

Effectiveness of Yoga as a Complementary Therapy for Anorexia Nervosa: A Systematic Review

Abstract

Anorexia nervosa (AN) is a severe psychiatric condition associated with high disability and mortality. The purpose of the present manuscript is to critically summarize evidence about the effectiveness of yoga for this condition. A bibliographic search was conducted in the main database sources (PubMed, Embase, and Scopus). Articles in English about the effectiveness of yoga in AN were included. Two hundred thirty-three articles were initially identified and 5 articles were included in the present review. With the exception of one study, all had several methodological limitations such as the presence of confounding factors (e.g., psychiatric comorbidity) or a too limited sample of patients. However, globally yoga seems to ameliorate AN symptoms, especially those regarding emotional dysregulation. Yoga is a candidate complementary treatment for the management of AN, but more randomized controlled studies with larger samples and limited bias are necessary to draw robust conclusions. It would be also interesting to verify in comparative trials the effectiveness of yoga with respect to other treatments such as psychotherapy or the administration of pharmacological compounds. Finally, the practice should be modified adapting to the specific needs of this type of patient.

Keywords: *Anorexia nervosa, asana, chakra, pranayama, treatment, yoga*

Introduction

Anorexia nervosa (AN) is a serious mental disorder associated with relevant disability and high mortality (at least 5 times more than the general population).^[1] Even though this disorder traditionally affects young females in Western countries, its incidence is increasing in non-Western countries, males, and very young people (<15 years).^[2] Both psychosocial and biological factors contribute to the development of this disorder.^[3] Among biological aspects, the presence of relatives affected by the disorder^[4] as well as a dysregulation of hormones/neuropeptides regulating appetite (e.g. leptin)^[5] were identified as risk factors for the onset of AN. In addition, chronic malnutrition would contribute to structural changes in the brain,^[6] in turn associated with persistence of symptoms.^[7] Some psychological factors were identified as conferring vulnerability to the disorder including perfectionism, cognitive rigidity, and social cognition deficits.^[8] Furthermore, specific clinical factors contribute to worsen the course of the disorder such as the presence of

substance use disorders,^[9] family history of AN,^[10] and early age at onset.^[11] All these aspects explain why about half of patients affected by AN do not respond to recommended treatments that consist mainly in cognitive behavioral approaches for adults.^[12,13] With regard to pharmacotherapy, only olanzapine but limited to weight gain is mentioned by guidelines for AN.^[14] In this context, new treatment approaches are, therefore, necessary to manage these patients.^[15] Different complementary and alternative approaches have been tested so now in patients affected by AN with variable results, including brain stimulation techniques,^[15] Pilates,^[16] expressive therapies, and traditional yoga.^[17]

Yoga is a practice born in ancient India whose purpose is to alleviate human suffering. It involves physical positions (*asana*), breathing approaches (*pranayama*), meditation techniques (*dhyana*), symbolic gestures (*mudra*), purification practices (*kriya*), and sacred verbal expressions (*mantra*).^[18] The idea is to enliven and correctly channel vital

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energy (*prana*)^[19] to bring physical and psychological benefits.^[19] The original technique (*hatha yoga*: *Ha*-sun and *tha*-moon) spread in Western countries during the 20th century, giving birth to numerous variants which differ in purpose, rhythm, and use of breathing (e.g., *ashtanga* or *yin yoga*).^[18] Yoga is based on a solid theoretical foundation (*samkhya*) which sees the individual as being made up of a spiritual component (*purusa*) and a material part (*prakriti*), which in turn is constituted by the physical/energetic body and mind.^[20] The energetic part includes conductors (*nadi*) and transformers (7 *chakras*) that support specific psychic functions, while the cognition includes intellect (*buddhi*), the identification of self (*ahamkara*), and the sensory mind (*manas*).^[20,21]

