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A Physiological Assessment Of Pranayama's Impact On Autonomic Nervous System Regulation

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Abstract
The ancient breathing techniques from yoga known as pranayamas are believed to promote meditative states, lower stress levels, and expand lung capacity. It is still necessary to identify the physiological processes by which these behaviours alter the human neurological system. Reviewing research on the effects of breathing exercises on the human brain and mind was the goal of this project. We looked at English-language articles that were published between 2010 and 2024. The PRISMA guidelines served as the foundation for the inclusion and exclusion criteria used to screen publications from the Science Direct, PubMed, and Virtual Health Library databases. In addition, the Prospective Register of Systematic Reviews registration and the patient/population, intervention, comparison, and outcome techniques were taken into consideration. Fourteen out of the fifty articles met the requirements. They were compared critically to one another and shown in a table with the following columns: study, nation, sample size, age, gender, goal, method, and result. The evaluated studies demonstrated a slight but constant shift in Autonomic nervous system (ANS) metrics towards parasympathetic dominance, an increase in paroxysmal gamma waves, changes in wave power and expression in EEG reading, and improved accuracy and focus in cognitive tests. The 14 publications together emphasise the effects of yoga breathing methods on emotional and cognitive functioning. Consequently, in order to effectively substantiate these results, more extensive, well planned, randomised studies of pranayama on a variety of systems must be conducted.

Keywords: Autonomic nervous system, Brain oscillation, Breathing techniques, Paroxysmal gamma, Pranayama

1. Introduction

Yoga is an ancient Indian discipline that uses its many practices to create a way of life. Practitioners use a variety of techniques and styles to practise it, such as Pranayama (breathing manipulation), Asana (posture), and meditation (concentration technique) [1]. One technique that has been shown to have several positive effects on human physiology is pranayama. The 2 distinct halves of the Sanskrit term Pranayama are Prana, which means vital power, and Yama, which means control [2]. The direct translation is "a yogic act for controlling the flow of vital energy that regulates all bodily physiological processes." In his Ashtanga yoga, Maharishi Patanjali emphasised the value of pranayama above asana for overall wellness [3]. Three steps make up pranayama: kumbhak (retention), purak (inhalation), as well as rechak (exhalation). Depending on the kind of pranayama, they may be done either alone or in combination. In humans, breathing is an active means of communication between the body and the mind, while pranayama is the practice of controlling one's own breathing [4]. The kind and length of the practice have a significant impact on the physiological reactions that different pranayama forms elicit [5-7]. Among them, Savitri, Bhasrika, Nadisuddhi, Kapalbhati, Bhramari Pranayama, and so forth are well renowned.

Though little is known about breathing, it is a highly interconnected process with significant physiological repercussions. Breathing and the use of breathing methods are considered essential to both physical and mental well-being in many cultures. Among them are the breathing exercises known as yogic pranayama, which have a rich and ancient history of usage in Eastern civilisations [8]. This is in line with a wealth of research that connects breathing to neuronal circuits. Breathing has been related to maladaptive nervous system effects like anxiety on several occasions. According to Goodwin and Buka [9], there was a substantial positive link between respiratory problems as early as the first year of life and the requirement for subsequent therapy for an anxiety condition. There is also a relationship in adult populations between nasal obstruction in chronic rhinosinusitis and anxiety and depression scores [10-12]. Moreover, there is a strong correlation between asthma and anxiety disorders and chronic obstructive pulmonary disease [13-15]. Additionally, specific correlations between olfactory deficiencies and neuropsychiatric symptoms, such as cognitive impairment in the early stages of several neurological illnesses like Parkinson's, have been proposed [16-19]. It's interesting to note that general relaxation-oriented breathing methods have been shown to reduce anxiety and PTSD symptoms in a variety of groups [20-23]. The same is true for pranayama-based yoga techniques, which have shown comparable benefits in treating depression and anxiety [24,25]. It should be mentioned that independent studies have also shown that basic breathing techniques like slow breathing and nasal breathing improve the health of the neurological system [26].

