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Rhythmic Auditory Stimulation, Controlled Isometric Handgrip and One-Nostril Breathing (RACHO) as a Combined Non-Pharmacological Strategy for Adults with Hypertension: A Narrative Review of Physiological and Psychological Evidence

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ABSTRACT:

Background: Blood pressure control in rural India remains poor, and a sizeable proportion of patients also report poor sleep, stress, anxiety or depressive symptoms. Rhythmic auditory stimulation, isometric handgrip exercise and slow left-nostril breathing are inexpensive practices that have each been studied for their effects on blood pressure or sleep, but they have not been evaluated together.

Aim: To review the evidence for each component of the RACHO package and to outline a mechanistic rationale for their combined use on blood pressure, sleep quality and psychological well-being in adults with hypertension.

Methods: PubMed/MEDLINE, Scopus, Web of Science, the Cochrane Library and Google Scholar were searched up to October 2026 for meta-analyses, systematic reviews, guidelines and relevant trials. Findings were grouped by component and outcome and appraised narratively.

Findings: In a network meta-analysis of 270 trials, isometric exercise training produced the largest fall in resting blood pressure of all exercise modes (systolic -8.24 mmHg, diastolic -4.00 mmHg). Slow-paced breathing reduced systolic pressure by roughly 5-7 mmHg, and among pranayama techniques the left-nostril forms appeared most promising. In hypertensive patients, music interventions lowered blood pressure and anxiety and

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depression scores and improved Pittsburgh Sleep Quality Index scores. Evidence supporting continuous white noise for sleep was of very low certainty. The three components appear to act on overlapping pathways, including sympathetic outflow, baroreflex sensitivity and vagal tone, peripheral resistance, stress reactivity and sleep.

Conclusion: RACHO is a low-cost package with a plausible biological basis that can be practised at home and delivered through rural primary care. Randomised trials that measure blood pressure, the Pittsburgh Sleep Quality Index and the Depression Anxiety Stress Scales-21 together are required to establish whether the combination is more effective than its individual components.

1. INTRODUCTION

Hypertension is the leading modifiable risk factor for cardiovascular death worldwide. The number of adults aged 30-79 years with hypertension doubled between 1990 and 2019, to an estimated 626 million women and 652 million men, yet in 2019 only 23% of women and 18% of men with hypertension had their blood pressure controlled below 140/90 mmHg [1]. The situation is worse in low- and middle-income countries, where the condition is often detected late and long-term follow-up is irregular.

In India, a meta-analysis of 142 community-based studies reported an overall prevalence of 29.8%, with 27.6% in rural areas and 21.1% in rural south India [2]. Awareness, treatment and control were considerably lower in rural than in urban populations; only about 25% of rural hypertensive adults were receiving treatment and about 10% had controlled blood pressure [2]. Figures from the fifth National Family Health Survey (2019-2021), summarised in a recent review, show a rural prevalence of 20.2% among women and 22.7% among men [3]. In practical terms, primary health care teams in rural Puducherry are dealing with a large number of patients who are untreated, non-adherent, or adherent but still uncontrolled.

Antihypertensive medication remains the mainstay of treatment, but current international guidelines recommend lifestyle and behavioural measures at all stages of management [4]. The American Heart Association (AHA) has also reviewed 'alternative' approaches, that is, methods other than diet and drugs, such as isometric exercise, device-guided slow breathing and meditation. The writing group considered it reasonable for individuals with blood pressure above 120/80 mmHg to use these methods as adjuncts, although most of them reduce systolic pressure by only 2-10 mmHg [5]. The statement also identified the combination of alternative approaches as an area needing research [5], and this is the question addressed in the present review.

Blood pressure is not the only concern. Hypertension frequently coexists with psychological problems. Depressive symptoms are present in about 26.8% of hypertensive adults globally [6]. An Indian meta-analysis reported a higher pooled prevalence of 39.8%, and 44.7% in the southern regional subgroup [7]. In older adults with hypertension the pooled prevalence is about 29% [8]. Anxiety is associated with an increased risk of incident hypertension (pooled hazard ratio 1.55 in prospective cohorts) [9], and chronic psychosocial stress shows a similar association (odds ratio 2.40) [10].

