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Efficacy of Heartfulness Meditation in Moderating Vital Parameters - A Comparison Study of Experienced and New meditators

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ABSTRACT

Objective: *To analyse and compare the effect of a 30-minute Heartfulness meditation session on vital parameters of experienced and new meditators.* ***Methodology:*** *The study conducted on a mixed group of participants include both experienced and new meditators of various age groups, Body Mass Index (BMI); patients with known illness as well as healthy volunteers. Variations in heart rate, respiratory rate and systolic blood pressure is recorded before and after a 30-minute heartfulness meditation session and analysed statistically.* ***Results:*** *At baseline, average heart rate (HR) and systolic blood pressure (SBP) is significantly lower in experienced meditators compared to new meditators. Heartfulness meditation is highly significant in moderating HR, RR and SBP.* ***Conclusion:*** *A 30-minute session of Heartfulness meditation produces significant relaxation of the autonomic nervous system and favourably moderates basic vital parameters across all groups. This influence is higher in New meditators particularly the younger group probably because stress is more amplified due to greater responsibilities in life and meditation is an effective tool in reducing stress. The enthusiasm and open mindedness of youth to try new things is also contributing factor for getting better benefits from the heartfulness meditation session. In the case of experienced meditators, the elderly group showed greater changes, probably because they put in the time and effort to pursue the practice of meditation seriously, and thus able to derive a greater benefit.*

Keywords: Fine needle aspiration cytology, Pilomatrixoma, Salivary gland Heartfulness meditation, Heart rate, Respiratory rate, Systolic blood pressure

Abbreviations: BMI: Body Mass Index; HR: Heart Rate; RR: Respiratory Rate; BP: Blood Pressure; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; Bpm: Beats Per Minute.

INTRODUCTION

Traditionally, vital signs have been described as body temperature, pulse, respiratory rate, and blood pressure. These basic and essential measurements indicating the status of the body's life sustaining functions, aids a clinician to determine health or disease and life or death. An abnormality in vital signs is often the earliest indicator of a progressive disease. The outcome of most lifestyle enhancement programs is to achieve a balanced and well-regulated human body where the vital parameters assume normal values.

Heart rate (HR) is a predictor of major cardiovascular events in both general population and patients with cardiovascular diseases. The total number of heartbeats in a lifetime remains fairly constant across species and there is an inverse

relationship between resting heart rate and life expectancy [1]. The association between resting HR and mortality has also been observed in elderly patients and in patients with hypertension and metabolic syndrome [2].

The resting heart rate of a human adult is about 70-75 beats per minute (bpm) [3], while an adolescent's is about 80-100 bpm. Women generally have higher HR than men, and this difference ranges from 3-7 bpm. Although the effect of age on HR is not well established, most studies have shown that HR tends to decrease with age [2]. In multivariate regression analysis, HR has been shown to decrease by 0.13 bpm per year in adulthood [2].

The normal limits of resting heart rate are not yet established. The reference range in adults is normally between 60 bpm (rates below this are termed bradycardia) and 90 bpm (rates above this are termed tachycardia). Several epidemiological and physiological studies have shown a significant correlation between HR and blood pressure. HR progressively increases with ascending quintiles of systolic and diastolic BP. However, HR is more strongly associated with systolic BP; this relationship being more apparent among males [4].

Blood pressure (BP) refers to the pressure exerted by blood against the arterial wall. It is influenced by cardiac output, peripheral vascular resistance, blood volume and viscosity as well as vessel wall elasticity [5]. The heart pushes blood through the arteries during contraction that creates a force called the systolic blood pressure. When the heart relaxes between beats, the diastolic blood pressure is measured. BP measurements are vitals they provide an indication of the capacity to deliver oxygen to the cells. When BP rises or goes below the normal range, it indicates a dysfunctional physical process or an effort by the body to maintain homeostasis.

Variations in BP are normal due to lifestyle changes such as exercise, medication, and sleep quality. Progressively increasing BP is a sign of impending cardiovascular disease. Isolated hypertension can be caused by underlying conditions such as artery stiffness, hyperthyroidism, diabetes, or heart valve problems. It is the most common form of high blood pressure in people above the age of 60, even though younger persons are also likely to be affected.

Having a high systolic pressure for a long period of time can increase the risk of having significant cardiovascular problems such as stroke, heart disease and chronic kidney disease. Increased levels of sympathetic activity are also associated with increased rates of cardiovascular morbidity [6].