Since the nervous system's several components are involved in breathing control, a quick synopsis of the nervous system is given here. Table 1 provides a concise synopsis of these similar processes [27]. The nervous system functions as a single, cohesive entity. Still, it is possible to distinguish certain organisational differences, the most general of which is

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between the central nervous system (CNS) and the peripheral nervous system (PNS). The brain and spinal cord make up the CNS, which is in charge of processing, perceiving, understanding, and responding. Conscious perception and voluntary reaction originate from higher brain areas, especially the cortex. An efferent division and an afferent division make up the PNS's organisational structure. In response to stimuli, the afferent, or "sensory," division produces impulses and sends them to the central nervous system. The somatic and autonomic nervous systems make up the efferent, or "motor," division, which emanates from the central nervous system (ANS). Two more divisions of the ANS are the parasympathetic and sympathetic branches [28]. Even while both divisions are always at least partially involved in functioning, one might briefly be considered to be under either sympathetic or parasympathetic dominance. A tranquil condition when non-immediate (the order of minutes) vital functions for life, such digestion, are completed and homeostasis is maximised is a hallmark of parasympathetic dominance. On the other hand, sympathetic dominance is typified by the cessation of non-essential activities and the activation of other mechanisms, such as the enhanced conversion of glycogen into glucose and the excretion of adrenaline, to prime the body for a rapid reaction. Short bursts of sympathetic dominance are always adaptive for a quick reaction to threat, while sustained sympathetic dominance is linked to long-term stress. Encouraging parasympathetic dominance is thus seen as beneficial to health since it promotes a reasonably calm state of being.

The self-induced humming sound in this pranayama exercise mimics mantra repetition method when we examine its advantages. Bhramari Pranayam alters the regular breathing pattern by inhaling briefly and exhaling slowly, which has a substantial effect on the physiological system [29]. When practicing Bhramari Pranayam for five to ten minutes straight, participants report feeling mentally refreshed and pleasant, and sometimes they even report entering a meditative state [30]. Thus, the Bhramari Pranayam method is a kind of meditation as well as a breathing exercise. It does not entail holding one's breath or using a different nostril to count as other pranayamas do. In addition to the aforementioned, the humming sound produced while breathing draws individuals in and increases their desire in doing pranayama. This makes it extremely easy to manage and verify accuracy via the humming sound that practitioners of pranayama generate.

According to reports, practicing Pranayam may effectively treat issues involving hormone imbalances as well as other illnesses including depression, anxiety, as well as hypertension. Drug dependence may be overcome thanks to Pranayam's soothing effects [31]. But up until now, relatively few scientific research have been conducted to examine the consequences of this approach.

2. Need of the review

Despite the fact that several studies have been conducted to examine the many benefits of pranayama, little is known about specific pranayama techniques. Bhramari Pranayam is one such technique with a number of health benefits but few scientific evidence to back it up. There is a paucity of information on the individual advantages of pranayama techniques; none of them specifically supports pranayam. In this study, we aim to examine the corpus of existing scientific literature on the Pranayam. We have thus thoroughly reviewed all of the research that is currently available on the topic in order to assess how the studies were carried out and which benefits of Pranayam were addressed. This assessment might assist in identifying the knowledge gaps in the existing corpus of work and explore possible new directions for scientific progress in this field.

3. Method

We followed "Preferred Reporting Items for Systematic Reviews and Meta Analyses (Prisma) criteria" for conducting this systematic review.

3.1. Search strategy

The first set of articles was gathered using the following predictors in"BREATH" OR "BREATHING" OR "PRANAYAMA" AND "BRAIN" OR "MIND." Pairs of people carried out the data extraction, analysis, and article selection processes. The search tactics were tailored based on the criteria that were accessible in every database [Table 1]. Following the discovery of the relevant literature, studies underwent a methodical filtering procedure according to predetermined inclusion and exclusion criteria. The completed papers were then reviewed through in their entirety for a content analysis.