Sleep is also relevant. Poor subjective sleep quality is associated with higher odds of hypertension [11], and in a large Chinese meta-analysis 52.5% of hypertensive patients reported poor sleep compared with about one-third of healthy controls [12]. Stress, low mood, inadequate sleep and elevated blood pressure are thus interrelated and may together sustain sympathetic overactivity. An intervention directed at only one of these factors may therefore have a limited overall effect.

The RACHO package was developed with these interrelationships in mind. It combines three simple practices that patients can continue at home after initial training:

- **Rhythmic auditory (RA) stimulation:** listening through headphones to soft, steady sounds such as rainfall, fan noise, white noise or gentle instrumental music for 15-20 minutes at bedtime.
- **Controlled handgrip (CH):** isometric handgrip at about 30% of maximal voluntary contraction (MVC), held for 2 minutes and repeated four times with 1-minute rest intervals, on three days a week.
- **One-nostril (O) breathing:** slow, relaxed breathing through the left nostril only, traditionally known as chandra nadi pranayama.

Each of these practices has been studied separately, largely within different disciplines: handgrip training by exercise physiologists, sound and music by sleep researchers, and nostril breathing by yoga researchers. There has been little attempt to bring these findings together for clinicians. The aims of this review were therefore (a) to summarise the best available evidence for each RACHO component, (b) to describe the physiological and psychological mechanisms through which each may act, and (c) to propose a combined model, testable in a trial, with blood pressure, sleep quality and psychological distress as related outcomes.

2. METHODS

A narrative review was considered more appropriate than a systematic review. As no study has yet tested the three components together, pooling of effect sizes for RACHO was not possible. The purpose was rather to bring together separate bodies of evidence and examine them within a common physiological framework.

The following databases were searched from inception to October 2026: PubMed/MEDLINE, Scopus, Web of Science, the Cochrane Library and Google Scholar. Three groups of search terms were combined: (i) hypertension, high blood pressure or blood pressure; (ii) intervention terms (isometric handgrip, isometric exercise, white noise, pink noise, auditory stimulation, music therapy, pranayama, unilateral nostril breathing, left nostril breathing, chandra nadi, alternate nostril breathing, slow breathing); and (iii) outcome terms (sleep quality, Pittsburgh Sleep Quality Index, stress, anxiety, depression, DASS-21). The reference lists of the retrieved reviews were also checked manually.

Preference was given to meta-analyses, systematic reviews, Cochrane reviews and scientific statements. Individual trials were included where review-level evidence was limited, mainly for single-nostril breathing in hypertensive patients. We included English-language studies in adults (18 years or older) and excluded studies in children or pregnant women and those in which the practice of interest formed only a small part of a wider programme. The findings were organised by component and outcome and interpreted in relation to the known mechanisms of blood pressure regulation.

3. ISOMETRIC HANDGRIP TRAINING

3.1 Effect on resting blood pressure

Isometric exercise has the strongest evidence base of the three components. An early meta-analysis of three randomised trials (81 participants) found reductions of about 13.8 mmHg in systolic and 6.1 mmHg in diastolic pressure [13]. In a later meta-analysis of 93 trials (5,223 participants) comparing different exercise types, Cornelissen and Smart reported that isometric resistance training reduced systolic pressure by 10.9 mmHg, compared with 3.5 mmHg for endurance training and 1.8 mmHg for dynamic resistance training, although only five isometric training groups were available for analysis [14].

Subsequent analyses have strengthened this finding. Carlson et al. pooled nine trials (223 participants) and found mean reductions of 6.77 mmHg systolic, 3.96 mmHg diastolic and 3.94 mmHg in mean arterial pressure, which were larger than those reported for aerobic or dynamic resistance training [15]. The largest analysis so far, by Edwards et al., included 270 randomised trials with 15,827 participants. Isometric exercise reduced blood pressure by 8.24/4.00 mmHg compared with 4.49/2.53 mmHg for aerobic training, and was ranked first for systolic reduction (SUCRA 98.3%) [16].

It should be noted that in the secondary network analysis, isometric wall squats ranked higher than handgrip exercise [16], and a meta-analysis of mechanisms came to a similar conclusion [17]. Handgrip is nevertheless the most widely studied isometric mode, and it is the only one that older rural adults, some of whom have knee or hip arthritis, can easily perform while seated at home using a ball or spring grip. A systematic review has also specifically examined low-intensity handgrip exercise in prehypertensive and hypertensive adults, which corresponds to the intensity used in RACHO [18].

