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Comparative Efficacy of Progressive muscle relaxation and Breathing exercises in Hypertension: A systematic review

Rohini S. Bhardwaj* and Prof. Pity Koul

SOHS, IGNOU
*Corresponding author: Rohini S. Bhardwaj

Abstract

Progressive Muscle Relaxation and breathing exercises are most researched upon non-pharmacological modalities for the treatment and prevention of Hypertension. There are various true and quasi-experimental studies published regarding the effectiveness of these two therapies on patients with hypertension. However, a comprehensive systematic review regarding these therapies is lacking. The systematic review and meta-analysis was conducted to understand the comparative efficacy of Progressive muscle relaxation an Breathing exercises on patients with hypertension. We conducted a systematic review on RCTs and quasi-experimental studies with pretest post-test control group design on patients with hypertension published between 2008-2018 in databases of PUBMED/MEDLINE, AMED (OVID) , CINAHL Plus ,Cochrane CENTRAL Trials, PsycINFO , ERIC, ScienceDirect ,SciencePubCo ,Scopus database, JSTOR ,ProQuest , Google Scholar , Semantic Scholar and Clinicaltrials.gov for these two therapies. Overall most of the studies reported decrease in physiological parameters which is extremely encouraging. PMR was seen to be most effective among the two therapies in lowering blood pressure of patients with hypertension.

Keywords: PMR, progressive muscle relaxation, breathing exercise, systematic review, meta-analysis

Introduction

Health is an essential component of a good quality of life. Diseases and handicaps can affect each individual different and can be the cause of death and life-threatening compilations. The modern day trend is the increase in Non-communicable diseases which threaten the global health [1]. Hypertension or high Blood pressure is also one of the chronic diseases associated with variety of complications like stroke, cardio-vascular diseases, premature death especially in the lower and middle income countries [2]. In current scenario, 26% of global population has been diagnosed with hypertension, and it is projects to rise by 29% by the year 2025, with immense impact on third world countries [3]. Hypertension is a disease with both a physiological and psychological aspects wherein not only the patient is in stress due to diagnosis but the need of lifelong drug and care creates a fear in their minds which in turn effects their health [4]. Systematic reviews reveal that various complementary therapies practiced by patients with Hypertension are successful for not only symptom-relief but also decreasing the raised Blood pressure [5]. It is said that the Relaxation therapies of progressive muscle relaxation, breathing exercises, meditation have an impact on the patients with Hypertension as they produce a relaxation response within the body and thus, are efficient in lowering the stress and Blood pressure in the patients [6-7]. These are popular and regularly used and researched therapies in care of Hypertensive patients.

Hypertension is a condition in which a patient suffers from high blood pressure having systolic BP (SBP) above 140 mm Hg and diastolic BP (DBP) above 90 mmHg. Progressive muscle relaxation also known as PMR is a relaxation technique involving tensing and relaxing the various muscle sets of the human body for producing a relaxation response in the body. Breathing exercises are also a type of relaxation technique which involve slow and deep inhaling and exhaling for increasing the oxygen content of the body without the use of device performed for therapeutic purposes. Many systematic reviews and meta-analysis

regarding effectiveness of a number of complementary therapies for hypertension have been performed. It has been established that these therapies aid in reducing Blood pressure. But none have compared these two therapies in order to find out which among these therapies is most efficient in lowering the Blood pressure of patients with hypertension even though extensive research in form of experimental, observational and other studies exists. It is hence, important to examine the comparative efficacy of these therapies to aid future research and practice towards choosing and applying the most effective relaxation therapy for patients with hypertension which is also the main aim of this research study.

Methods

***1. Protocol development and registration*:** The Protocol of this meta-analysis has been registered with PROSPERO on 25th February'20 with registration number of CRD42020134537.

***2. Literature Search*:** For progressive muscle relaxation : hypertension, "blood pressure*", "high blood pressure*" AND relaxation , muscle relaxation, progressive muscle relaxation, jacobson's muscle relaxation, jacobson relaxation, NOT pregnan*, NOT gestational, NOT preeclampsia, NOT pre-eclampsia , NOT pregnancy induced hypertension. For breathing exercises: hypertension, "blood pressure*", "high blood pressure*" AND breathing exercise*, pranayam*, breathing NOT pregnan*, NOT gestational, NOT preeclampsia, NOT pre-eclampsia , NOT pregnancy induced hypertension.

3. Eligibility criteria:

Types of studies and their selection: Inclusion criteria: True experimental studies (RCTs with all designs excluding factorial designs) and quasi-experimental research studies with Pretest and Post test control group design, Written in English, Published within a peer reviewed journal, Published or written between 2008-2018.

Exclusion criteria: Cross-sectional/longitudinal studies, Ongoing studies, unpublished articles, conference proceedings, case series studies and abstracts/ posters will not be included, Full text is not available or can't be retrieved.