The sex hormones act as defenders of the cardiovascular system in women. Oestrogen enhances vascular dilatatory mechanisms and baroreflex regulation [7]. Women have reduced sympathetic nervous system activity, augmented sympathetic inhibition and higher cardiac vagal tone as compared to men [7-11].

Respiratory rate is the number of breaths per minute which is usually 12 to 20 for an adult at rest. An abnormal RR with values outside the range of the specified values is usually due to various psychological disorders, cardiorespiratory problems and several other comorbidities as well as effects of narcotic usage or drug overdose [12].

Autonomic nervous system links brain and body [13]. Several researchers have studied the effects of yogic practices on autonomic nervous system [14-17]. It has been found that such yogic practices improve the efficiency of cardio respiratory system [18-26].

When conventional medicine becomes ineffective in improving circulation and optimizing vital parameters, alternate mind-body therapies such as meditation is considered as a complementary treatment option.

Meditation induces a state of deep relaxation and calmness. This is due to the changes produced in pertinent areas of the brain which improves the performance of the brain and circulatory system. The heart pumps slowly and steadily; significantly reduces the possibility of overload; as a result, there is less likelihood of stress and fatigue [27-29].

MATERIALS AND METHODS

The study is conducted at Free Medical Centre (FMC), Babuji Memorial Ashram, Manapakkam, Chennai from 1st March 2017 to 31st May 2017. The participants are predominantly out-patients with minor health problems such as skin ailments, allergies, minor injuries, gastro intestinal complaints as well as individuals who are accompanying the patients. Experienced meditators practicing heartfulness meditation for at least 1 hour a day, for 6 days a week for a period of at least 1 year and new or first-time meditators are among those who volunteered. Demographic information such as age, sex, height, weight, BMI, known chronic comorbidities, known mental illness and current medications are collected. Each participant is explained in detail about the study process and, appropriate consent is taken before the start of the session.

A 30-minute heartfulness meditation session is conducted by a certified heartfulness trainer and the vital parameters are recorded at the beginning and again at end of the session.

Individuals who have taken medications known to alter HR, RR, and BP (Anti-hypertensive, sedatives, anti-histamines etc.) within the last 12 hours are excluded from the study. Heart rate, respiratory rate and blood pressure in the right upper arm are recorded using a digital multipara monitor-Philips Intellivue MP20.

Data analysis

The total number of participants who volunteered for the study is 151, of which 17 come under the exclusion criteria, and the rest 134 are included for final analysis. Data collected from individuals is verified for completeness of information before they are fed into a statistical package for analysis. Mean, standard deviation, t and p values are analysed for baseline and post meditation recordings. Box and whisker plots are made for the vital parameters; box plots to represent the median and the interval between 25% and 75% percentiles and whisker plots to indicate the range.

RESULTS

Table 1 Distribution of demographic profile

Variables	New meditators n (%)	Experienced meditators n (%)
Age (in years)		
18-25	12 (15)	3 (5.5)
25-40	21 (26.3)	11 (20.4)
40-60	28 (35)	19 (35.2)
Above 60	19 (23.7)	21 (38.9)
Gender		
Female	51 (66.2)	26 (33.8)
Male	29 (50.8)	28 (49.1)
BMI		
<18.5 (Underweight)	9 (75)	3 (25)
18.5-24.9 (Normal)	31 (55.4)	25 (44.6)
25-29.9 (Overweight)	22 (64.7)	12 (35.3)
≥ 30 (Obese)	18 (56.3)	14 (43.7)

Overall 80 participants are new meditators, and the remaining 54 are experienced meditators. Demographic profile of each group is depicted in Table 1.

Table 2 Overall comparison of vital data between experienced meditators and new meditators at baseline

Variables		Test Value = 0					
		T	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Experienced Meditators	Heart Rate at Baseline	46.094	53	0.00*	83.1481	79.53	86.766
	Respiratory Rate at Baseline	89.615	53	0.00*	22.1481	21.652	22.644
	Systolic BP at Baseline	48.539	53	0.00*	129.1481	123.811	134.485
New meditators	Heart Rate at Baseline	62.236	79	0.00*	83.2	80.539	85.861
	Respiratory Rate at Baseline	69.298	79	0.00*	21.2875	20.676	21.899
	Systolic BP at Baseline	55.548	79	0.00*	132.1625	127.427	136.898

In this study, the baseline values of heart rate and systolic BP are significantly lower in experienced meditators as compared to new meditators (Table 2).