3.2 Training protocol

Most trials have used a similar protocol of four 2-minute contractions at 20-50% MVC with 1-4 minutes of rest between contractions [19]. The time required is small, about 33 minutes per week in the early handgrip studies [20]. The RACHO protocol (30% MVC, 4 × 2 minutes, 1-minute rest, on three non-consecutive days per week) falls within this range. Because 30% MVC is difficult to judge subjectively, maximal grip strength should be measured at baseline with a hand-held dynamometer, and participants should then train at the target force using a calibrated device or a ball of suitable resistance.

3.3 Proposed mechanisms

The mechanisms have not been fully established. Suggested mechanisms include improved endothelium-dependent dilatation in conduit and resistance vessels, reduced oxidative stress and improved autonomic regulation of heart rate and blood pressure [19]. Early handgrip studies mainly reported favourable autonomic changes [20]. In a meta-analysis of haemodynamic outcomes, isometric training reduced total peripheral resistance and resting heart rate (by about 1.55 beats per minute) and increased stroke volume, while cardiac output did not change. The authors concluded that the fall in blood pressure is explained mainly by reduced peripheral resistance, probably due to better autonomic control of vasomotor tone [17].

3.4 Safety and guideline position

Blood pressure rises transiently during sustained muscle contraction. Participants should therefore be told not to hold their breath (Valsalva manoeuvre), and those with very high or unstable blood pressure should be medically assessed before starting. Adverse events have rarely been reported in trials. The AHA statement graded isometric handgrip as Class IIb, Level of Evidence C (may be considered) [5]. This grading was based on the small trials available at the time, and the evidence has since been considerably strengthened by the meta-analyses discussed above.

4. AUDITORY STIMULATION: NOISE, MUSIC AND SLEEP

4.1 Continuous noise as a sleep aid

Two different types of auditory intervention are relevant here, broadband noise (white or pink noise) and music, and the two are often discussed as if they were the same. The evidence for continuous noise is weaker than its popularity would suggest. In a systematic review of 38 studies, Riedy et al. found inconsistent results, with some studies reporting better sleep and others worse. The certainty of evidence that continuous noise improves sleep was very low by GRADE criteria, and the authors raised concerns about possible adverse effects on sleep and hearing [21].

Capezuti et al. reviewed 34 studies (1,103 adults) and analysed noise types separately. Improvements in sleep were reported in one-third of white noise studies, 81.9% of pink noise studies and two-thirds of studies using mixed audio, and no adverse effects were reported with short-term use [22]. In hospitalised adults exposed to unpredictable ward noise, a review of seven randomised trials suggested that sound machines improved sleep efficiency and were well tolerated [23]. Sound masking may therefore be most useful in noisy surroundings, which is often the case in rural homes with shared rooms, livestock or road traffic.

4.2 Music and sleep quality

The evidence for music is stronger. In a meta-analysis of ten randomised trials (557 participants) with acute or chronic sleep disorders, music improved sleep quality (standardised mean difference -0.63). The effect was cumulative, and chronic sleep problems needed more than three weeks of intervention [24]. In adults without a sleep disorder the overall effect was not significant, but interventions lasting three weeks or longer did improve sleep quality [25]. A Cochrane review concluded that listening to music may improve subjective sleep quality in adults with insomnia [26], and in adults with mental health problems the effect on sleep quality was moderate (Hedges' g -0.66) after removal of an outlying study [27].

4.3 Music in patients with hypertension

Findings in hypertensive patients have changed over the past ten years. Kühlmann et al. observed only a trend towards lower blood pressure, with systolic pressure falling from about 144 to 134 mmHg in music groups, and were unable to establish a causal effect [28]. Do Amaral et al. found a reduction in systolic pressure (-6.58 mmHg) but no clear change in diastolic pressure [29]. More recent meta-analyses have reported wider benefits. Cao and Zhang included 20 trials in which 1,154 patients received music therapy, and reported mean reductions of 9.00 mmHg systolic, 6.53 mmHg diastolic and 3.76 beats per minute in heart rate, along with lower anxiety and depression scores and a 1.61-point improvement in the Pittsburgh Sleep Quality Index [30]. A subsequent meta-analysis of 21 trials found reductions of 8.26/5.91 mmHg together with lower anxiety and depression scores [31].