Types of Participants: Inclusion criteria: Adults with mean age of 18 years and above (both male and female) , Must be diagnosed with hypertension (Systolic BP above 140 and diastolic BP above 90 mm Hg i.e. stage 1 and stage 2 hypertension patients) or hypertension along-with other associated diseases like heart disease, diabetes with or without the antihypertensive therapy**.**

Exclusion criteria: Adults with gross medical or surgical illness or psychopathology, Pregnant women with gestational/pregnancy induced hypertension.

Types of Interventions: Inclusion criteria: Progressive Muscle Relaxation or Breathing Exercises or combination of these two therapies in experimental group (for this article we are not including the studies under this criteria), Control group receives other intervention of physical training like walking, jogging, exercise, other interventions like routine nursing care, education, or "no intervention".

Exclusion criteria: Studies with multiple interventions. However, relevant data may be picked up as required, Studies/Comparative studies without control group**.**

Types of Outcome Measures : Reduction in Stress, Reduction in Systolic BP (SBP), Reduction in Diastolic Blood Pressure (DBP)

Literature search

1. Data Sources: We performed a systematic review on RCTs and quasi-experimental studies conducted on patients with hypertension published between 2008-2018 in PUBMED/MEDLINE, AMED (OVID) , CINAHL Plus ,Cochrane CENTRAL

Trials, PsycINFO , ERIC, ScienceDirect ,SciencePubCo ,Scopus database, JSTOR ,ProQuest , Google Scholar , Semantic Scholar and Clinicaltrials.gov.

2.Data Collection:Search strategy devised was applied to the databases. The results from 11 databases were downloaded in form of BIBTEX (bibliography and typesetting software) or RIS (Research Information Systems) format. These were then uploaded into Mendeley reference management system. Citations from remaining 3 databases namely SciencePubCo , Semantic Scholar and Clinicaltrials.gov were imported into Mendeley reference management system by a Mendeley chrome plugin/web importer. One reviewer (PhD scholar) independently extracted the data which was then rechecked by the guide. Any discrepancies/disagreements were thereafter sorted out.

3.Data Extraction: The relevant data from eligible studies was extracted to ensure comparability of data based on the categories of First Author's name, Gender, Duration of Illness, Age of participants, Sample size, Changes in the stress level (before and after intervention), Changes in the Systolic BP (before and after intervention), Changes in the Diastolic BP (before and after intervention) .Any missing information was enquired from the respective authors.

4. Literature Quality Evaluation

Risk of Bias Assessment:

The quality of the selected eligible studies was analyzed by Cochrane Risk of bias tool for Randomized studies and Risk Of Bias In Non-randomized Studies - of Interventions tool for Quasi-randomized studies. Most of the randomized studies were found to have moderate quality while most of the quasi-experimental studies were found to have low quality. But all of the studies were included in further analysis i.e. quantitative synthesis or meta-analysis. Fig 1, 2, 3 and 4 gives the Risk of Bias assessment of the studies ,