Table 3 Duration (in years) of experienced meditators practicing meditation

Experienced Meditators	N	Minimum	Maximum	Mean	Std. Deviation
	54	1	51	15.5217	12.48553

The average duration of practice of meditation in the case of experienced meditators in the study varies between 1 to 51 years. Mean value is 15.52 ± 12.5 years (Table 3).

Table 4 Sub group analysis of heart rate before and after heartfulness meditation for experienced meditators and new meditators

Parameters	Before Meditation (mean ± SD)	After Meditation (mean ± SD)	't '	P-Value
Experienced meditators				
Heart rate in female (n=26)	83.462 ± 12.7286	79.808 ± 10.1628	2.612	0.015*
Heart rate in male (n=28)	82.857 ± 13.9542	77.786 ± 11.8552	4.371	0.000*
Heart rate below 40 yrs (n=14)	84.143 ± 13.8833	79.071 ± 10.9998	2.711	0.018*
Heart rate above 40 yrs (n=40)	82.800 ± 13.1932	78.650 ± 11.1598	4.01	0.000*
Heart rate below 25 BMI (n=28)	80.571 ±12.9026	76.679 ±10.6703	3.197	0.004*
Heart rate above 25 BMI (n=26)	85.923 ±13.3144	81.000 ±11.1463	3.651	0.001*
Heart rate in patients (n=24)	81.867 ± 13.1483	77.300 ± 10.1239	3.588	0.001*
Heart rate in non-patients (n=30)	84.750 ± 13.4948	80.583 ± 12.0069	3.254	0.004*
New meditators				
Heart rate in female (n=51)	85.373 ± 12.2604	78.510 ± 10.8118	6.07	0.000*
Heart rate in male (n=29)	79.379 ± 10.5472	75.966 ± 9.9301	2.786	0.009*
Heart rate below 40 yrs (n=33)	84.273 ± 13.3446	77.788 ± 11.3599	3.567	0.001*
Heart rate above 40 yrs (n=40)	82.447 ± 10.9660	77.447 ± 9.9931	6.808	0.000*
Heart rate below 25 BMI (n=40)	84.175 ± 11.6880	76.200 ±10.0720	6.093	0.000*
Heart rate above 25 BMI (n=40)	82.225 ± 12.2903	78.975 ± 10.8781	3.23	0.003*
Heart rate in patients (n=45)	83.743 ± 12.1203	79.486 ± 11.3510	3.63	0.001*
Heart rate in non-patients (n=35)	76.111 ± 9.6771	82.778 ± 11.9485	5.464	0.000*

The effect of heartfulness meditation in both experienced and new meditators is significant in reducing heart rate across all age groups, in both sexes irrespective of their comorbidity and obesity status. The p-value is highly significant at $p<0.05$ (Table 4).

Table 5 Sub group analysis of respiratory rate before and after heartfulness meditation for experienced meditators and new meditators

Parameters	Before meditation (mean ± SD)	After meditation (mean ± SD)	't '	P-Value
Experienced meditators				
Respiratory rate in female (n=26)	22.077 ± 12.7286	21.308 ± 13.9542	2.301	0.030*
Respiratory rate in male (n=28)	22.214 ± 10.1628	21.143 ± 11.8552	3.217	0.003*
Respiratory rate below 40 yrs (n=14)	22.000 ± 1.9215	21.143 ± 1.2924	1.578	0.139
Respiratory rate above 40 yrs (n=40)	22.200 ± 1.8003	21.250 ± 1.6132	3.681	0.001*
Respiratory rate below 25 BMI (n=28)	22.143 ± 2.0315	21.071 ± 1.5853	2.948	0.007*
Respiratory rate above 25 BMI (n=26)	22.154 ±1.5923	21.385 ± 1.4718	2.606	0.015*
Respiratory rate in patients (n=24)	22.400 ± 1.6938	21.400 ± 1.5888	3.181	0.003*
Respiratory rate in non-patients (n=30)	21.833 ± 1.9486	21.000 ± 1.4446	2.318	0.030*
New meditators				
Respiratory rate in female (n=51)	21.765 ± 12.2604	20.490 ± 10.8118	2.919	0.005*
Respiratory rate in male (n=29)	20.448 ± 3.4598	18.931 ± 4.3747	2.786	0.009*
Respiratory rate below 40 yrs (n=33)	20.182 ± 3.1370	18.121 ± 4.3067	3.23	0.003*
Respiratory rate above 40 yrs (n=47)	22.064 ± 2.1509	21.191 ± 2.7555	2.679	0.010*
Respiratory rate below 25 BMI (n=40)	21.200 ± 3.1639	19.775 ± 3.8927	3.229	0.003*
Respiratory rate above 25 BMI (n=40)	21.375 ± 2.2948	20.075 ± 3.6961	2.626	0.012*
Respiratory rate in patients (n=45)	22.343 ± 2.0856	21.886 ± 1.5295	1.39	0.174
Respiratory rate in non-patients (n=35)	20.467 ± 2.9357	18.400 ± 4.2821	4.085	0.000*