Cao and Zhang's review is of particular interest because it examined, in hypertensive patients, almost the same three groups of outcomes that RACHO targets: blood pressure, sleep and mood [30]. However, the sleep estimate was based on only two

studies, and many of the included trials were small, single-centre and unblinded. Music also has an emotional component that broadband noise lacks, so these findings cannot be applied directly to white noise.

4.4 Relevance to the RACHO auditory protocol

Some practical points follow for the RACHO auditory protocol. Rhythmic music or natural sounds (rainfall, running water, soft instrumental music) are probably preferable to pure white noise, and pink noise may be used where the main purpose is masking. The intervention should be continued for at least three to four weeks before sleep outcomes are assessed [24,25]. Headphone volume should be kept low, with an upper limit agreed with participants, because of the concern about hearing [21]. Steady low-level sound is thought to reduce arousal in response to sudden noise and to lower sympathetic activity at bedtime. Music, being pleasant, may in addition act through emotional pathways, which would explain its effect on anxiety and depressive symptoms.

5. LEFT-NOSTRIL (CHANDRA NADI) BREATHING

5.1 Slow breathing and blood pressure

Before considering whether the nostril matters, the effect of slow breathing itself has to be considered, as the evidence for this is larger and more consistent. A meta-analysis of 17 randomised trials of device-guided and non-device-guided (pranayama) slow breathing found mean reductions of 5.62 mmHg systolic and 2.97 mmHg diastolic, with high heterogeneity. The authors suggested that slow breathing could be offered as an initial option to low-risk patients who are unwilling to start medication [32]. A 2024 meta-analysis of 15 trials found somewhat larger reductions (7.06/3.43 mmHg) and a small fall in heart rate [33]. The AHA statement graded device-guided slow breathing as Class IIa, Level of Evidence B (reasonable to use), which is a higher grade than that given to isometric handgrip [5].

The physiological effects of slow breathing are reasonably well understood. In healthy individuals it alters diaphragmatic activity, haemodynamics and cardiorespiratory coupling, and shifts the balance between sympathetic and parasympathetic activity [34]. A systematic review of techniques using fewer than 10 breaths per minute reported consistent increases in heart rate variability and respiratory sinus arrhythmia, together with EEG changes associated with emotional regulation and psychological well-being [35]. Zaccaro et al. suggested two possible mechanisms: focused attention on internal bodily sensations, and stimulation of nasal mechanoreceptors, which may influence wider cortical activity through the olfactory bulb [35]. The second mechanism is of direct relevance to nasal, and particularly single-nostril, breathing.

5.2 Is there a nostril-specific effect?

In yoga tradition, left-nostril breathing (chandra nadi) is considered calming and right-nostril breathing (surya nadi) stimulating. Some support for this comes from a systematic review of 13 pranayama trials, which reported acute systolic reductions of 2-10 mmHg and chronic reductions of 4-21 mmHg; the best results were seen with slow techniques involving nostril manipulation, mainly left-nostril breathing [36]. The authors cautioned, however, that the low quality of the studies left the findings open to selection bias [36]. Another review of pranayama found that slow techniques improved cardiovascular and autonomic variables whereas fast techniques did not, but that results for specific-nostril techniques were inconsistent [37].

Most of the direct evidence in hypertensive patients comes from Indian centres, including two studies from Puducherry. At JIPMER, 22 patients with essential hypertension on standard treatment performed 27 rounds of left-nostril breathing, after which heart rate, systolic pressure, pulse pressure and rate-pressure product were significantly reduced [38]. In a randomised trial, also from JIPMER, alternate nostril breathing for 10 minutes twice daily for five days reduced systolic and diastolic pressure, heart rate and rate-pressure product [39]. Although these studies were small and of short duration, they indicate that the practice is acceptable to Indian patients with hypertension and can be used safely alongside medication.

5.3 Relevance to the RACHO breathing protocol

On the basis of this evidence, the RACHO breathing protocol uses a slow rate of about 10 breaths per minute or less, since much of the benefit appears to depend on rate [32,35]. Breathing is through the left nostril, in keeping with tradition and with the limited trial data available [36,38]. Exhalation is smooth and unforced, without breath retention, so that the practice stays within the form that has been studied and found safe. As the additional benefit of single-nostril breathing over slow breathing

alone is uncertain [37], breathing rate should be recorded in any RACHO trial so that the two effects can be separated during analysis.