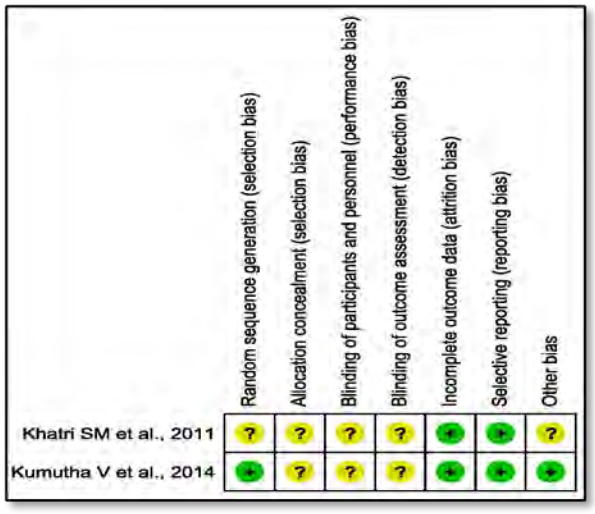

Fig 1a:Risk of Bias summary for RCTs of PMR

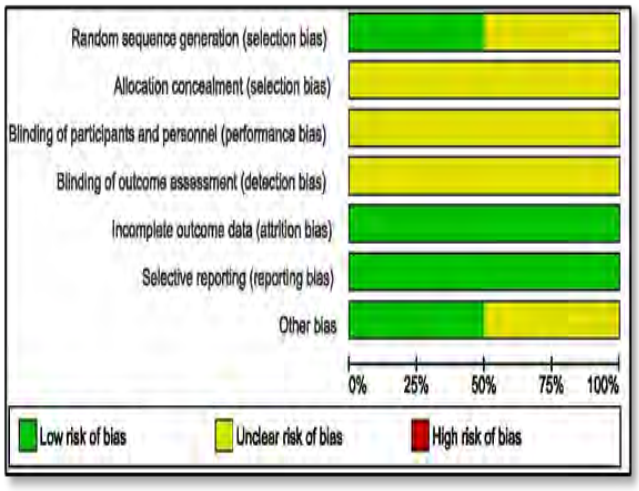

Fig 1b:Risk of Bias graph for RCTs of PMR

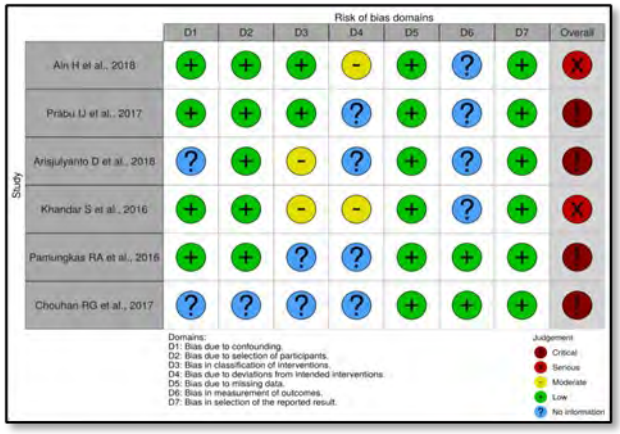

Fig 2a:Risk of Bias summary-Quasi-experimental studies of PMR

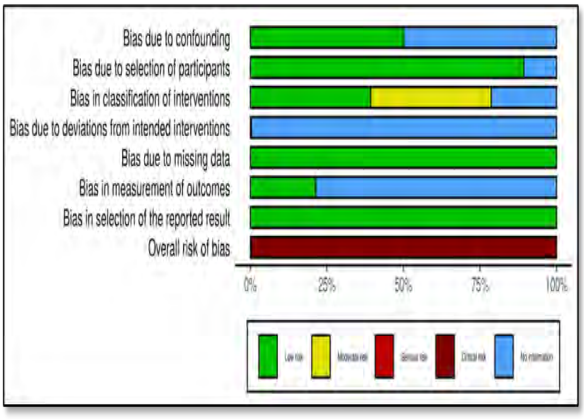

Fig 2b:Risk of Bias graph -Quasi-experimental studies of PMR

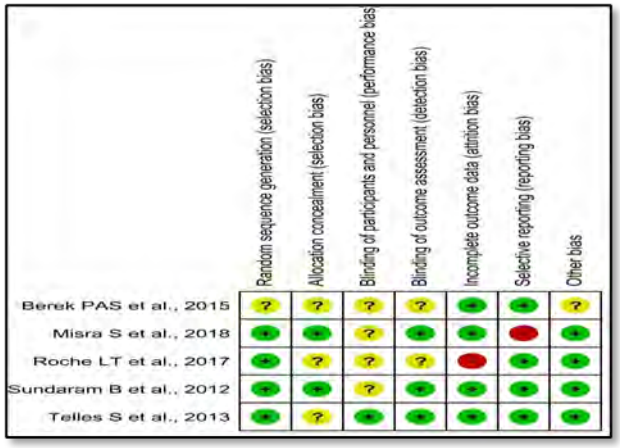

Fig 3a:Risk of Bias summary for RCTs of Breathing Exercises

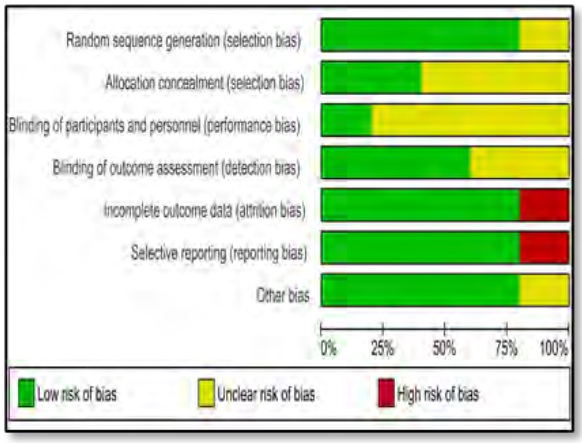

Fig 3b:Risk of Bias summary for RCTs of Breathing Exercises

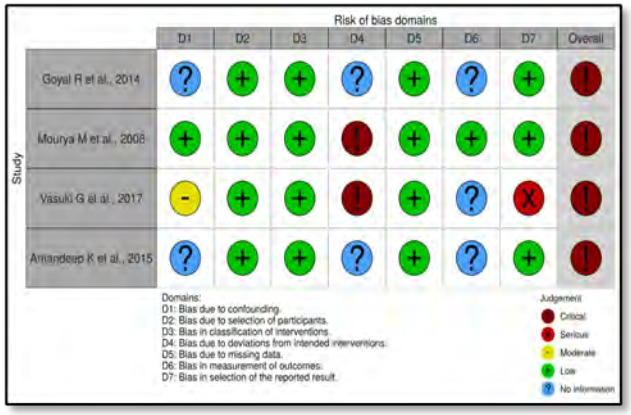

Fig 4a:Risk of Bias summary -Quasi-experimental studies Of Breathing Exercises

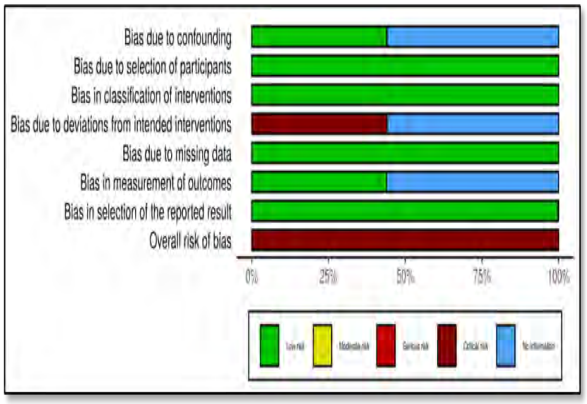

Fig 4b:Risk of Bias graph - Quasi- experimental studies Of Breathing Exercises

Statistical Analysis:

The Comprehensive Meta-analysis programme(CMA) was used for comparison of the effectiveness of these therapies using sub-group analysis. The software was used to calculate individual and effect sizes which were then compared. Effect sizes were

calculated based on Post test data for experimental and control group. The effect size was reported as Hedges' g. The magnitude is interpreted to be small for g=0.2-0.49, medium for g=0.50-0.79 and large for g> or equal to 0.080. Heterogeneity was measured using Q reported in analysis. Forest plots were used to express the findings at 95% Confidence Interval.

Results

Literature retrieval situation: A broad based search with only an initial limitation of year range of 2008-2018 was used. A total of 2,62,833 citations were retrieved with about records 1,71,513 remaining after de-duplication process. Out of this 1,71,457 records were excluded after title abstract check. Thereafter 56 articles were chosen for full paper search out of which a total of 21 articles as per inclusion and exclusion criteria were identified exclusively for PMR ,about 8 studies and Breathing exercises, 9 studies and 4 studies involved combination of these therapies (Fig 5).

Characteristics of the Included Studies:

Characteristics of Included studies for PMR has been represented in Table 1. Total sample size in 8 studies was 393. Most of the studies had sample size of 41-60 (76%) with participants between 40 to 60 years (37.5%), majority of patients enrolled in the included studies were females (67%), conducted over duration of 3 to 4 weeks (43%), of studies were quasi experimental studies. All the studies i.e. 100% reported outcome measure of Systolic Blood pressure,75% studies reported Diastolic BP while stress was the least reported outcome i.e. only of the studies (12.5%). Characteristics of Included studies for Breathing Exercises has been represented in Table 2. Total sample size in all the 9 studies was 640 with sample size of 40-70 (67%), most of studies had age of participants ranging between 20 to 60 years, females constituted 47% of the enrolled patients in the studies, most of the studies were conducted over duration of 5 to 10 weeks (34%) ,many of studies were Randomized controlled trials. All the studies (100%) reported outcome measure of Systolic Blood Pressure. About 88% studies reported Diastolic Blood pressure while the least reported was the outcome measure of stress i.e.11.1%.

Comparative subgroup analysis

1.Stress: Mixed effects analysis showed high heterogeneity in terms of Q value (test of heterogeneity) for the studies, Q=93.608, p=0.00 overall showing that the effects of the two therapies were statistically different. Both the therapies showed large effect sizes. PMR had the largest effect size followed by Breathing exercises .The effect size of PMR was quite large based on only one study i.e. Kumutha, V , 2014[9] , for which Hedges g was 12.554 ,95% CI [-14.885 , -10.223], p=0.00 which was statistically significant. The effect size of Breathing Exercises followed based on one study i.e. Roche, LT et al , 2017[17] , for which Hedges g was 1.306 ,95% CI [-2.147 , -4.65], p=0.002 which was statistically significant. Fig 6 shows the graphical display of the data related to outcomes.

2. Systolic BP (SBP): Mixed effects analysis showed some heterogeneity in terms of Q value (test of heterogeneity) for the studies, Q=7.980, p=0.018 overall showing that the effects of the therapies was statistically different. The effect size of PMR was quite large based on 8 included studies for which Hedges g was 2.442 ,95% CI [-3.480 , -1.404], p=0.00 which was highly statistically significant. The effect size of Breathing Exercises followed based for which Hedges g was 1.735 ,95% CI [-2.623 , -0.848], p=0.000 which was also statistically significant. Fig 7 shows the graphical display of the data related to the outcomes.

3.Diastolic BP (DBP):

Mixed effects analysis showed some heterogeneity in terms of Q value (test of heterogeneity) for the studies , Q=0.497, p=0.000 overall showing that the effects of the therapies was statistically different. PMR had the largest effect size followed by Breathing exercises and. The effect size of PMR was quite large based for which Hedges g was 1.440 ,95% CI [-2.170 , -0.710], p=0.000. The effect size of Breathing exercises followed with Hedges g was 0.962 ,95% CI [-1.664 , -0.260], p=0.007.combination of Breathing Exercises was based on 9 studies. Fig 8 shows the graphical display and the data related to the outcomes.