Table (1). Scientific databases and predictors used to screen for eligible articles [Source: Author]

Academic databases	Strategy
PubMed	((BREATHING[Title/Abstract]) OR BREATH [Title/Abstract] OR PRANAYAMA[Title/Abstract]) AND (MIND [Title/Abstract] OR BRAIN [Title/Abstract]). Filters: Full text, during the last 10 years, in humans, written in English.
Science direct	((BREATHING[Title/Abstract]) OR BREATH [Title/Abstract] OR PRANAYAMA[Title/Abstract]) AND (MIND[Title/Abstract] OR BRAIN [Title/Abstract]). Filters: During the last 10 years, research articles only.

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Virtual health library	(tw:(BREATHING)) OR (tw:(BREATH)) OR (tw:(PRANAYAMA)) AND (tw:(MIND)) OR (tw:(BRAIN)). Filters: During the last 10 years, written in English.

3.2. Selection Criteria

The following inclusion and exclusion criteria were used to choose the studies:

- **Inclusion Criteria**: Research on the impact of pranayama on physiological indicators of the autonomic nervous system, such heart rate variability, blood pressure, and cortisol levels, were considered for inclusion. Both observational studies and randomised controlled trials (RCTs) were taken into account.
- **Exclusion Criteria**: Excluded from consideration were studies that only included psychological or cognitive effects of pranayama without any physiological measurements. Case studies and non-peer reviewed publications were also disregarded.

3.3. Data extraction

Following a thorough search and the selection of the studies based on inclusion criteria, two reviewers worked separately to extract the data, and discrepancies were settled by discussion. The material was then thematically removed from the final batch of articles after the writers evaluated them together. The research's goal, the technique used, the study environment, the key results, any interventions made, and any implications or suggestions arising from the study's conclusions are among the data that were extracted.

3.4. Data Synthesis

Important results, such variations in blood pressure, respiration rate, and heart rate, were taken out of research that qualified. Findings were combined with an emphasis on the physiological significance of pranayama in order to evaluate its effect on ANS regulation.

4. Result

For the purpose of this evaluation, a total of 14 research with 933 individuals were judged suitable (Figure 1). There was a great deal of variation in the designs, reporting styles, instruments, and end measures between the research. Thus, meta-analysis was deemed inappropriate. To more accurately represent the work of the current investigation, we have used in our reporting here any naming conventions and phrases that were often utilised internally by a publication. When overt mistakes were fixed for studies, there were only minor departures from this; when relevant, this will be made very explicit.

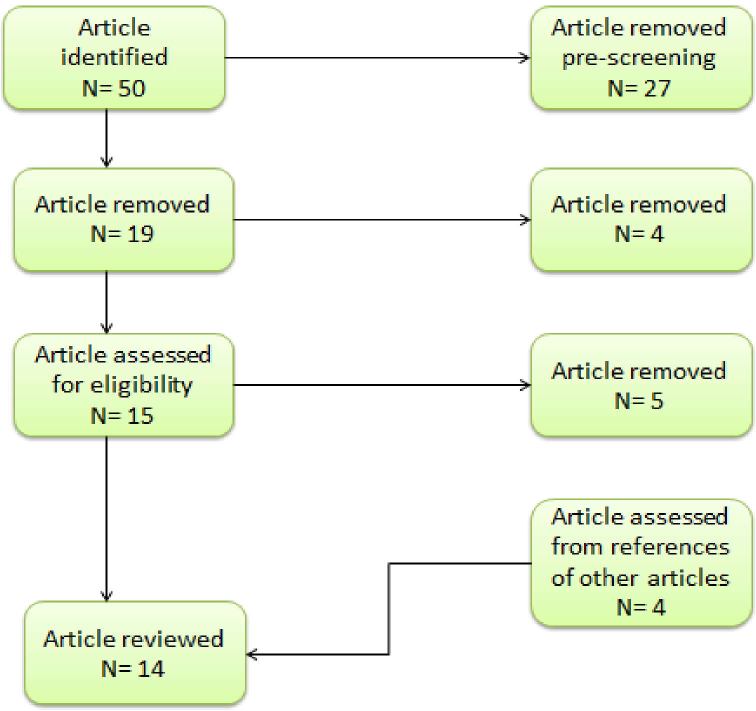

Figure (1). Prisma flow diagram illustrating the data synthesis procedure [Source: Author]