6. OUTCOME MEASURES

6.1 Rationale for multiple outcomes

The choice of outcomes for RACHO follows from the associations described in the introduction. Stress and anxiety predict later hypertension [9,10], hypertension and poor sleep commonly coexist [11,12], and depressive symptoms are frequent among Indian hypertensive patients [7]. A trial that measures only blood pressure could miss benefits, or harms, that matter most to patients. Measuring physiological and psychological outcomes together also allows mediation to be examined, for example whether improved sleep accounts for part of any reduction in blood pressure.

6.2 Blood pressure

Systolic and diastolic blood pressure remain the primary physiological outcomes, and the method of measurement is as important as the device used. Guidelines recommend a validated, calibrated device with an appropriately sized cuff. The patient should be seated with the back supported and the arm at heart level after about five minutes of rest, and the average of several readings should be used rather than a single reading [4]. In a trial, measurements should be taken at the same time of day and, where possible, by an assessor blinded to group allocation, since even minor observer bias can obscure an effect of 5-8 mmHg.

6.3 Sleep quality: the Pittsburgh Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) assesses sleep over the previous month using 19 self-rated items grouped into seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication and daytime dysfunction. The global score ranges from 0 to 21, and a score above 5 indicates poor sleep quality [40]. A systematic review and meta-analysis supported its use as a screening tool in clinical and non-clinical populations, with the global score and most component scores distinguishing good from poor sleepers [41]. Its factor structure remains uncertain, and many validation studies did not test it formally [42], but internal consistency and test-retest reliability are generally good [43]. The global PSQI score is also the outcome most often reported in music and auditory trials [23,30], so RACHO findings could be compared directly with earlier work. Since the PSQI is a self-report measure, it is better regarded as lying between the physiological and psychological domains than as a purely physiological outcome.

6.4 Psychological distress: the DASS-21

We propose the Depression Anxiety Stress Scales-21 (DASS-21) for the assessment of psychological distress. It contains three seven-item subscales for depression, anxiety and stress [44], which correspond to the three psychological factors associated with hypertension [6,9,10]. The stress subscale is especially relevant, because chronic stress is the psychological state most closely linked to sympathetic overactivity. A review of 48 studies using the COSMIN methodology found high-quality evidence for the bifactor structure, internal consistency and construct validity of the scale, although criterion validity had been established only for the depression subscale [45]. The DASS-21 is brief and freely available. In rural areas where literacy levels vary, it should be administered by an interviewer using a validated Tamil version or one prepared by careful forward-backward translation.

Blood pressure, the PSQI and the DASS-21 together form a short, low-cost set of measures that can be completed in a single home or sub-centre visit.

7. PROPOSED INTEGRATIVE FRAMEWORK

Isometric exercise, sound and breathing may appear unrelated, but the evidence reviewed above suggests that they act on overlapping parts of the same regulatory system (Figure 1). Handgrip training appears to lower blood pressure mainly by reducing peripheral resistance, through improved autonomic control of vasomotor tone and better endothelial function [17,19]. Slow breathing shifts sympathovagal balance towards vagal predominance and increases heart rate variability [34,35]. Rhythmic sound and music seem to act mainly on arousal and emotion, helping sleep onset and reducing anxiety and depressive symptoms [24,30].

These pathways are interconnected. Both poor sleep and chronic stress maintain sympathetic activity, and both are associated with higher blood pressure [10,11]. A practice that improves sleep or reduces stress may therefore lower blood pressure indirectly, and a practice that reduces sympathetic tone may in turn improve sleep and mood. On this basis we would expect the combined package to have additive, and possibly synergistic, effects, as each component acts at a different point in the cycle. This hypothesis is plausible but has not been tested, and testing it should be the main objective of a RACHO trial.

