Original Article

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Effect of alternate nostril breathing exercise on blood pressure, heart rate, and rate pressure product among patients with hypertension in JIPMER, Puducherry

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Abstract:

INTRODUCTION: Hypertension has a direct relationship with the circulation, respiration, and function of vital organs. Similarly, complementary therapy such as alternate nostril breathing exercise has a direct effect on mental and physical health.

MATERIALS AND METHODS: This is a quantitative experimental research with randomized controlled trial design. A total of 170 and 85 individuals were allotted to each group. Patients in the study group were instructed alternate nostril breathing exercise two times a day (10 min duration of exercise each time) for 5 days along with routine treatment, and patients in the control group underwent routine treatment.

RESULTS: There was a marked reduction in systolic blood pressure (BP), diastolic BP, heart rate, and rate pressure product after the continuous 5-day alternate nostril breathing exercise in the study group. $P < 0.0001$ demonstrated a statistically significant difference in systolic BP, diastolic BP, heart rate, and rate pressure product that existed pre- and post-assessment on 1st day and 5th day.

CONCLUSION: It can be concluded that regular simple alternate nostril breathing exercise effectively reduces hypertension.

Keywords:

Diastolic pressure, hypertension, rate pressure product, systolic pressure

Introduction

Hypertension, a "psychological classical silent killer," is the hallmark of various cardiovascular disorders. Hypertension would become a greater global burden in the next 15–20 years. If one believes that "old is gold," then yoga is quite effective and widely believed to reduce blood pressure (BP).[1] Health and holistic health is closely related, which gives importance to physical, mental, social, spiritual, and sexual health as a whole. Hypertension has a direct relationship with the circulation, respiration, and function of vital organs. Similarly, complementary therapy such as alternate nostril breathing exercise has a direct effect on mental and physical health. Hence, alternate nostril breathing exercise emphasizes on the promotive, preventive, and curative measures and helps to maintain normal BP. Alternative therapy in nursing is a valuable aspect of health-care system. It is mainly based on the promotion, maintenance, prevention, and rehabilitation of diseases.[2]

Breathing exercises are one of the nonpharmacological modalities. Alternate

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nostril breathing exercise helps in stimulating the main nerve in the parasympathetic nervous system and the vagus nerve, thus helping in decelerating the heart rate, lowering the BP, and calming the body and mind. Because antihypertensive drugs have many side effects and complications, their rate of noncompliance is high. Complementary therapy such as alternate nostril breathing exercise is proved to be most effective in reducing the BP among hypertensive patients.[3]

So far, only few studies regarding the effect of alternate nostril breathing exercise on BP, heart rate, and rate pressure product have been done in India. At present, no study has been conducted to assess the effect of alternate nostril breathing exercise on BP, heart rate, and rate pressure product with an interventional duration of 5 days. Hence, the main aim of this study is to assess the quick effect of alternate nostril breathing exercise and to bring this exercise into practice to reduce the BP of hypertensive patients, which will help them stop taking antihypertensive drugs and stick on the exercise regimen.

The study results will demonstrate the effect of alternate nostril breathing exercise on BP, heart rate, and rate pressure product. This will also help in the identification of myocardial stress of hypertensive patients by calculating the rate pressure product. Thus, alternate nostril breathing exercise proves to be an effective, yet inexpensive intervention, when compared to routine treatment for hypertension, in reducing the heart workload of hypertensive patients. Our research hypothesis is that alternate nostril breathing exercise plays a role in reducing BP, heart rate, and rate pressure product. The study objectives were to assess the effect of alternate nostril breathing on BP, heart rate, and rate pressure product among hypertensive patient in the study group and to compare the BP, heart rate, and rate pressure product among the hypertensive patients in the study and control groups.