Discussion

The meta-analysis investigated the efficacy of the progressive muscle relaxation and breathing exercises and the differences in the effects of these therapies on Stress, Systolic and Diastolic BP of patients with hypertension. The results indicate that the two therapies had indeed a great difference in the effect sizes based on Hedges g for the three outcome measures and the differences between the two therapies was also highly significant. Since this is a new meta-analysis , the resultant effect sizes are similar to effect of these and other complementary therapies for Hypertension [25-28]. Since, both of these therapies are widely used in research for patients with hypertension, it is important to be aware of the effectiveness of each therapies and which is better in reducing stress and BP of these patients. This is one of the many strengths of this study.

However, in light of low quality of studies for both the therapies, one needs to look at these results with caution. Also, more studies for breathing exercises have been rigorously conducted under controlled environment than progressive muscle relaxation and hence, can have an impact on the results that have been deduced. This is perhaps one of the important limitations of the study.

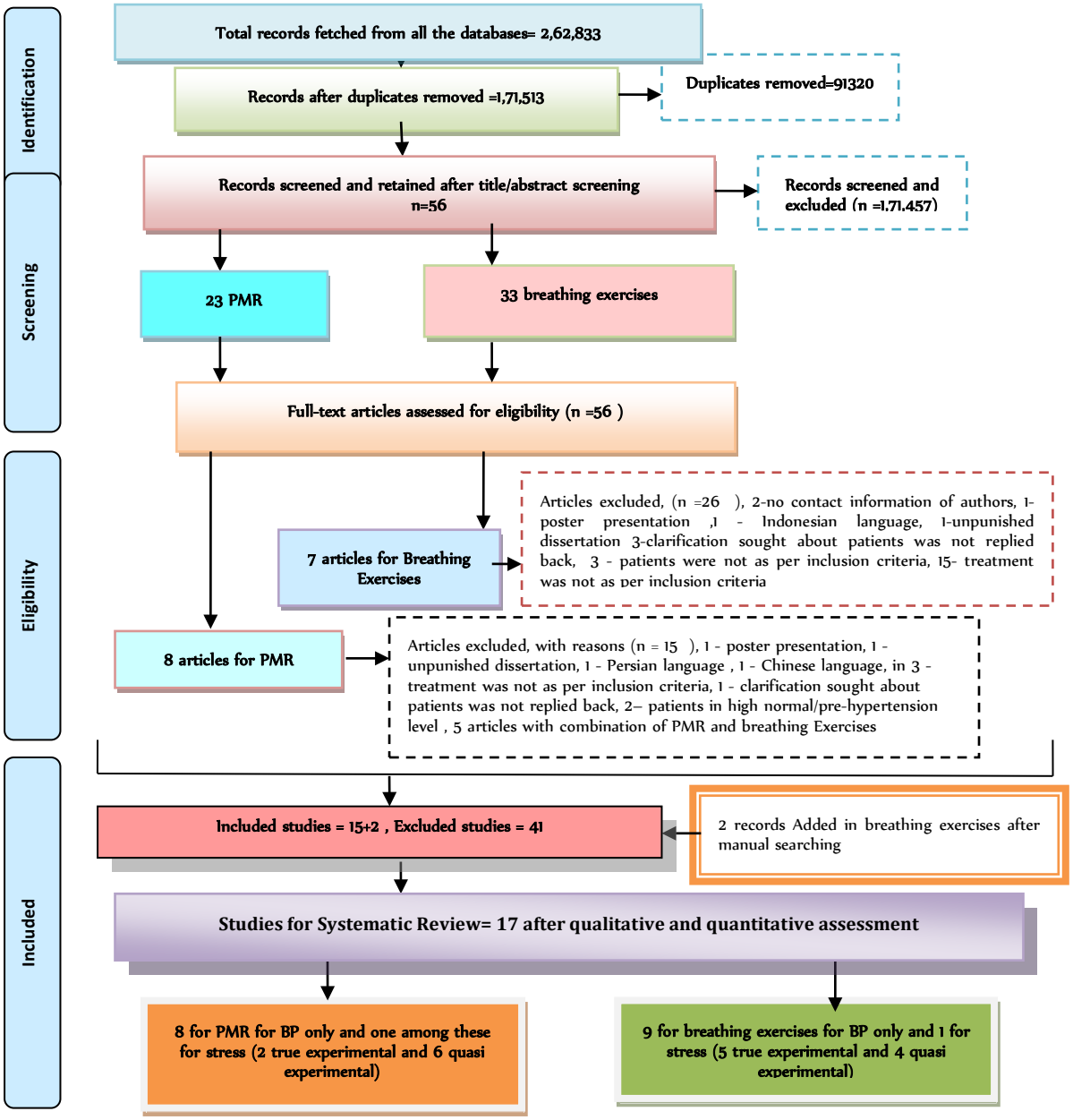

Fig 5: Studies included in Meta-analysis after Systematic review

Conclusion

The evidence produced by this meta-analysis suggests that these two therapies have excellent effect on lowering physiological and psychological parameters of patients with hypertension. However, in for future, conducting more randomized controlled trials for Progressive muscle relaxation and breathing exercises would add more value to this evidence.