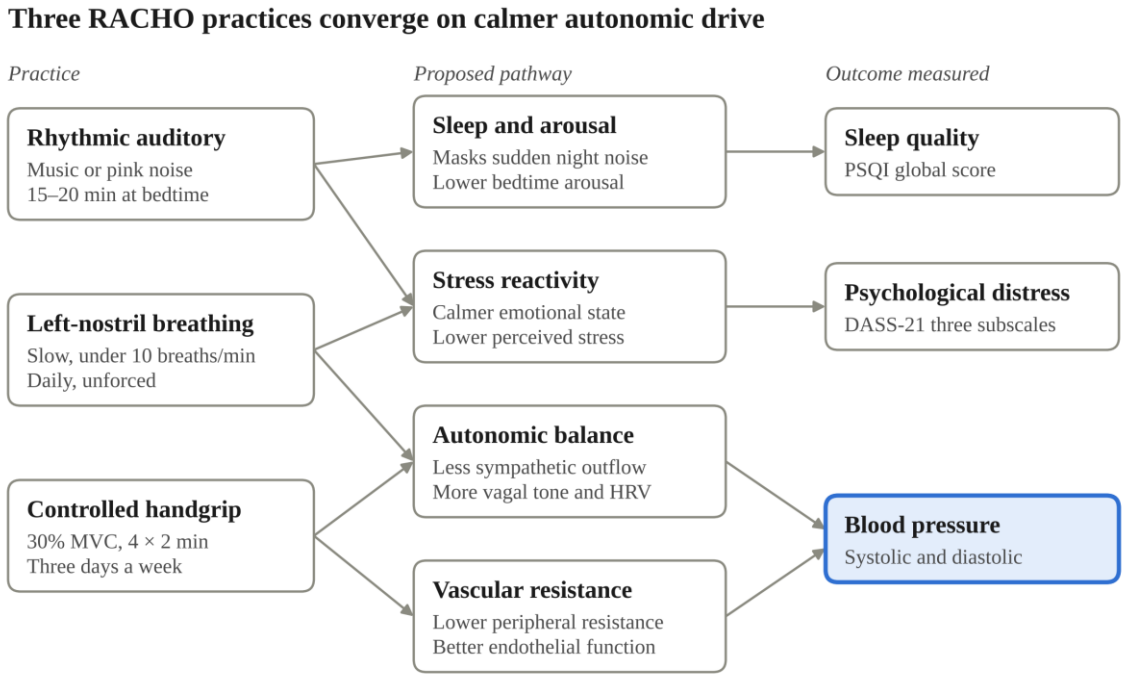


Figure 1. Proposed RACHO framework showing the three practices, the four proposed pathways and the three outcomes. Arrows indicate the main hypothesised links. The pathways are not independent, as sleep and stress also influence autonomic tone and blood pressure.

Table 1. Key evidence for each RACHO component

Component	Key source	Design and size	Main finding	Certainty and notes
Controlled handgrip	Edwards et al. 2023 [16]	Network meta-analysis, 270 RCTs, 15,827 participants	Isometric training -8.24/-4.00 mmHg; ranked first for systolic BP	High volume; handgrip ranked below wall squat as a sub-mode
Controlled handgrip	Cornelissen & Smart 2013 [14]	Meta-analysis, 93 trials, 5,223 participants	Isometric -10.9 mmHg systolic vs -3.5 endurance	Only 5 isometric groups
Controlled handgrip	Carlson et al. 2014 [15]	Meta-analysis, 9 RCTs, 223 participants	-6.77/-3.96 mmHg	Larger than dynamic training effects
Controlled handgrip	Edwards et al. 2022 [17]	Mechanistic meta-analysis	Lower peripheral resistance and heart rate; cardiac output unchanged	Indicates mechanism of BP reduction
Rhythmic auditory (noise)	Riedy et al. 2021 [21]	Systematic review, 38 studies	Mixed effects of continuous noise on sleep	Very low certainty (GRADE)

Component	Key source	Design and size	Main finding	Certainty and notes
Rhythmic auditory (noise)	Capezuti et al. 2022 [22]	Systematic review, 34 studies, 1,103 adults	Pink noise positive in 81.9% of studies, white noise in 33%	No adverse effects reported
Rhythmic auditory (music)	Cao & Zhang 2023 [30]	Meta-analysis, 20 RCTs, 2,306 participants	-9.00/-6.53 mmHg; lower anxiety and depression; PSQI -1.61 (2 studies)	Small, mostly unblinded trials
Rhythmic auditory (music)	Wang et al. 2014 [24]	Meta-analysis, 10 RCTs, 557 participants	Sleep quality SMD -0.63	Needs more than 3 weeks
One-nostril breathing	Brandani et al. 2017 [36]	Systematic review, 13 trials	Chronic systolic falls of 4-21 mmHg; left-nostril forms best	Low study quality
One-nostril breathing	Chaddha et al. 2019 [32]	Meta-analysis, 17 RCTs	Slow breathing -5.62/-2.97 mmHg	High heterogeneity
One-nostril breathing	Bhavanani et al. 2012 [38]	Pre-post study, 22 hypertensive patients	Immediate fall in heart rate and systolic BP	Single session, Puducherry

BP, blood pressure; RCT, randomised controlled trial; SMD, standardised mean difference; PSQI, Pittsburgh Sleep Quality Index.