Materials and Methods

This study with quantitative experimental research design was conducted in the Medicine Outpatient Department (OPD), JIPMER, Puducherry. The study demonstration was given to the study group participants at the Advanced Centre for Yoga Therapy, Education and Research (ACYTER) department. The study inclusion criteria were both men and women between the age group of 30 and 60 years, patients diagnosed with hypertension taking antihypertensive medication, patients with BP of mild (120–139 mmHg or 80–89 mmHg) and moderate (140–159 mmHg or 90–99 mmHg) degrees according to the Joint National Committee classification, and patients who were attending medicine OPD and hypertension clinic. The exclusion criteria were patients who have a previous experience of yoga and patients who were chronic smokers. The study population included patients with hypertension who were attending medicine OPD, JIPMER. A total of 170 and 85 participants were enrolled in each group. The sample size was estimated using the statistical formula based on nonequivalence trial for comparing two independent means, with a power of 95% at 0.05% level of significance. The study participants who met the inclusion criteria were selected by using random allocation lottery method. Sociodemographic data were collected from the patients through interview method. BP and heart rate were measured using automated digital sphygmomanometer. Rate pressure product was calculated using the following formula:

Rate pressure product = heart rate × systolic BP.

Intervention of the research study

For study group

Patients in the study group were instructed alternate nostril breathing exercise two times a day (10 min duration of exercise each time) for 5 days along with routine treatment, and the control group patients were provided routine treatment. The study group patients were given a demonstration about alternate nostril breathing exercise and they have to do it along with the routine treatment twice a day for 5 days. The investigator assessed the pre- and post-BP, heart rate, and rate pressure product on the 1st day and 5th day. Patients were asked to sit in a comfortable sitting position with the head, neck, and trunk erect in a straight line during the practice of alternate nostril breathing in a calm and quiet room. Then, the patients were asked to close one of their nostrils (say right nostril) by their thumb and slowly breathe in up to maximum, through the left nostril. They were asked to close their other nostril (left) by their ring finger and open the right nostril to exhale slowly up to maximum. Then, they were instructed to inhale through the same right nostril (with left nostril closed) and then to open the left nostril and exhale as instructed previously. They have to perform the alternate nostril breathing exercise for 10 min, twice a day. BP and heart rate were measured by the researchers after the procedure using an automated digital sphygmomanometer. An instruction has given to repeat the same alternate nostril breathing exercises two times daily for 5 days. Throughout the intervention week, the researcher has followed up and ensured no changes in antihypertensive medications and encouraged participants to perform breathing exercises training in the ACYTER department.

During the second assessment, after the 5th day of the intervention, participants were instructed to be in a comfortable sitting position. Patients' BP and heart rate were measured, and then they were instructed to perform

the trained breathing exercise procedure. Post procedure, systolic BP and diastolic BP and heart rate were measured using an automated digital sphygmomanometer and rate pressure product was recorded, and all the results were recorded in the assessment data sheet.

For control group

Patient in the control group were administered routine standard treatment without alternate nostril breathing exercise. Patients' systolic BP, diastolic BP, heart rate, and rate pressure product were assessed similar to that performed for study group patients. After the completion of postassessment data collection, alternate nostril breathing exercise was taught to all the participants.

Results

Among 170 patients, half of the participants (53% control group and 52% study group) were in the age group of 51–60 years; 54% and 63.5% of female were in control and study groups, respectively. Majority of the patients in both groups had completed primary level education. Nearly 52% of patients and 47% of patients in the control group and study group, respectively, were employed.

Table 1 summarizes the clinical variables of hypertensive patients. It reveals that out of 170 patients height were 46 (54%) and 51 (60%) belong to 151–160 cm in control and study groups respectively. The body mass index of the patients was 54 (63.5%) in the control group and 47 (55.3%) in the study group who were considered overweight. Fourteen (16.5%) patients in both groups had smoking habit; among them, 12 (85.7%) patients in the control group and 10 (71.4%) patients in the study group had smoking habit for >5 years. In the control and study groups, 11 (78.6%) and 6 (42.9%) patients, respectively, were continuing smoking. A total of 29 (34.1%) and 22 (25.9%) patients had the habit of alcohol consumption in the control and study groups, respectively; among them, 22 (75.9%) and 18 (81.8%) patients had the habit for ≥5 years. In the control and study groups, 8 (80%) and 3 (60%) patients, respectively, were continuing the habit of alcohol consumption. Majority (78 [91.8%] and 77 [91.8%]) of the patients had hypertension alone in the control and study groups, respectively. Among the 170 patients, 34 (40%) and 31 (366.5%) had hypertension for ≥5 years in the control and study groups, respectively.