Among the experienced meditators, respiratory rate is significantly reduced in both sexes, irrespective of their comorbidity and obesity conditions, the p-value is highly significant at $p<0.05$. This reduction however does not reach statistical significance in the case of participants in the age group of less than 40 years.

In the case of new meditators, respiratory rate is significantly reduced in both sexes, across all age groups irrespective of obesity status, the p-value is highly significant at $p<0.05$. This reduction however does not reach statistical significance in participants with comorbidities (Table 5).

Table 6 Sub group analysis of systolic BP before and after heartfulness meditation for experienced meditators and new meditators

Parameters	Before meditation (mean ± SD)	After meditation (mean ± SD)	't '	P-Value
Experienced meditators				
Systolic BP in female (n=26)	125.808 ± 19.6612	125.038 ± 23.2301	0.298	0.768
Systolic BP in male (n=28)	132.250 ± 19.2808	126.143 ± 17.0070	2.684	0.012*
Systolic BP below 40 yrs (n=14)	117.429 ± 16.2940	112.571 ± 13.0249	2.024	0.064
Systolic BP above 40 yrs (n=40)	133.250 ± 19.0905	130.175 ± 20.1900	1.399	0.17
Systolic BP below 25 BMI (n=28)	130.536 ± 20.4495	125.214 ± 21.3912	2.409	0.023*
Systolic BP above 25 BMI (n=26)	127.654 ± 18.8233	126.038 ± 18.9240	0.598	0.555
Systolic BP in patients (n=24)	132.833 ± 19.6663	131.167 ± 19.4619	0.606	0.549
Systolic BP in non-patients (n=30)	124.542 ± 18.7987	118.667 ± 18.9385	3.253	0.004*
New meditators				
Systolic BP in female (n=51)	131.451 ± 21.7828	125.569 ± 19.6105	3.447	0.001*
Systolic BP in male (n=29)	133.414 ± 20.6856	127.759 ± 20.9858	3.874	0.001*
Systolic BP below 40 yrs (n=33)	124.333 ± 21.1478	116.333 ± 16.6145	4.014	0.000*
Systolic BP above 40 yrs (n=47)	137.660 ± 19.7938	133.404 ± 19.3173	2.889	0.006*
Systolic BP below 25 BMI (n=40)	125.925 ± 22.2208	121.525 ± 22.5172	3.25	0.002*
Systolic BP above 25 BMI (n=40)	138.400 ± 18.5414	131.200 ± 16.0147	3.629	0.001*
Systolic BP in patients (n=45)	142.057 ± 22.6442	138.200 ± 20.1009	2.236	0.032*
Systolic BP in non-patients (n=35)	124.467 ± 16.6864	117.156 ± 14.4536	4.085	0.000*

Among experienced meditators, Systolic BP is significantly reduced in males and in non-obese participants. In the case of new meditators, Systolic BP is significantly reduced in all sub-groups (Table 6).