4.1. Effects of Bhramari on markers of autonomic activity

All all, there were eight major outcomes covered by the eight studies that comprised the autonomic group—five of which were longitudinal and three of which were acute—and over 748 participants—645 of whom were in the longitudinal studies and 103 of whom were in the acute studies. Tables 2 and 3 provide a comprehensive breakdown of

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autonomic outcomes per research. In general, studies revealed a slight but steady trend towards parasympathetic dominance.

Table 2: Longitudinal studies examining the effects of Bhramari on markers of autonomic nervous system function [Source: Author]

Participant information	**Intervention**	**Data collection protocol**	**Results**	**Reference**
Experiment group: 127 males & 109 females. No experience, all healthy. 13 – 18 years (mean n/r)	3 to 6 breaths per minute, then 2 minutes rest for 5 rounds, 5 times a week for 6 months, inhalation/exhalation ratio n/r. Eyes closed, tragus depressed.	ECG, sampling frequency n/r. Testing conducted in the morning after 15 minutes of 'supine rest seated on a couch', ECG then recorded for 5 minutes	Intervention relative to control #: ΔHR; - 6.5 bpm†, ΔR-R; 43.1 ms†††, ΔNN50; 4†, ΔRMSDD; 2.1 ms†	[32]
			Intervention group: HR pre; 74.3±4.3 bpm, HR post; 69.7±5.3*** bpm, ΔHR; -4.6±1.4† bpm, RR pre; 739.1±53.2 msec, RR post; 779±61.6*** msec, ΔRR; 39.9±8.3††† msec, NN50 pre; 26.3±10.2, NN50 post; 29.7±11***, ΔNN50; 3.4±0.5†, RMSDD pre; 60±13.5 ms, RMSDD post; 62.1±16.9 ms***, ΔRMSDD; 2.1±0.3 ms†.	
Control group: 141 males & 101 females. No experience, all healthy. 14 – 18 years (mean n/r).	Non-treatment group used as control, performed only their usual routine		Control group: HR pre; 73.2±6.1 bpm, HR post; 75.2±5.7 bpm, ΔHR; 2±1.5† bpm, RR pre; 753.8±49 ms, RR post; 750±57.5 ms, ΔRR; -3.2±0.9 ms†††, NN50 pre; 27.3±10.6, NN50 post; 26±11.1, ΔNN50; -0.6±0.9†, RMSDD pre; 58.8±14.3 ms, RMSDD post; 58.1 ± 13 ms, ΔRMSDD; -0.7±1.2 ms†.	

22 males & 32 females. Experience n/r, 9 male and 12 female hyper-reactors, 13 male and 20 female hyporeactors to cold pressor test. 18 -24 years (mean n/r).	Preformed for 15 minutes in the morning, 15 minutes in the evening, inhalation/exhalation ratio n/r and hand placement/Mudra n/r. Duration of 90 days. Selfcontrol.	Sphygmomanometer, cold pressor test, 3°-4°,C hand submerged to the wrist. Elevation over of systolic pressure over 20 mmHg or diastolic over 15 mmHg was considered hyper-reactive	Base hypo-reactors Systolic; 114.7±6.7, base hypo-reactors Diastolic; 74.7±5.9, base hyperreactors; 119±6.3, base hyper-reactors Diastolic; 76.4±5.7. Hypo-reactors post test rise Systolic; 13.2, Hypo-reactors post test rise Diastolic; 9.1. Hyper-reactors post test rise Systolic; 19.2, Hyper-reactors post test rise Diastolic; 14.7. Hyper-reactors post intervention rise Systolic; 15.7±2.9*** (T value 6.4), hyper-reactors post intervention rise Diastolic; 11.6±1.9*** (T value 5.6). Hyper-reactor HR pre; 79.1±5.2, Hyperreactor HR post; 71.3±5.4**. Hyper-reactors respiratory rate pre; 20.4±2.2, Hyper-reactors resporatory rate post; 16.5±1.4**	[33]