Study	Study Design	Groups	N	Age	Men	Study duration	Pretest SBP	Posttest SBP	Pretest DBP	Posttest DBP	Pretest Stress score	Posttest Stress score
Khatri SM et al., 2011 [8]	RCT	Jacobson's relaxation	29	52.2 (9.2)	8(27%)	3 week	151.17 (4.33)	142.79 (5.19)	92.03 (3.02)	86.56 (2.51)	NA	NA
		Control group	27	54.0 (9.9)	10(38%)		152 (4.52)	150.04 (5.12)	90.56 (2.67)	89.63 (2.43)	NA	NA
V, Kumutha et al., 2014[9]	RCT	PMR	30	60-65 years	10 (33.3%)	3 weeks	NR	NR	NR	NR	NA	NA
		Control group	30	60-65 years	12(40%)		NR	NR	NR	NR	NA	NA
Ain H et al., 2018 [10]	Quasi experimental	PMR	25	51.18 (3.4)	3 (12%)	3 days	149.9 (0.5)	138.9 (0.87)	88.2 (0.63)	83.13 (1.15)	NA	NA
		Control	25	66.82 (3.4)	5 (20%)		148.1 (2.4)	146.7 (0.92)	87.9 (0.34)	86.9 (0.87)	NA	NA
Prabhu IJ et al., 2017[11]	Quasi experimental	PMR	30	52.25 (5.3)	23 (76.7%)	5 days	156.2 (12.0)	135.2 (10.07)	113.33 (10.79)	94.40 (10.22)	NA	NA
		Control	30	53.18 (5.6)	21 (70%)		157.2 (10.21)	143.47 (3.15)	109.87 (8.5)	98.93 (6.14)	NA	NA
S Kep, D.A. et al.,2018 [12]	Quasi experimental	PMR	14	46.96 (10.02)	7 (50%)	NR	152.44	142.14	NR	NR	NA	NA
		Control	13	48.23 (9.18)	6 (46.2%)		159	157.58	NR	NR	NA	NA
Khandare S et al., 2017[13]	Quasi experimental	PMR + Antihypertensive agents	25	35-55 years	NR	4 weeks	111.9 (3.09)	104.1 (3.55)	NR	NR	NA	NA
		Control +Anti hypertensive agents	25	35-55 years	NR		111.8 (3.12)	108.1 (3.11)	NR	NR	NA	NA
Pamungkas RA et al., 2016[14]	Quasi experimental	PMR	20	53.91 years (0.5)	4 (20%)	NR	150 (21.5)	136 (19.02)	93 (10.83)	82.5 (5.50)	NA	NA
		Control	20	54.34 years (0.63)	4 (20%)		151 (13.3)	153.5 (7.45)	90.5 (8.25)	91.5 (8.12)	NA	NA
Chauhan RG et al., 2017[15]	Quasi experimental	PMR	25	50.7 (5.6)	12 (48%)	1 week	143.92 (12.94)	129.12 (8.64)	98.16 (9.81)	86.48 (5.92)	NA	NA
		Control	25	50.26 (6.1)	13 (52%)		142.96 (8.25)	142.56 (7.89)	102.32 (11)	102.16 (11.15)	NA	NA