Patients with AN present mental fixity with a focus on thoughts related to their body image.^[22] On the one hand, the mind is hyperactive, but on the other, it is totally dissociated from internal (e.g., appetite) and external sensations (e.g., altered perception of one's own body and that of others).^[22] Self-satisfaction in resisting appetite and altered perception of the surrounding environment contributes to deficits in social cognition.^[23] From the yoga point of view, patients affected by AN would present, therefore, hypertrophy of self (*ahamkara*) as well as a deficit in inferior *chakras* (I and II), excess of III *chakra*, and deficit of IV *chakra*. *Ahamkara* is continuously potentiated by the desire for an even slimmer body and from the heroic resistance to hunger.^[24] In addition, these patients have difficulty in fulfilling primary needs (e.g., nutrition for survive-I *chakra*), in having a balanced position between pleasure and pain (II *chakra*), in resting (III *chakra*), and in having intimate relationships with others (IV *chakra*).^[25] They have problems to access to upper *chakras* as a result of the unstable foundations of the lower ones.^[25]

Yoga may have different beneficial effects on patients with AN by reducing anxiety before meals,^[26] ameliorating the distortion of body image,^[27] enhancing introspection and interoception,^[28,29] increasing bone mineral density,^[30] balancing brain-gut axis,^[31] and finally, suspending judgment toward oneself.^[32] On the other hand, the practice should be adapted for these patients to avoid potential side effects including excessive physical exercise,^[28] orthorexia,^[33] and extreme focus on physical appearance.^[31] Furthermore, more severe patients may have difficulty assuming certain poses (e.g., chair pose-*uktatasana*) due to the deterioration of large muscles such as the quadriceps femoris.^[34] Despite these limitations, yoga can be helpful as it has demonstrated to ameliorate immune function and stress hormone release in healthy subjects^[35] and these beneficial effects would seem to be proportional to the frequency and experience in practicing yoga.^[36] Neuroimaging studies demonstrated a beneficial effect of yoga on different brain areas^[37] including those that are more involved in AN pathophysiology such as the cingulate cortex.^[38] Finally, this practice seems to positively

modulate appetite hormones such as ghrelin^[39] whose values are altered in AN patients.

In light of these considerations, the purpose of this review is to summarize the emerging available data about the effectiveness of yoga in patients with AN. This article could be an incentive to reflect on how to adapt the practice to obtain the maximum benefits of yoga in these patients.

Methods

The present project of the review was registered on the Open Science Network (<https://osf.io/nj4g6/>). A bibliographic search was conducted by two researchers independently, in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses Guidelines for systematic reviews, through the following databases: PubMed, Embase, and Scopus. Articles published until June 30th, 2024, were included. The keywords “yoga,” “pranayama,” and “dhyana” were individually matched with the term “anorexia” (MeSH terms: Anorexia AND [yoga OR pranayama OR dhyana]). This search strategy was applied for all mentioned databases (PubMed, Embase, and Scopus). Articles in English about the effectiveness of yoga in AN were included. The exclusion criteria were the following: animal studies, reviews, editorials, meta-analyses, case reports, articles in languages different from English, unavailability of main data, and studies with most patients with an eating disorder diagnosis different from AN.

A first selection of articles was realized according to the title, thus excluding those with subjects not affected by AN or who did not undergo Yoga sessions as well as reviews, meta-analyses, editorials, and case reports. After this initial screening, each article underwent a full-text review to determine its relevance and adherence to the inclusion criteria. The screening and the extraction, as well as the full-text review, were performed by two researchers independently (MB and FL) and the articles on which there was no consensus were evaluated collectively. Finally, an evaluation of the quality of the included studies was performed according to the Qualitative Assessment Tool for Quantitative Studies.^[40]

Results

General considerations

Two hundred thirty-three articles were initially identified, 112 were duplicated, and 116 were excluded according to the abovementioned criteria [Figure 1]. The remaining 5 articles were included and the findings are described in the present review [Table 1]. In Table 2, the quality evaluation of the studies is reported. All the articles with the exception of one^[41] had multiple weaknesses concerning the selection bias, study design, or the presence of confounders. The included studies do not specify if subjects were practicing any physical activity or had previous experience of yoga