"Note. *p =<05, **p =<0.01, ***p = 0.001. †Between group =<0.05, ††between group =<0.01, †††between group =<0.001."

Table 3: Studies examining the acute effects of pranayama on markers of autonomic function [Source: Author]

Participant information	**Intervention particulars**	**Data collection protocol**	**Results**	**Reference**
Experiment group: 17 males & 15 females. No experience, all hypertensive. 30 – 70 years (mean n/r).	Preformed for 5 minutes, eyes closed, 6 to 4 bpm, inhalation/exhalation ratio n/r and hand placement/Mudra n/r.	Ambulatory blood pressure monitor, Digital Holter recorder, low frequency band 0.04-0.15 Hz and high frequency band 0.15-0.4 Hz. 5 mins of resting, 5 mins of intervention, then recover (duration n/r), readings taken throughout all	Findings of interest: RMSDD during; 21.4±1.6† m	[34]
			Intervention group: HR n/r, N-N n/r, R-R n/r, RMSDD pre; 20.9±1.7 sec, RMSDD during; 21.4±1.6† sec, RMSDD post; 22.4±1.7 ms, Systolic pre; 131.7±9.6 Hg, Systolic during; 131.7±12.8 Hg, Sytolic post; 131.7±10.9 Hg, Diastolic pre; 91.4±7.7 Hg, Diastolic during; 94.5±8.81 Hg, Diastolic post; 92.3±8.7 Hg.	
Control group: 19 males & 16 females.	Slow breathing used as control,		Control group: HR n/r, N-N n/r, R-R n/r, RMSDD pre;	

No experience, all hypertensive. 30 – 70 years (mean n/r)	Preformed for 5 minutes, eyes closed, 6 to 4 bpm, inhalation/exhalation ratio n/r and hand placement/Mudra n/r, "sss" used instead of "mmm".	phases.	23.4±1.7 sec, RMSDD during; 28.9±1.7 sec, RMSDD post; 21.4±1.6 sec, Systolic pre; 127.8±12.9 Hg, Systolic during; 127.1±16.3 Hg, Sytolic post; 125.8±12.6 Hg, Diastolic pre; 88.1±9.8 Hg, Diastolic during; 87.4±11.3 Hg, Diastolic post; 88.3±9.2 Hg.	
9 males & 7 females. One year of yoga experience, all healthy. Age range n/r (23.5 ± 3.0).	Preformed for 5 minutes, 6 bpm, inhalation/exhalation ratio n/r and hand placement/Mudra n/r.	ECG, sphygmomanometer, electrodes placed as standard limb lead II configuration, sampling rate of 1024Hz. HRV recordings taken for 5 mins at baseline, 5 min during and 5 mins postintervention.	Findings of interest #: ΔHR during; 4.17 bpm*, ΔSBP post; -5 Hg*, ΔSDP post; -4.5 Hg*. HR pre; 83.1±8 bpm, HR during; 87.4± 6.4* bpm, HR post; 81.8± 6.6 bpm, R-R pre; 736.3±81.4 msec, R-R during; 727.2±82.1 msec, R-R post; 745.2±64.7 msec, N-N pre; 61.8±47.3, N-N during; 51.6±28.7, N-N post; 57.7±52.8, RMSDD pre; 39.3±16.9 sec, RMSDD during; 37.4±19 sec, RMSDD post; 40.6±13.1 sec, Systolic pre; 115.5±7.8 Hg, Systolic post; 110.5±8.6* Hg, Diastolic pre; 76.9±6.3 Hg, Diastolic post; 72.4±5.9* Hg	[35]

"Note. *p =<05, **p =<0.01, ***p = 0.001. †Between group =<0.05, ††between group =<0.01, †††between group =<0.001."