Table 1: Characteristic of Included studies of PMR

Study	Study Design	Groups	N	Age	Men	Study duration	Pretest SBP	Posttest SBP	Pretest DBP	Posttest DBP	Pretest Stress score	Posttest Stress score
Telles S et al., 2013[16]	RCT	Anuloma-viloma	30	49.7 (9.5, 20-59)	NR	10 minutes	133.67 (14.26)	128.00 (±10.64)	85.67 (8.58)	84.33 (7.28)	NA	NA
		Breath awareness	30	49.7 (9.5, 20-59)	NR		130.67 (16.39)	127.20 (13.72)	84.33 (10.73)	83.73 (9.26)	NA	NA
		Reading a magazine	30	49.7 (9.5, 20-59)	NR		140.83 (14.22)	139.53 (18.65)	81.20 (9.42)	81.33 (9.37)	NA	NA
Roche LT et al., 2017[17]	RCT	Himalayan Tradition (HT) Meditation	25	59.42 (9.88)	2(16.66%)	8 weeks/ 2 Months	NR	NR	NR	NR	NR	NR
		Pranayama group	25	60.95 (8.38)	8(42.11%)		133.42 (16.71)	130.79(22.23)	81.77 (12.04)	84.63 (11.21)	27.95 (7.1)	19.79 (6.67)
		Yoga Practice group	25	54.14 (9.65)	5 (35.71%)		NR	NR	NR	NR	NR	NR
		Control group	25	54.40 (8.92)	5(50%)		133.4 (15.79)	130.6 (19,31)	80.3 (12.55)	83.3 (15.5)	26.3 (6.07)	28.1 (5.08)
Misra S et al., 2018 [18]	RCT	In class group	23	59.6 (13.1)	13 (57%)	10 weeks	155.4 (15.9)	150.5 (16.3)	NR	NR	NA	NA
		Youtube/DVD group	38	62.8 (10.1)	20 (53%)		152.5 (15.5)	145.3 (11.7)	NR	NR	NA	NA
		Control group	22	58.6 (12.0)	10 (46%)		149.2 (23.7)	150.1 (17.2)	NR	NR	NA	NA
SundaramBeta.,2012 [19]	RCT	Slow Breathing Excercise group	20	53.00 (5.40)	12 (60%)	4 weeks/	140.10 (7.4)	136.70 (5.39)	84.50 (6.79)	80.5 (5.9)	NA	NA
		Control group	20	52.15 (4.58)	14 (70%)		139.50 (6.51)	139.70 (5.92)	83.40 (5.54)	84.20 (4.80)	NA	NA
Goyal R et al., 2013[20]	Quasi-experimental	Test group	25	46 (0.85)	16 (64%)	6 Weeks	148 (1.62)	127 (2.42)	NA	NA	NA	NA
		Control group	25	46 (1.11)	15 (60%)	6 Weeks	144 (1.41)	141 (2.41)	NA	NA	NA	NA
Mourya M et al., 2008 [21]	Quasi-experimental	without intervention	20	NR	12 (60%)	3 Months	146 (2.43)	145 (5.56)	90.7 (1.98)	90.7 (2.41)	NA	NA
		Slow breathing exercise	20	NR	10 (50%)	3 Months	144 (3.48)	134 (5.15)	91.6 (2.19)	84.6 (2.41)	NA	NA
		Fast breathing exercise	20	NR	9 (45%)	3 Months	146 (2.43)	143 (5.34)	90.7 (1.98)	89.6 (2.45)	NA	NA
Vasuki G et al., 2017[22]	Quasi - experimental	Control group	30	46 (4.2)	NR	Week 12	148 (8.42)	143.8 (7.8)	90 (10.2)	87.5 (8)	NA	NA
		Breathing exercise	30	47 (4.2)	NR		139.1 (14)	123.8 (6.5)	91.7(9.4)	80.3 (4.4)	NA	NA
Kaur, A et al., 2015[23]	Quasi-experimental	Breathing exercise	30	47.7 (10.56)	15 (50%)	11 days	158.2 (8.69)	135.53 (5.39)	105.93 (8.19)	89.26(4.15)	NA	NA
		Control group		50.76 (9.8)	16(26.7)		153.26(10.23)	149,2(7.49)	101.33 (8.19)	100.33 (7.1)	NA	NA
Berek PAS et al., 2015[24]	Quasi-experimental	Slow deep breathing	37	48.81 (10.01)	NR	2 weeks	157.65 (17.69)	129.05 (5.80)	99.84 (7.94)	82.92 (5.22)	NA	NA
		Control group	33	51.03 (10.09)	NR		163.70 (12.36)	147.70 (9.23)	99.70 (8.05)	90.45 (7.61)	NA	NA
		Low salt diet (LS)	33	47.97 (13.61)	NR		159.09 (14.19)	135.00 (9.08)	97.58 (9.67)	85.18 (4.62)	NA	NA
		Both SDB+LS	39	48.46 (7.28)	NR		161.41 (15.350	137.46 (9.61)	99.97 (12.13)	88.97 (6.47)	NA	NA

Table 2: Characteristic of Included studies of Breathing Exercises

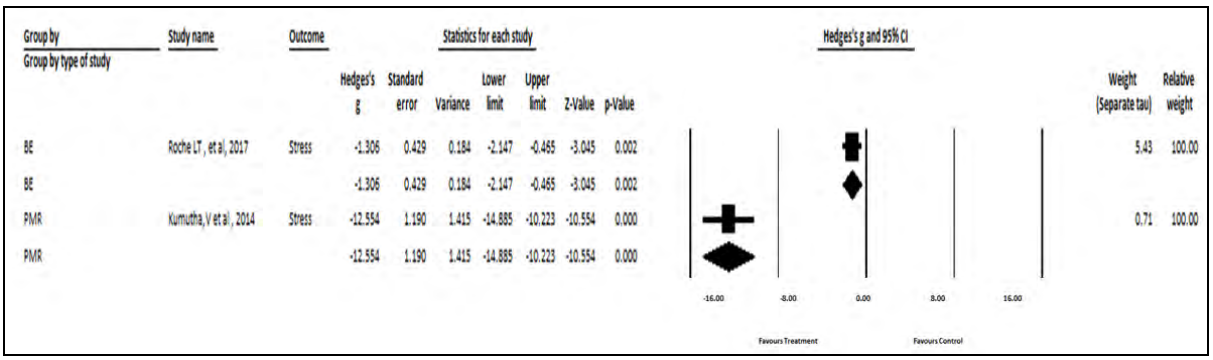

Fig 6: Forest Plot comparing Effect sizes of Stress in Experimental group versus Control Group for PMR and Breathing Exercises