8. DISCUSSION

8.1 Gaps in the evidence

Several gaps remain. No trial has yet tested the three components in combination, although the AHA identified the combining of alternative approaches as a research priority more than ten years ago [5]. The evidence for continuous white noise is of very low certainty [21]; music and pink noise appear more promising, but they have not been compared directly in hypertensive adults. Nostril-specific breathing is supported only by small, short and mostly unblinded studies, and whether it adds anything to slow nasal breathing is not known [36,37]. Isometric handgrip trials have rarely included rural, low-income or Indian participants, and few have reported sleep or psychological outcomes, so it is not known whether the systolic reductions of 8-11 mmHg seen in these trials apply to this population [14,16]. Finally, very few trials in this area lasted more than a few months, and there is little information on long-term adherence to home practice.

8.2 Suggested design for a RACHO trial

A randomised controlled trial (individual or cluster) in rural Puducherry comparing RACHO plus usual care with usual care alone would address several of these gaps; a factorial design could later be used to assess the individual components. The intervention period should be at least eight weeks, since the effect of auditory interventions on sleep takes three weeks or more to appear [24,25] and most isometric training programmes last four weeks or longer [14,15]. Blood pressure, PSQI and DASS-21 should be measured at baseline, at mid-intervention and at the end of the intervention, with a further follow-up visit to assess whether the effects persist. Process measures, including practice diaries, handgrip force checks, breathing rate and headphone volume, would show which components participants actually use. Antihypertensive medication and adherence must also be recorded and adjusted for in the analysis, as changes in medication use could otherwise be mistaken for an intervention effect.

8.3 Implications for rural nursing and primary care

RACHO requires very little equipment: a rubber ball or spring grip, a basic mobile phone with headphones, and a short training session. Community health nurses and mid-level health providers could teach the package during routine hypertension follow-

up and check technique at each visit. Apart from a charged phone, no electricity is needed during practice, which makes the package suitable for households with an irregular power supply or those living far from a health facility. Patients should be clearly told that it is an addition to prescribed medication and not a substitute for it, as the AHA statement also emphasises [5]. Nurses should also identify patients for whom the techniques may not be suitable, such as those with very high or unstable blood pressure (handgrip), nasal obstruction (nostril breathing) or hearing problems (headphone use).

8.4 Limitations

This review has some limitations. Being a narrative review, it did not follow a registered protocol; studies were selected on the basis of relevance and quality, and no formal risk-of-bias assessment or new meta-analysis was performed. Some selection bias in the studies cited is therefore possible. Several of the meta-analyses summarised here had high heterogeneity, small included trials and limited blinding, and their pooled estimates should be interpreted with caution. Lastly, the combined mechanistic model presented in Section 7 is a hypothesis derived from separate bodies of literature and requires direct testing.

9. CONCLUSION

The strength of evidence differs across the three RACHO components. Isometric handgrip training is supported by several meta-analyses showing reductions in resting blood pressure. Slow breathing has moderate support, while the evidence for left-nostril breathing is preliminary but encouraging. Auditory interventions appear to benefit sleep and mood when music or pink noise is used, whereas the evidence for white noise is weak. The common feature of all three is their likely action on stress responses and sympathetic activity, which contribute to raised blood pressure, poor sleep and low mood. As a package, the techniques are inexpensive, safe for most patients, easy to learn and feasible in rural homes. A well-designed randomised trial measuring blood pressure, PSQI and DASS-21 together is now needed to determine whether the combined effect is greater than that of the individual components.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

Ethics Statement

Not applicable. This narrative review is based on previously published literature and did not involve human participants or animals; ethical approval was therefore not required.

Data Availability Statement

No new data were generated or analysed in this review. All data discussed are available in the cited publications.

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