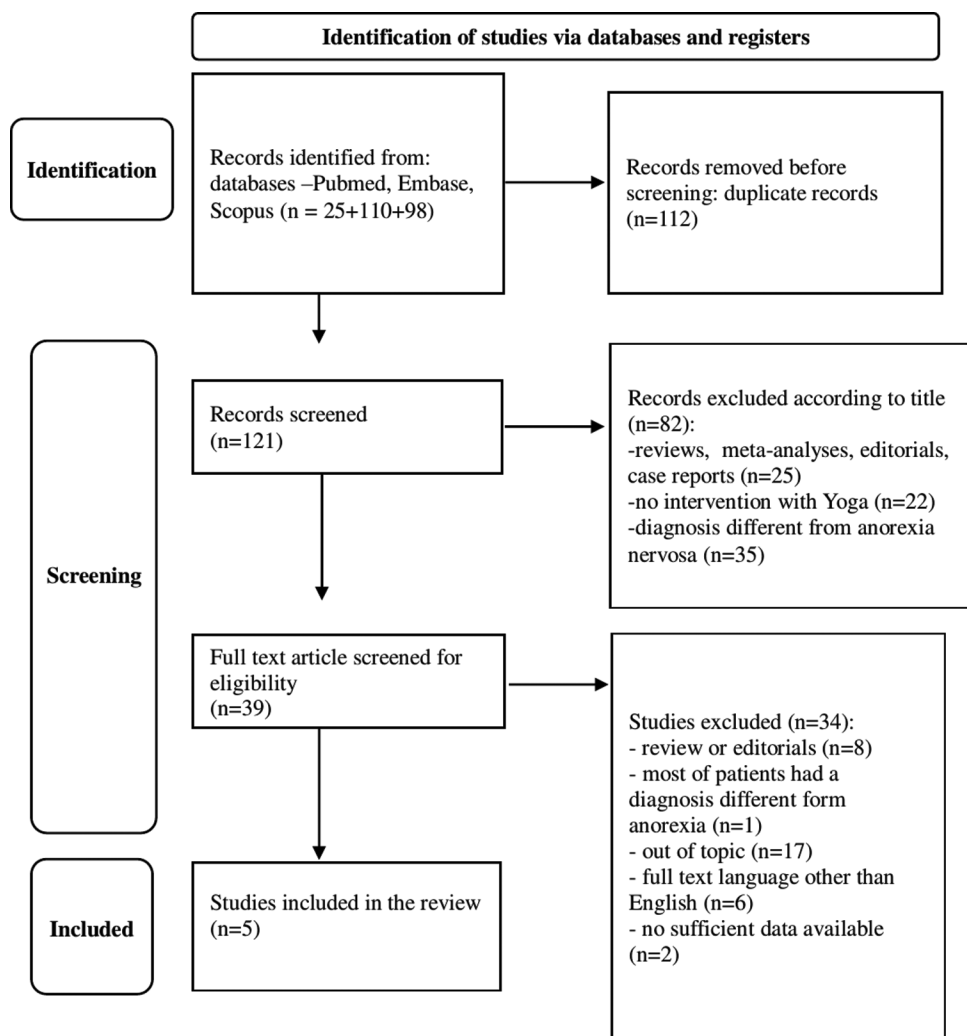


Figure 1: Preferred Reporting Items for Systematic Reviews and Meta-analyses diagram for systematic reviews

with the exception of the study by Demartini *et al.* where it is reported that all participants were naive to yoga.^[29]

Going into detail about the quality of the included studies, Carei *et al.* did not exclude the possibility of psychiatric comorbidity,^[41] the study by Pacanowski *et al.*^[42] had a small sample size and potential selection bias (all subjects were within a residential program), Simone *et al.*^[43] as well as Demartini *et al.*^[29] published the results of nonrandomized small sample size, the study by Ziv *et al.*^[30] consisted of a very small sample size and did not exclude comorbid depressive disorders.

Type of practice

The type of administered yoga sequence varied across the studies. In one of these, it is only specified that the practice was administered by certified Yoga Alliance instructor following a manual of instructions.^[41] In another, this information is not available,^[43] while in the article by Ziv *et al.*^[30] is reported that a gentle yoga intervention was administered to patients. On the contrary, the studies by Pacanowski *et al.*^[42] and Demartini *et al.*^[29] as the first authors

reported more details about this aspect. In the first article, the authors declared to have applied a practice focused on reducing anxiety before meals and balancing an autonomous system. For this purpose, the yoga teachers recurred to alternate nostril breathing (*nadi shodhana*) and *asana* such as downward dog (*adho mukha svanasana*), warrior 2 (*virabhadrasana 2*) and tree pose (*vrksasana*), supine pigeon (*supta kapotasana*), and legs up the wall (*viparita karani*). *Nadi Shodhana* is a calming breath, the *asanas* are all grounding potentiating the low *chakras* and, with the exception of *virabhadrasana 2*, are cooling poses. In the second article, the classes included 45 min of warm-up with backward and forward bends, adapted inversions and twists, 15 min of deep relaxation, and finally, 15 min of alternate nostril breathing. Backward bends potentiate the IV *chakras* linked to emotions and quality of relationships, which are compromised in patients affected by AN.^[44]