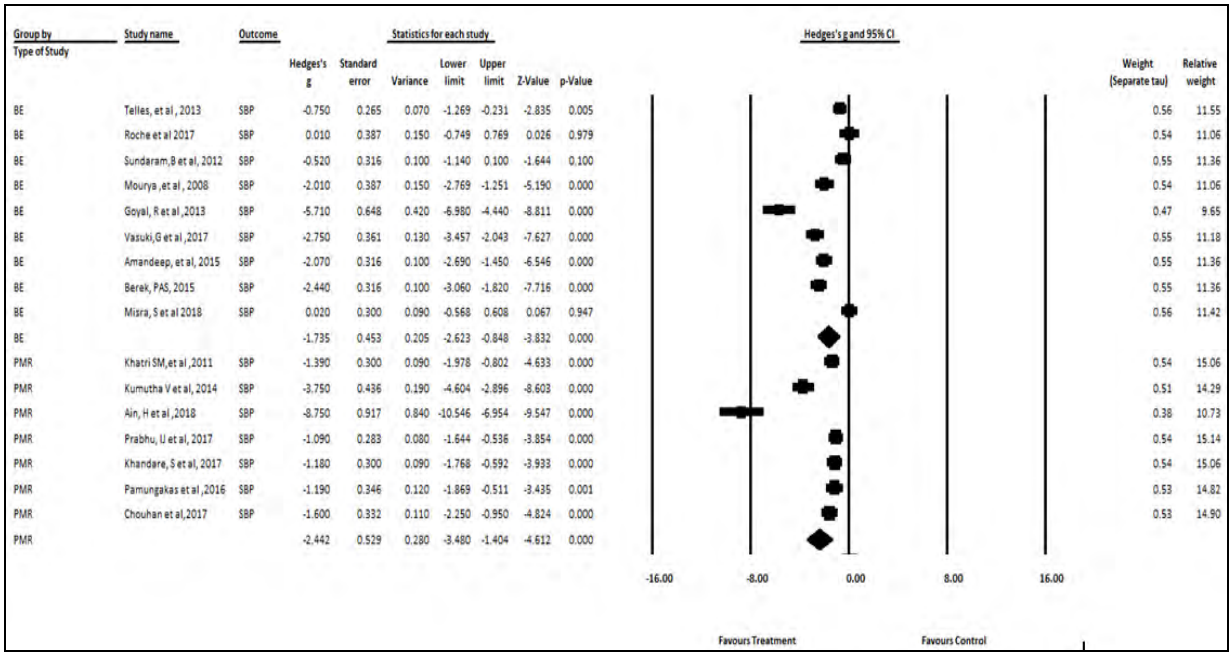

Fig 7: Forest Plot comparing Effect sizes of SBP in Experimental group versus Control Group for PMR and Breathing Exercises

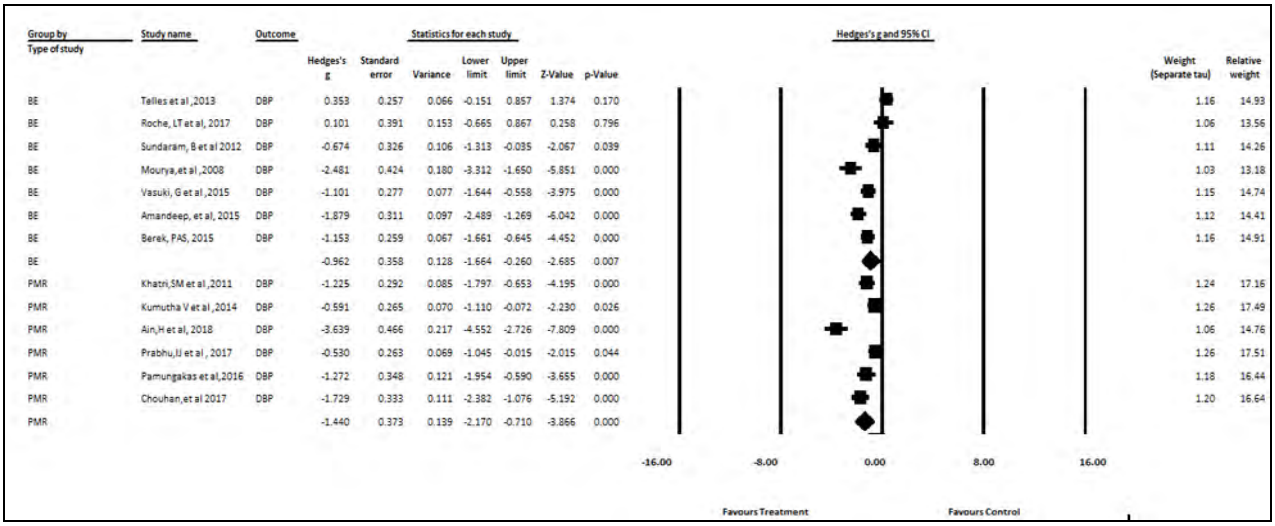

Fig 8: Forest Plot comparing Effect sizes of DBP in Experimental group versus Control Group for PMR and Breathing Exercises

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