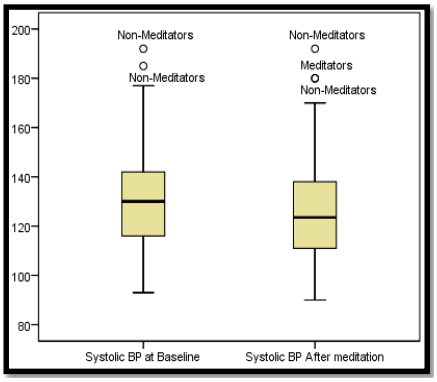

Figure 1a Vital parameters box plots

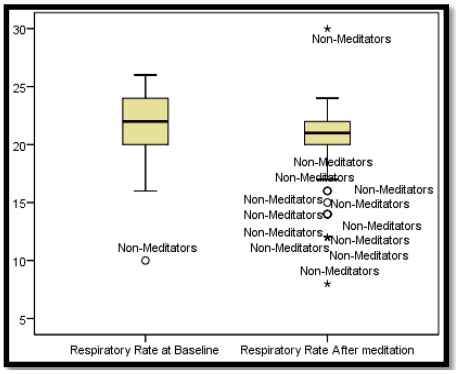

Figure 1b Vital parameters box plots

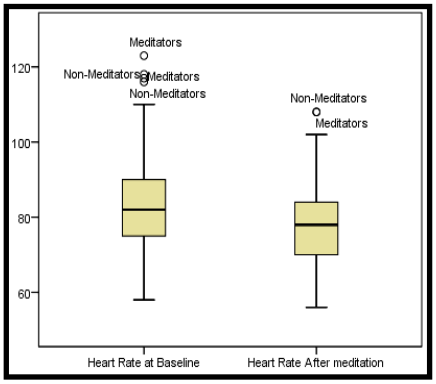

Figure 1c Vital parameters box plots

Vital parameters box plots: The central line represents the median, the box gives the interval between the 25% and 75% percentiles and the whisker indicates the range. 'O' indicates mild outliers and '*' indicates extreme outliers

From the Figures 1a-1c, respiratory rate after meditation shows large number of outliers in new meditators indicating a very significant reduction in the respiratory rate in this subgroup after the meditation.

DISCUSSION

In our study, mean heart rate at baseline is significantly lower in Experienced meditators than in new meditators. After a 30-minute heartfulness meditation session, heart rate is considerably reduced in both populations. This effect is also noticed in the sub group analysis based on gender, age group, obesity, and comorbidities. This observation is similar to the results observed in previous studies [30-32]. Heart rate is a direct indicator of sympathetic drive. Conditions having high central sympathetic activity such as anxiety, stress, obesity, cardiovascular diseases, renal diseases, metabolic syndrome etc., are associated with a high heart rate.

Meditation produces relaxation response moderating sympathetic and parasympathetic activities; thus, regulates heart rate. Researchers find that heartrates are notably reduced during meditation when compared to heart rates at rest [27].

Decrease in heart rate reduces the risk for cardiovascular disease and premature death. It also aids in physical fitness, regulating body weight and circulation of body fats. Reduced heart rate can be a sign of reduced stress. When the heart beats more slowly, it pumps more blood with each beat; making it more efficient. An efficient heart experiences less strain and is less likely to suffer an infarction [12].

After heartfulness meditation, respiratory rate is significantly decreased in all sub groups of Experienced meditators except in lower than 40 years age group. In case of new meditators, respiratory rate is decreased in all sub groups except those with comorbidities.

Regular meditation helps in maintaining a balanced lifestyle and also regulates breathing in healthy individuals. Youth and middle-aged people shoulder many days to day responsibilities and lead stressful lives as compared to the elderly. This group might take a longer time to go deep in meditation as compared to the elderly, even though they get relief from anxiety and stress during the session. This is reflected in our study where young experienced meditators participating in a 30 minutes of meditation session did not show significant reduction in RR even though HR and SBP are reduced. Probably these participants would have shown significantly reduced RR if the meditation have been continued a little longer. New meditators, who have never experienced meditation before, usually have very high levels of stress and anxiety compared to the age-matched controls in experienced meditators. In these cases, as the meditation session takes place, they get considerable relief from anxiety and stress; as a result, a significant reduction in RR is noticeable.

Comorbidities are seen mostly with elderly people. When it comes to regular practice of meditation, elders have more time to practice regularly and thus able to obtain maximum benefits even though they have comorbidities. Participants with comorbidities, such as hypertension, cardiac problems, chronic respiratory problems, diabetes etc. who are not meditators are not showing significant decrease in RR with one session of meditation. They probably need greater duration of practice to obtain these benefits.

Slow respiratory rate positively impacts cardiovascular and respiratory performance. It also improves exercise tolerance and produces calmness leading to general well-being in an individual [33].