Psychometric tools

Three studies employed the eating disorder examination questionnaire (EDE-Q) to assess the severity of AN

Table 1: Summary of the findings about the effectiveness of yoga on anorexia nervosa

Study	Country	Type of study	Sample	Intervention	Outcome	Results
Carei <i>et al.</i> , 2010 ^[41]	US	8-week randomized controlled study	53 outpatients, aged 11–21 years, most of them affected by AN (55%)	Patients were randomized to standard care ($n=27$) or augmentation with 8-week individualized yoga (Viniyoga) administered twice a week for 1 h ($n=26$)	Change in the following rating scale scores EDE-Q EDE-FP BDI-II STAI Change in BMI	↓ EDE-Q scores at 3 months from baseline > in yoga versus nonyoga group (time × treatment effect: $P=0.05$, $d=0.51$) After each yoga session participants showed a significant ↓ EDE-FP than the beginning of each practice ($P<0.01$) ↓ BDI-II scores in both groups (no significant treatment differences) ↓ STAI scores in both groups (no significant treatment difference) ↑ BMI from baseline > in yoga versus non-yoga group (treatment effect: $P=0.04$, $d=0.62$)
Pacanowski <i>et al.</i> , 2017 ^[42]	US	5-day randomized controlled study	38 young adults hosted in a residential eating disorder treatment facility, most of them affected by AN (58%)	Participants were randomized to standard care (e.g. supervised free time) ($n=18$) or yoga intervention ($n=20$): 1 h of yoga before dinner for 5 days	Variations in the following rating scale scores after 5 day-intervention EDE-Q Negative affect portion of the PANAS	Yoga=standard care ($P=0.81$, $d=0.08$) Yoga > standard care ($P=0.007$, $d=0.46$)
Simone <i>et al.</i> , 2017 ^[43]	Italy	7-week open-label study	8 adolescents	Participants underwent 14 yoga sessions (twice a week) with a duration of 60–80 min each	Variations in the following rating scale scores at the end of the intervention EDI-3 PWB	Significant improvement only on emotional dysregulation item ($P<0.05$) No statistically significant change
Demartini <i>et al.</i> , 2021 ^[29]	Italy	Single hatha yoga class observational study	15 young adults affected by AN and 20 healthy controls	Both patients and healthy controls underwent to a single 75-min hatha yoga class	Variation in IAC measured by heartbeat count	Healthy controls but not patients improved their IAC after the single yoga session ($P=0.009$, $d=0.97$)
Ziv <i>et al.</i> , 2023 ^[30]	Israel	24-week randomized controlled study	15 female adolescents affected by AN	Patients on standard outpatient care were randomly divided into 2 groups: Twice weekly yoga sessions (yoga group: $n=7$) and non-yoga group	Change in bone mineral density, depressive symptoms (BDI) and AN psychopathology (EDI-2)	The adjunct of yoga to standard treatment resulted in statistically significant improvement of axial bone mineral density, depression ($P=0.049$), and AN psychopathology ($P=0.02$) in comparison with the non-yoga group

AN: Anorexia Nervosa, BDI: Beck depression inventory, BDI-II: BDI, second edition, BMI: Body mass index, d: Cohen’s d, EDI: Eating disorder inventory, EDE-Q: Eating Disorder Examination Questionnaire, EDE-FP: Eating disorder examination modified food preoccupation item, n : Sample size, IAC: Interoceptive accuracy, PANAS: Positive and negative affect schedule, PWB: Psychological Well-Being Scale, STAI: State-Trait Anxiety Inventory, US: United States

symptoms,^[30,41,42] while another the eating disorder inventory-3 (EDI-3).^[43] EDE-Q is a reliable instrument to evaluate dietary restraint, body dissatisfaction, and overvaluation of weight and shape in patients affected by AN:^[45] it consists of 28 items (scored from 0- no days to 6-all days) grouped in 4 subscales (restraint, and eating, weight and shape concerns).^[46] Questions 13–18 do not contribute to the total score and ascertain the frequency of bingeing and compensatory behaviors.^[46] The EDI-3 is a

questionnaire consisting of 91 items that assess 12 different psychological dimensions (3 strictly related to eating disorders).^[47] Demartini *et al.*^[29] as well as Ziv *et al.*^[30] measured AN severity by administering EDI-2, a previous version of EDI-3 consisting of the same 91 items, but with a different scoring system.^[48] Furthermore, the different authors used other rating scales to measure the presence and severity of psychopathological aspects different from eating disorders: Depression by the Hamilton Depression Rating