4.2. Longitudinal effects of Bhramari on autonomic state and function

Table 2 summarises research looking at Bhramari's long-term impact on autonomic function. The only two randomised, control, single blind trials were Kuppusamy et al. [32] and Maheshkumar et al. [36]. Because of the nature of their research, neither Rampalliwar et al. [37] nor Jain et al. [33] were able to use a control group or be randomised. Generally speaking, very little information on the design and methods of these two research was given. The same cannot be stated for Goyal et al. [38], who did use a control group but did not disclose any blinding or randomisation procedures. Heart rate (HR) change for the longitudinal studies varied from -6 in moderate hypertensives as reported by Goyal et al. [38] to - 7.8 bpm in healthy (but inactive) **persons** as reported by Jain et al. [33]. It should be mentioned that, for the sake of comparison, Kuppusamy et al. [32] and Rampalliwar et al. [37] both found -6.5 for a healthy population.

4.3. Acute effects of Bhramari on autonomic state

One of the 3 acute investigations fits the definition of a traditional randomised control trial. Although Ghati et al. [34] used a control group and randomisation that was compatible with this design, they omitted any discussion of blinding. Nevertheless, based on a review of the available data, it is plausible to assume that blinding—at least partial blindness, or single blinding—did take place in this case. It should be noted that the study's control group vocalised the sound "SSSS." Intergroup analysis will not be acceptable in this specific instance, but it does not exclude this research from inclusion since it does not alter the intervention parameters as defined for the objectives of this review. The two additional investigations were of a single group. Again without mentioning blinding, Nivethitha et al. [39] carried out a research including 4 distinct pranayamas, each of which had a randomly assigned sequence for each participant.

In summary, the HR variations observed in acute investigations varied between -1.3 and -2 bpm [39, 35]. According to Goyal et al. [38], Nivethitha et al. [35], only the latter was significant, with the range of BP change being SBP 0 and DBP 0.9 to SBP -5 and DBP -4.5 [38,35]. Only Ghati et al. [34] reported the RMSSD measure and saw a non-significant rise of 1.5 ms. Furthermore, LF/HF experienced a comparable decrease of 0.5 in Ghati et al. [34] and an increase of 2.13 in Nivethitha et al. [35]; the latter was not significant, while the former by definition cannot be confirmed as significant.

4.4. Effects of Bhramari on brain waves

Research revealed enhanced wave power as well as expressiveness, symmetrical activation, especially in the temporal areas, and an increase in paroxysmal gamma waves. Ten subjects in all were watched in the six EEG experiments. This covered two noteworthy data sets: one of two persons described in Rajkishor et al. [43], Prasad and Matsuno [44], as well as Prasad et al. [45], and one of 8 people reported in Jin et al. [40], Vazquez et al. [41], as well as Vialatte et al. [42]. Vazquez et al. [41], who carried out both a new and a conventional analysis. To reconstruct the whole 128 channel EEG, this technique included principal component analysis initially, blind signal separation, feeding into a proximal gamma waves detector, source localisation, and back projection. The results of this innovative approach were mostly consistent with those of the standard study.

4.5. Risk of bias assessment

The risk of bias in each study was evaluated using the Revised Cochrane risk-of-bias instrument for randomised trials (RoB 2) tool [46]. The use of this technique was a convoluted and dubious process because of the significant variability throughout research, which weren't usually in the form of randomised controlled trials. Consequently, while processing studies, the greatest charity was used.