In the case of experienced meditators, after heartfulness meditation, systolic blood pressure is decreased in all sub groups although it did not reach statistical significance in women compared with men, in people with comorbidities compared with healthy volunteers and in obese people compared with non-obese people. In the case of new meditators, systolic blood pressure decreased in all sub groups.

For experienced meditators, the baseline BP for women is significantly lower compared to men. The women in experienced meditators also have lower values than the women of the new meditators group. This could be due to the fact that they are already emotionally stable as a result of the practice of regular meditation. While their emotional temperament is stable; women tend to ruminate and hence change in the BP before and after is not highly significant.

Regular practice of meditation optimizes the working of autonomic nervous system. This is reflected by the fact that the baseline systolic BP and HR is lower in experienced meditators compared with new meditators. A single session of meditation on an optimized autonomic nervous system will show only a marginal benefit.

There is not much reduction in BP in experienced meditators compared to new meditators who showed a remarkable difference. This is because new meditators are likely to have stress and anxiety in their minds and hence a short meditation session could stabilize the system and produce relaxation. Obesity and morbidities such as diabetes mellitus, hypertension, coronary artery disease, cerebrovascular disease, etc are associated with high sympathetic drives [34].

Regular meditators would have already benefitted from meditation and developed optimization of the autonomic nervous system. Even though the short meditation session reduced systolic BP; it could not achieve statistical significance. A longer session probably would have given a statistically significant reduction in systolic BP. Experienced meditators with comorbidities did not show immediate effect because of an already optimized sympathetic drive and absence of stress and anxiety.

Like previous studies, our study also shows that meditation lowers blood pressure by about 5-10 millimetres of mercury [35]. The beneficial effects of meditation may vary greatly from person to person. If they are stress induced, the effect of meditation will be conspicuous.

The correlation between meditation and reduction in BP is not yet clearly established. It has been observed that meditation leads to reduction in stress and physiological arousal, thereby having a regulatory effect on the autonomic nervous system. Regulation of blood pressure reduces risk of peripheral artery disease, coronary artery disease, heart failure, improves vision and lowers the risk of chronic kidney disease [36].

Meditation eases stress and anxiety and hence reduction in stress induced systolic BP is always significant and instant. Abnormalities in vital parameters and physiological changes due to stress and anxiety will be positively influenced [28].

Heartfulness meditation produces changes in the body and mind similar to a relaxation response that is contrary to the changes seen with fight or flight response. The effects seen with relaxation response are reduction in heart rate, respiratory rate, and muscle tension; decrease in blood pressure and oxygen consumption at resting levels. It also produces a shift from normal waking brain wave patterns to a pattern in which slower brain waves predominate [28].

The same changes were observed during meditation. Meditation explores the basic physiological changes that occur as a result of relaxation response including decrease in the activity of sympathetic nervous system. Furthermore, the mind is more receptive to new information thereby helping to increase therapeutic potential and acts as an adjunct to standard medical treatments.

Regular practice of meditation blocks the ability of stress hormones to influence the brain and the body. Sleep and relaxation response bring a decrease in oxygen consumption; this change occurs more rapidly with the relaxation response.

Continued practice of meditation can bring feelings of greater control over life. Physical benefits as well as psychological benefits occur during regular practice especially in stress induced conditions.

CONCLUSION

Heartfulness meditation produces relaxation response on nervous system, cardio vascular system, respiratory system and brings moderation in overall body's physiology and psychology. Sympathetic nervous system is affected by anxiety, stress and mental tension which take a toll on the fight or flight response. These negative effects become diminished in regular meditators as the very process of meditation results in regulation of thoughts and emotions.

Studies show that meditation moderates autonomic nervous system by which the heart rate, temperature, respiratory rate and blood pressure slows down. In our original study, we compared the differences in the changes in vital parameters between experienced meditators and new meditators. Overall, we found that a single session of 30 minutes heartfulness meditation favourably moderates HR, RR and SBP in both experienced meditators and new meditators. As shown in previous studies, these responses varied based on the gender, age, obesity status and associated comorbidities.

Young meditators who were meditating for the first time showed enthusiastic response and open-mindedness to try novel methods of self-improvement; they also possess high sympathetic drive which is due to stress. Hence the effect is distinctly noticeable. In the case of experienced meditators, the elderly generally has more time to practice regularly, therefore show greater improvements compared to young people.

DECLARATIONS

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Conflicts of interest

Competing interest declared none.

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