Table 2: Evaluation of the quality of included studies

Study	Quality rating
Carei <i>et al.</i> , 2010 ^[41]	2
Pacanowski <i>et al.</i> , 2017 ^[42]	3
Simone <i>et al.</i> , 2017 ^[43]	3
Demartini <i>et al.</i> , 2021 ^[29]	3
Ziv <i>et al.</i> , 2023 ^[30]	3

Global rating was performed according to these criteria (Qualitative Assessment Tool for Quantitative Studies) - 1: Selection bias (sample size power and number of subjects who agreed to participate into the study), 2: Study design (randomized versus nonrandomized trials), 3: Confounders (yes/no), 4: Blinding (yes/no), 5: Data collection methods (self-reported data, observations by investigators or medical records), 6: Presence of description of numbers and reasons for withdrawals and drop-outs. 1: Strong (no weak ratings according to above criteria), 2: Moderate (1 weak rating according to above criteria), 3: Weak (two or more weak ratings according to above criteria)

Scale (HAM-D)^[29] or the Beck Depression Inventory (BDI or BDI-II),^[30,41] anxiety by the Hamilton Anxiety Rating Scale (HAM-A)^[29,42] or the state-trait anxiety inventory,^[41] alexithymia by the Toronto Alexithymia Scale,^[29] negative mood by the Negative Affect portion of the Positive and Negative Affect Schedule,^[42] psychological well-being (PWB) by the PWB Scale.^[43]

Uncontrolled studies

The study by Simone *et al.*^[43] evaluated the effects of 14 yoga sessions (twice a week) in a small group of adolescents with AN, observing the effectiveness of the practice limited to emotional dysregulation.

Controlled studies

In a first study,^[41] 53 outpatients were randomized to receive yoga (twice a week) or standard care. The yoga group showed more improvement in eating disorders as well as in anxiety/depression in comparison with subjects who received standard care. Pacanowski *et al.* randomized 38 young adults to a short-term intensive yoga schedule (1 h for 5 days) or standard care, observing an amelioration of negative affect, but not of eating disorders in the active group.^[42] In another study, the authors evaluated the effects of a single class of hatha yoga in patients affected by AN versus healthy controls: These latter, but not the patients showed an amelioration of interoceptive accuracy.^[29] Finally, 15 female adolescents were randomized to receive or not twice weekly yoga sessions: The patients who had practiced yoga benefited from an improvement of axial bone mineral density, cognitive distortion, and depression than the non-yoga group.^[30]

Discussion

Few studies with small sample sizes investigated the potential use of yoga to treat AN. Globally, the limited available data indicate a beneficial effect of this practice

in subjects affected by AN with a probable larger effect on emotional dysregulation or mood symptoms.^[30,41-43] The only study that failed to find results in support of yoga had evaluated the effect of a single class.^[29] Of note, as reported for other mental conditions such as perinatal affective disorders, the duration and frequency of yoga are proportional to the effectiveness of the intervention.^[49] Of note, a more balanced immune function was found in yoga experts than novices,^[36] thus supporting the evidence that constant practice can lead to long-lasting beneficial effects.^[50]

On the other hand, the potential side effects of yoga should be taken into account, especially when this practice is applied to patients affected by AN. Actually, a study reported that long-term practitioners could show a high prevalence of orthorexia as well as more concerns for physical appearance than beginners.^[33] Furthermore, if some dynamic practices can be useful for overweight,^[51] they could be harmful in AN inducing an excess of physical exercise. However, a survey submitted to a cohort of community women revealed that yoga is perceived as beneficial in the management of patients with AN.^[52] In light of these considerations, a panel of experts concluded that yoga is a promising technique to manage subjects with AN, but further studies are needed to outline a definitive opinion.^[53]