Table 2 shows the effect of alternate nostril breathing exercise on systolic BP among the hypertensive patients before and after the intervention in the study group on 1st and 5th days. The mean difference of 1st day pre- and post-assessment was 0.17, and the 5th day pre- and post-assessment was 46.22. Similarly, the mean value difference was calculated from 1st day preassessment (134.64) and 5th day postassessment (80.42) was 54.22 (134.64–80.42 = 54.22). There was a marked reduction in the systolic BP after the continuous 5-days alternate nostril breathing exercise in the study group. The paired *t*-test was carried out to find whether the difference in systolic BP existed between pre- and post-assessment. $P < 0.0001$ indicated that the difference in systolic BP pre- and post-assessment on the 1st day and 5th day was statistically significant.

Table 3 shows the effect of alternate nostril breathing exercise on diastolic BP among the hypertensive patients before and after the intervention in the study group on the 1st and 5th days. The mean difference of 1st day pre- and post-assessment was 0.57 and the 5th day pre- and post-assessment was 0.11. Similarly, the mean value difference was calculated from 1st day preassessment (86.78), and 5th day postassessment (80.31) was 6.47 (86.78–80.31 = 6.47). It shows that there was a marked reduction in the diastolic BP after the continuous 5-day alternate nostril breathing exercise in the study group. The paired *t*-test was carried out to find whether the difference in diastolic BP existed between pre- and post-assessment. $P < 0.05$ indicated that the difference in diastolic BP pre- and post-assessment on the 1st day was statistically significant and $P < 0.001$ pre- and post-assessment on the 5th day was statistically significant.

Table 4 shows the effect of alternate nostril breathing exercise on heart rate among the hypertensive patients before and after the intervention in the study group on the 1st and 5th days. The mean difference of 1st day pre- and post-assessment was 0.89 and the 5th day pre- and post-assessment was 1.37. Similarly, the mean value difference was calculated from 1st day preassessment (87.62) and 5th day postassessment (84.21) was 3.41 (87.62–84.21 = 3.41). It shows that there was a reduction in the heart rate after continuous 5-day alternate nostril breathing exercise in the study group. The paired *t*-test was carried out to find whether the difference in heart rate existed pre- and post-assessment. $P < 0.0001$ indicated that the difference in heart rate pre- and post–assessment on the 1st day and 5th day was statistically significant. Table 5 shows the effect of alternate nostril breathing exercise on rate pressure product among the hypertensive patients before and after the intervention in the study group on the 1st and 5th days. The mean difference of 1st day pre- and post-assessment was 1319.24 and the 5th day pre- and post-assessment was 173.88. Similarly, the mean value difference was calculated from 1st day preassessment (12981.88) and 5th day postassessment (10665.84) was 1319.24 (12981–11662.64 = 1319.24). It shows that there was

Table 1: Clinical variables of patients with hypertension (*n*=170)

Variables	Control group (*n*=85), *n* (%)	Study group (*n*=85), *n* (%)	Total, *n* (%)	χ^2	*P*
Height (cm)					
140-150	13 (15.3)	12 (14.1)	25 (14.7)	2.77	0.427 (NS)
151-160	46 (54)	51 (60)	97 (57.1)		
161-170	24 (28.2)	17 (20)	41 (24.1)		
171-180	2 (2.4)	5 (5.9)	7 (4.1)		
Weight (kg)					
40-50	8 (9.4)	5 (5.9)	13 (7.6)	1.89	0.755 (NS)
51-60	26 (30.6)	33 (38.8)	59 (34.7)		
61-70	35 (41.2)	34 (40)	69 (40.6)		
71-80	14 (16.5)	11 (12.9)	25 (14.7)		
81-90	2 (2.4)	2 (2.4)	4 (2.4)		
BMI					
Normal (18.5-24.9)	30 (35.3)	35 (41.2)	65 (38.2)	1.87	0.393 (NS)
Overweight (25-29.9)	54 (63.5)	47 (55.3)	101 (59.4)		
Obese (>30)	1 (1.2)	3 (3.5)	4 (2.4)		
History of smoking					
Yes	14 (16.5)	14 (16.5)	28 (16.5)	0.00	1.000 (NS)
No	71 (83.5)	71 (83.5)	142 (83.5)		
Duration of smoking (years)					
<5	2 (14.3)	4 (28.6)	6 (21.4)	0.84	0.357 (NS)
>5	12 (85.7)	10 (71.4)	22 (78.6)		
Still continuing smoking					
Yes	11 (78.6)	6 (42.9)	17 (60.7)	3.74	0.053 (S)*
No	3 (21.4)	8 (57.1)	11 (39.3)		
History of alcoholism					
Yes	29 (34.1)	22 (25.9)	51 (30)	1.37	0.241 (NS)
No	56 (65.9)	63 (74.1)	119 (70)		
Duration of alcoholism (years)					
<5	7 (24)	4 (18.2)	11 (21.6)	0.26	0.609 (NS)
>5	22 (75.9)	18 (81.8)	40 (78.4)		
Still continuing alcoholism					
Yes	8 (80)	3 (60)	11 (73.3)	1.88	0.169 (NS)
No	2 (20)	2 (40)	4 (26)		
Diagnosis					
Hypertension	78 (91.8)	77 (90.6)	155 (91.2)	0.073	0.787 (NS)
Hypertension and diabetes	7 (8.2)	8 (9.4)	15 (8.8)		
Duration of illness (years)					
<5	51 (60)	54 (63.5)	105 (61.8)	0.224	0.636 (NS)
>5	34 (40)	31 (36.5)	65 (38.2)		
Drug intake					
One drug	72 (84.7)	69 (81.2)	141 (82.9)	2.108	0.350 (NS)
Two drugs	13 (15.3)	14 (16.5)	27 (15.9)		
>Three drugs	0	2 (2.4)	2 (2.4)		

