participants with acute respiratory infection (ARI) illness] item severity estimates. Global item severity estimates calculated using area under the curve trapezoidal approximation of the WURSS scores and duration of illness. [‡]Wisconsin Upper Respiratory Symptom Survey data from participants with ARI illness. Global item severity estimates calculated using area-under-the-curve trapezoidal approximation of the WURSS scores and duration of illness.

when compared with the symptom severity domain ($d = -0.2$, $P < 0.001$).

Discussion

The results from the MEPARI trial indicate that training in meditation evoked a larger reduction in global ARI illness severity as compared to exercise or the wait-list control participants. This significant impact was found among individual, subgrouped, and the overall pooled WURSS items. Compared with exercise or control, subjects who were meditating reported the lowest severity estimates on 21 of 22 items of the WURSS. Because these trends consistently favor meditation over exercise, and exercise over control, it is unlikely that the findings are due to chance only. Fever displayed the least sensitivity to the intervention of all WURSS items, but was lowest in meditation and highest in control. The finding of low reporting of fever-inducing infections is consistent with the low prevalence of flu during the 2009–2010 influenza season.

Although both interventions appeared effective, exercise appeared to confer less protection from ARI illness severity in this study than did meditation. Our study shows ARI severity was reduced in the exercise group compared with the control group, but MBSR reduced it even more. Nevertheless, this finding agrees with prior literature which shows moderate-intensity exercise not only improves the immune system but also reduces incidence of ARI illness.[22,23] Our study and others also support the general health benefits of exercise for preventing ARI illness.[12] In a recent 12-week study involving 1002 adults, Nieman *et al.*[13] reported reductions in duration and severity of ARIs with exercise.

Quality of life and function during ARIs appeared to be improved with both exercise and meditation, consistent with the known and hypothesized health benefits of these behaviors. The additional impact of meditation on our measures of function and quality of life beyond symptom severity reduction may be an important finding. This effect may reflect the psychological and perceptual benefits of mindfulness meditation, which help people to be more aware of bodily sensations without being distressed by them.[24]

These findings demonstrate the clinical value of assessing daily and functional activities of individuals during an illness episode.[25] Adequate assessments of quality of life and function as well as symptom severity are essential if we are to understand the full impact of ARIs in the course of investigating the value of preventive and therapeutic interventions.

The conclusions from this study may be limited by the following: (i) potential biases resulting from self-report, perhaps related to expectancy, placebo, or Hawthorne effects; (ii) relatively small number of participants who had an ARI during the MEPARI trial; or (iii) possibility of less symptom reporting during the late phase of illness, which may be associated with resolution of natural colds.[26]

Nevertheless, the findings were strengthened by rigorous methodology of a randomized clinical trial, high retention of participants, and the use of a validated instrument for capturing both symptom and quality-of-life measures. The analyses were further substantiated by the use of item-level effect size estimations. Although many researchers have tended to pay more attention to statistical significance rather than effect size, the use and understanding of effect

Table 3. WURSS* item-level effect size estimates (between groups)

WURSS items	Exercise (n = 47) versus control (n = 51) ''d'' (95% CI)	Meditation (n = 51) versus control (n = 51) ''d'' (95% CI)
Symptom severity domain		
Runny nose	−0·29 (−0·68, 0·11)	−0·39 (−0·78, 0·0054)
Plugged nose	−0·21 (−0·61, 0·18)	−0·33 (−0·73, 0·056)
Sneezing	−0·056 (−0·45, 0·34)	−0·21 (−0·60, 0·18)
Sore throat	−0·038 (−0·43, 0·36)	−0·33 (−0·72, 0·064)
Scratchy throat	−0·16 (−0·55, 0·24)	−0·43 (−0·83, −0·041)
Cough**	−0·14 (−0·54, 0·26)	−0·49 (−0·88, −0·092)
Hoarseness	−0·15 (−0·55, 0·24)	−0·21 (−0·59, 0·18)
Head congestion	−0·24 (−0·64, 0·16)	−0·41 (−0·80, −0·032)
Chest congestion	−0·069 (−0·47, 0·33)	−0·34 (−0·73, 0·054)
Headache	−0·17 (−0·56, 0·23)	−0·42 (−0·82, −0·032)
Body ache	−0·053 (−0·45, 0·34)	−0·46 (−0·85, 0·066)
Fever	0·13 (−0·27, 0·53)	−0·095 (−0·48, 0·29)
Pooled effect size	−0·12 (−023, −00051)	−0·34 (−0·45, −0·23)
Difference between intervention effects***	−0·22 (−0·32, −0·12)	
Impact on function and quality of life domain		
Feeling tired**	−0·22 (−0·62, 0·17)	−0·60 (−0·99, −0·20)
Think clearly	−0·25 (−0·65, 0·15)	−0·56 (−0·96, −0·17)
Sleep well**	−0·21 (−0·60, 0·19)	−0·61 (−1·010, −0·21)
Breathe easily	−0·27 (−0·67, 0·13)	−0·55 (−0·95, −0·16)
Exercise walk or climb stairs**	−0·17 (−0·57, 0·23)	−0·51 (−0·90, −0·11)
Accomplish daily activities	−0·23 (−0·62, 0·17)	−0·56 (−0·96, −0·17)
Work outside the home	−0·15 (−0·55, 0·25)	−0·52 (−0·91, −0·12)
Work inside the home	−0·22 (−0·62, 0·17)	−0·55 (−0·95, −0·16)
Interact with others	−0·29 (−0·69, 0·11)	−0·58 (−0·97, −0·18)
Live your personal life	−0·27 (−0·67, 0·13)	−0·57 (−0·97, −0·18)
Pooled effect size	−0·23 (−0·35, −0·10)	−0·56 (−0·69, −0·44)
Difference between intervention effects***	−0·33 (−0·37, −0·30)	
Combined WURSS items		
Overall Pooled effect size	−0·17 (−0·25, −0·084)	−0·44 (−0·52, −0·36)
Difference between intervention effects***	−0·27 (−0·35, −0·20)	

''d'', Cohen's standardized effect size (computed using mean, standard deviation, and sample size); CI, confidence interval.
*Wisconsin Upper Respiratory Symptom Survey data from participants with acute respiratory infection illness.
**Items significant on probability analysis (two-sided $P < 0.05$).
***Two-sample t-test used to compare intervention effects between exercise and meditation.

size has gained a growing following among those interested in clinical and translational research, evidence-based medicine, and comparative effectiveness.[19,27,28]

In conclusion, previous research has suggested that behavioral interventions, such as mindfulness meditation or regular, moderate-intensity exercise, can enhance health by improving immune[29,30] and psychosocial functions.[11] Exercise has previously been reported to reduce the risk, severity, and duration of ARIs.[13] The MEPARI trial suggests that both moderate-intensity exercise and mindfulness meditation may prevent ARIs and reduce the impact and that mindfulness meditation may be the more potent of the two interventions. This report extends knowledge gained from the MEPARI trial by examining the impact at an item-level analysis of symptoms, function, and quality of life. The analyses indicate that training in mindfulness meditation may provide even greater benefit than exercise in reducing overall illness severity, attributable more to improved function and quality of life than to the severity of specific symptoms.

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Author contributions

Chidi N. Obasi was the lead author for this study and is responsible for the analysis and generation of the manuscript. All co-authors contributed substantially and approved the final version of this report.

Conflicts of interest

The authors have no conflict of interests pertaining to this work.

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