5. Discussion

To the best of the authors' knowledge, this review examined as many outcome domains as possible in order to examine the effects of pranayama, making it the most comprehensive and extensive of its type. Upon examination of the retrieved data, it is evident that Bhramari has a consistent, if somewhat little, impact. Starting with the ANS research, every single one of them indicated some kind of impact. Upon examining the ranges associated with the impact under consideration, some intriguing patterns emerge. Specifically, the longitudinal studies seem to exhibit higher levels of statistical significance and effect magnitude compared to the acute investigations. This is true for variations in HR, RMSSD, and LH/HF data, with only longitudinal studies showing any discernible relationship [39,38,35,33].

The EEG experiments, which were all conducted on an acute time scale and showed at least some degree of consistent impact independent of experience level, further emphasise the significance of this fact. First, the spectral power and fundamental symmetry alternation is noteworthy. Prasad et al. [45] discovered that although all wave bands underwent some degree of modification, not all wave types could be examined equally because of confounding variables taken into consideration in the current investigation. Theta and Gamma waves, on the other hand, are significant because they are linked to a calm, deliberate state of meditation and deliberate, focused directed awareness, respectively. In this research, both subjects had an offset of Theta waves with a novel wave pattern (spikes absent in the control condition) and an initial rise in gamma wave strength that decreased to control levels before stabilising. This was true for both hemispheres, however subsequent research with more focused analytics revealed lateralisation tendencies.

According to Jin et al. [33], Vazquez et al. [41], and Vialatte et al. [42], the temporal lobes seemed to be the primary area of activity. It is also important to highlight the work of Vialatte et al. [42], who located activity on the left temporal lobe using a LORETA. Vazquez et al. [41] also identified this area. Nonetheless, these results are limited to PGW activity, with nothing to be stated regarding Theda symmetry. Regarding Theda waves, however, Vialatte et al. [42] also discovered that both wave types had the same power-dropping impact as reported by Prasad et al. [45].

In fact, the sample size and cohort concerns should be brought out most explicitly when discussing the limits of the EEG investigations. To the best of our knowledge, the six investigations had a total of 10 participants, most of whom are probably male. This makes it more difficult to cross-check research findings in order to draw meta conclusions. In addition, each study utilised a different analytical approach for the most part, and data reporting varied from one study to the next. Furthermore, some of these analytic methods are now considered to be relatively outdated, and the absence of standardisation for brainwave ranges—such as high and low frequency waves as described by Prasad et al. [45] further emphasises the previously noted problem.

Interestingly, however, there was one last area of agreement between Vazquez et al. [41] as well as Vialatte et al. [42]: the signal was clearly impacted by the inhalation/ exhalation cycle. While not the primary focus of either research, they both noted that the signal obtained during exhale was more steady and clearer than during inhalation. Since PGW patterns were the main focus of these investigations, the phenomena in the brain was constant throughout. The PGW signature itself of interest was really only present during exhale for four (B1, I2 - 5) of the eight subjects, according to Vialatte et al. [42], who also provided some metrics on this occurrence. While it was present upon inhalation for the other individuals as well, it was, as previously indicated, weaker and more unsteady. However, a delay value of 1.2±0.1 sec may be obtained from the data of the first four subjects. Once again, the results show that breathing in and out has a constant, quantifiable impact on the cortex, even if the total sample size of these two experiments is too small to allow for a thorough evaluation or confirmation of such an effect.

6. Conclusion

Breathing methods based on yoga have been used for millennia and have been transmitted orally and in writing down to the present day. This review aimed to elucidate the impact of pranayama based on the research that has been conducted so far. The restricted breadth of research on pranayama is aided by the heterogeneity of the existing studies, which cover a variety of topics. Despite the small number of studies, this opens up the possibility of further in-depth investigation into this area. In conclusion, it has been shown that the autonomic nervous system (ANS) is significantly impacted by the practice of pranayama, which incorporates controlled breathing methods. Because pranayama modulates the balance of the autonomic nervous system, it has therapeutic promise for the management of respiratory diseases, hypertension, and stress-related illnesses. To completely comprehend its long-term impacts and therapeutic uses in medical and wellness settings, further research—including clinical trials—is necessary.

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