*P<0.05. S=Significant, NS=Nonsignificant, BMI=Body mass index

Table 2: Mean and standard deviation of systolic blood pressure among patients with hypertension before and after alternate nostril breathing exercise in the study group (*n*=85)

Systolic BP assessment	Mean	SD	Mean difference	Paired *t*-test	*P*
1st day					
Preassessment	134.64	6.735	0.17	2.746	0.007 (S)***
Postassessment	134.47	6.645			
5th day					
Preassessment	126.64	6.548	46.22	6.057	0.000 (S)***
Postassessment	80.42	2.897			

***P<0.001. S=Significant, SD=Standard deviation, BP=Blood pressure

Table 3: Mean and standard deviation of diastolic blood pressure among patients with hypertension before and after alternate nostril breathing exercise in the study group (*n*=85)

Diastolic BP assessment	Mean	SD	Mean difference	Paired *t*-test	*P*
1st day					
Preassessment	86.78	3.600	0.57	4.270	0.000 (S)***
Postassessment	86.21	3.678			
5th day					
Preassessment	80.42	2.897	0.11	1.919	0.058 (S)*
Postassessment	80.31	2.984			

**P*<0.05 and ****P*<0.001. S=Significant, SD=Standard deviation, BP=Blood pressure

Table 4: Mean and standard deviation of heart rate among patients with hypertension before and after alternate nostril breathing exercise in the study group (*n*=85)

Heart rate assessment	Mean	SD	Mean difference	Paired *t*-test	*P*
1st day					
Preassessment	87.62	9.434	0.89	5.760	0.000 (S)***
Postassessment	86.73	8.954			
5th day					
Preassessment	85.58	7.777	1.37	9.069	0.000 (S)***
Postassessment	84.21	7.862			

****P*<0.001. S=Significant, SD=Standard deviation

Table 5: Mean and standard deviation of rate pressure product among patients with hypertension before and after alternate nostril breathing exercise in the study group

Rate pressure product assessment	Mean	SD	Mean difference	Paired *t*-test	*P*
1st day					
Preassessment	12,981.88	10,850.66	1319.24	1.120	0.266 (NS)
Postassessment	11,662.64	1405.028			
5th day					
Preassessment	10,839.72	1195.877	173.88	9.218	0.000 (S)***
Postassessment	10,665.84	1188.762			

****P*<0.001. S=Significant, NS=Nonsignificant, SD=Standard deviation

Table 6: Effect of alternate nostril breathing exercise on physiological parameters of patients with hypertension on the 5th day in the study group (*n*=170)

Physiological parameters	Preassessment (*n*=85)		Postassessment (*n*=85)		Mean difference	Paired *t*-test	*P*
	Mean	SD	Mean	SD			
Systolic BP	126.64	6.548	80.42	2.897	46.22	2.746	0.007 (S)**
Diastolic BP	80.42	2.897	80.31	2.984	00.11	1.919	0.058 (S)*
Heart rate	85.58	7.777	84.21	7.862	1.37	9.069	0.000 (S)***
Rate pressure product	10,839.72	1195.877	10,665.84	1188.762	173.88	9.218	0.000 (S)***

P<0.001. S=Significant, SD=Standard deviation, BP=Blood pressure
* 95% *P*<0.05 0.02-0.05
** 99% *P*<0.01 0.002-0.01
*** 99.9% *P*<0.001 0.000-0.001

a reduction in the rate pressure product after the continuous 5-day alternate nostril breathing exercise in the study group. The paired *t*-test was carried out to find whether the difference in systolic BP existed pre- and post-assessment. $P < 0.0001$ indicated that the difference in systolic BP pre- and post-assessment on the 5th day was statistically significant.

Table 6 shows the effect of alternate nostril breathing exercise after 5-day intervention in the study group. The finding reveals that there was reduction in the systolic BP, diastolic BP, heart rate, and rate pressure product after the continuous 5-day alternate nostril breathing within the study group pre- and post-assessment on the 5th day of intervention.

Table 7 shows that there were not much changes in the systolic BP, diastolic BP, heart rate, and rate pressure product after 5 days of routine management in the control group.

Table 8 shows that the systolic BP, diastolic BP, heart rate, and rate pressure product were much better in the study group after 5 days of alternate nostril breathing exercise

than that of the control group among hypertensive patients.

Discussion

A total of 170 hypertensive patients were involved in the research study, with 85 patients randomly allotted to each group. Patients in the study group should practice the alternate nostril breathing exercise two times a day (10 min duration of exercise each time) for 5 days along with routine treatment, and the control group patients should continue with routine treatment alone. Table 1 shows that the "Chi-square" test was applied to find out the statistical difference between the clinical variables between the two groups. There was no significant difference among the clinical variables of both groups, except for the variable of continuous smoking habit ($P < 0.053$). Because the difference in clinical variable – continuing smoking habit – was found to be statistically significant, it was used as one of the covariates in the independent "*t*-" test analysis to compare the post mean values of both groups.

Table 7: Mean and standard deviation of routine treatment on physiological parameters of patients with hypertension on the 5th day in the control group (*n*=170)

Physiological parameters	Preassessment (*n*=85)		Postassessment (*n*=85)	
	Mean	SD	Mean	SD
Systolic BP	132.59	6.263	84.49	4.492
Diastolic BP	84.49	4.492	84.49	4.492
Heart rate	87.58	6.303	87.58	6.303
Rate pressure product	11,618.00	921.301	11,618	921.301

BP=Blood pressure, SD=Standard deviation

The first objective was to assess the effect of alternate nostril breathing on BP, heart rate, and rate pressure product among the hypertensive patients in the study group. Tables 2–6 show that there was reduction in systolic BP, diastolic BP, heart rate, and rate pressure product after 5 days of continuous alternate nostril breathing exercise. The findings showed that there was improvement in the mean value pre- and post-assessment in systolic BP (126.64 and 80.42), diastolic BP (80.42 and 80.3), heart rate (85.58 and 84.21), and rate pressure product (10839.72 and 10665.84) after continuous 5-day intervention of alternate nostril breathing exercise. The paired "*t*-" test was carried out to find whether difference in systolic BP, diastolic BP, heart rate, and rate pressure product existed pre- and post-assessment. $P < 0.0001$ indicated that the difference in systolic BP pre- and post-assessment on the 5th day was statistically

Table 8: Comparison of blood pressure, heart rate, and rate pressure product among patients with hypertension in the control and study groups before and after the intervention

Variables	Systolic BP	Diastolic BP	Heart rate	Rate pressure product
Control group (*n*=85)				
1st day preassessment				
Mean	133.61	85.74	87.20	13,104.49
SD	7.410	3.726	7.554	13,366.531
1st day postassessment				
Mean	133.61	85.74	87.20	11,563.32
SD	7.410	3.726	7.554	1627.856
5th day preassessment				
Mean	132.59	84.49	87.58	11,618.00
SD	6.263	4.492	6.303	921.301
5th day postassessment				
Mean	84.49	84.49	87.58	11,618
SD	4.492	4.492	6.303	921.301
Study group (*n*=85)				
1st day preassessment				
Mean	134.64	86.78	87.62	12,981.88
SD	6.735	3.600	9.434	10,850.676
1st day postassessment				
Mean	134.47	86.21	86.73	11,662.64
SD	6.645	3.678	8.954	1405.028
5th day preassessment				
Mean	126.64	80.42	85.58	10,839.72
SD	6.548	2.897	7.777	1195.877
5th day postassessment				
Mean	80.42	80.31	84.21	10,665.84
SD	2.897	2.984	7.862	1188.762

SD=Standard deviation, BP=Blood pressure

significant. The study findings proved that alternate nostril breathing exercise had better effect in the reduction of BP among hypertensive patients.

The present study findings were in accordance with those of Isaac *et al*.'s study on the effectiveness of breathing exercises on hypertension among patients with chronic renal failure. A total of sixty chronic renal failure patients with hypertension were selected in their study. The study findings showed that the obtained "*t*" value was significant at $P < 0.05$ level. It reported that the breathing exercise was effective in reducing the level of BP among patients with chronic renal failure.[4] Sandeep *et al*. conducted a study on the effect of alternate nostril breathing exercise on cardiovascular functions among hypertensive patients. The study was conducted in selected hospitals of Punjab. A sample of 100 hypertensive patients (fifty in the experimental group and fifty in the control group) were selected. The study revealed that the posttest systolic BP in experimental and control group standard deviation were 5.95 and 5.3, respectively, the posttest diastolic BP in experimental and control group were 5.91 and 4.94. The posttest pulse rate in experimental and control groups was 2.29 and 2.94, respectively. It indicated that there was a significant difference in the pre- and post-cardiovascular functions with 0.05% level of significance.[5]

The study results were in accordance with those of Ghiya *et al*.'s study on the influence of alternate nostril breathing on heart rate variability in nonpractitioners of yogic breathing. A total of twenty healthy individuals with no prior experience in alternate nostril breathing exercise were engaged in their study. The results revealed that, when compared to preintervention, the postintervention values showed $P < 0.05$, which showed a great significance in heart rate.[6] Mohamed *et al*. conducted a study on the effect of slow deep breathing exercise on BP and heart rate among newly diagnosed patients with essential hypertension. The study was conducted at medical and surgical departments of a general government hospital in Egypt. The study was conducted on 120 adult patients diagnosed with hypertension. The study showed that the highest mean score was observed in systolic BP (146.89), diastolic BP (83.49), and heart rate (79.75). There was an observable reduction in the mean scores of systolic BP (138.17), diastolic BP (77.96), and heart rate (75.68). There was a high statistically significant difference between pre and post intervention of breathing exercise concerning systolic and diastolic BP as well as heart rate.[7]

The second objective was to compare the BP, heart rate, and rate pressure product among the hypertensive patients in the study and control groups. Tables 7 and 8 show that the systolic BP, diastolic BP, heart rate, and rate pressure product were much better in the study group after 5 days of alternate nostril breathing and routine management when compared to the control group with routine management alone in patients with hypertension. There were no much changes in the systolic BP, diastolic BP, heart rate, and rate pressure product after 5 days of routine management within the control group pre- and post-assessment on the 1st and 5th days. The present study findings were supported by D'Silva *et al*. who conducted a study on the effectiveness of deep breathing exercise on heart rate variability, BP, anxiety, and depression on patients with coronary artery disease. In their study, a total of 45 patients were selected and trained with the exercise for 2–3 days and were instructed to practice the exercise twice a day for 2 weeks. The study findings revealed that majority of cardiac patients were anxious 39 (86.66%), 23 (57.5%) patients had mild depression, and 3 (7.5%) patients had severe depression. Deep breathing exercise was found to be effective in reducing anxiety and diastolic BP of patients with coronary artery disease than patients without slow and deep breathing exercise.[8]

Conclusion

Hypertension can be reduced by following simple alternate nostril breathing regularly. It does not require any special equipment and major training for the nurses to demonstrate the exercise to patients. Nurses should be familiar on alternate nostril breathing technique and incorporate it in the routine nursing intervention to all patients to reduce stress, and improve cardiovascular function, respiratory function, and well-being of the patients.

Acknowledgment

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Ethical consideration

Permission to conduct the study was obtained from the Nursing Research Monitoring Committee and institute's Ethical Committee (Human studies), JIPMER. Official permission was also obtained from the head of the Department of Medicine and director of ACYTER, JIPMER.

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Conflicts of interest

There are no conflicts of interest.

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