Evidence limitations

A number of aspects of the available literature need to be discussed. First of all different types of practices were applied to the patients. Only two studies specified the type of sequence: One was focused on the reduction of premeal anxiety,^[41] while the other^[29] included poses facilitating emotional liberation (e.g., backward bends) or introspection (adapted inversions).^[54] In addition, yoga was administered to patients treated in different healthcare contexts reflecting variable severity of illness: Outpatient clinics for eating disorders,^[29,30,41] residential eating disorder facilities,^[42] and inpatient clinics.^[43] Furthermore, the subjects included in the studies (where specified) could have comorbid psychiatric conditions, especially mood and anxiety disorders^[29,41] as well as be treated with psychotherapy or pharmacotherapy.^[41]

Other aspects that should be taken into account in the interpretation of the results of the included studies are (1) the fact that sample sizes are small; (2) the use of different rating scales to assess the severity of AN; and (3) the differences in the cultural contexts and mental health organization of countries where the trials were conducted. With regard to the psychometric scales, the core symptoms of AN were assessed by similar tools, while there was greater variability regarding the assessment of emotional aspects, although the studies agreed in identifying an improvement in this aspect as a result of practice. It is clear that in the future, it will be

necessary to clarify which psychopathological dimension is most impacted by yoga.

The heterogeneity of the studies limits the generalizability of the results in the sense that it is not possible to know if all yogic variants can be beneficial in these patients. It is likely that yoga can improve some symptoms of AN. The practice generally calms the mind and this is certainly beneficial for these patients.^[37] On the other hand, in subjects affected by AN overly dynamic techniques such as *Ashtanga-Vinyasa* should be avoided for two reasons: excessive caloric expenditure and weakness of the hip and shoulder girdle muscles, which requires slow, careful transitions.

Review limitations

The main limitation of the present review is the paucity of data and studies about the effectiveness of yoga for AN. Another limitation is the exclusion of articles written in languages other than English. However, we decided to finalize this review as this technique can be useful for managing these patients in light of its versatility. Differently from other authors who in the past realized review articles including all patients with eating disorders,^[55] we focused only on AN for the specific clinical characteristics of this disorder requiring a precise adaptation of yoga sequencing.

Future directions

These first data open a series of questions regarding the application of yoga in subjects suffering from AN. First of all, it would be interesting to understand which practice is most suitable for subjects with AN which, according to Ayurvedic principles, would consist of a deficit in the low *chakras*.^[56] A sequence that includes grounding poses (e.g., wide child-*prasarita balasana* or dangling pose-*baddha hasta uttanasana*) but without excessive calorie expenditure could be explored. In addition, patients with AN experience hyperactivity,^[57] so relaxing breathing techniques (e.g., alternate-nostril breathing-*nadi shodana*) could be applied to re-balance the autonomic nervous system.^[58] Furthermore, a more exhaustive list of the benefits of the practice could be evaluated: For example, patients' improvement in food awareness could be quantified.^[59] Another aspect that should be explored is the synergic effect of yoga with standard treatments such as cognitive behavioral therapy (CBT) or pharmacotherapy. The practice could reduce the amount of distorted thoughts that are the target of CBT. Similarly, it can prevent anxiety, mood dysregulation, and altered sense of appetite in combination with pharmacological compounds.

Finally, it would be interesting to measure biomarkers that demonstrate the biological benefits of yoga, especially on the metabolic and endocrine systems that are compromised in subjects affected by AN.^[60] The available literature shows a downregulation of the hypothalamic–pituitary–adrenal

axis in yoga practitioners,^[61] but future studies could investigate the impact of AN and yoga on neuropeptides both involved in social behavior and regulation of appetites such as oxytocin and ghrelin.^[62] Furthermore, another line of research could concern the brain–gut axis given the role of yoga in regulating the functioning of internal organs and the impairment of the functioning of this system in subjects with AN.^[63]

Conclusions

The available data on yoga in the management of AN are very few, but promising for further exploring the use of this technique in this condition. The advantage of yoga is its extreme versatility which allows to create personalized lessons.^[64] Furthermore, compared to other complementary treatments, it has the advantage of being supported by a broad theoretical background based on spiritual texts, Ayurvedic medicine, and functional anatomy.^[65] As mentioned above, Yoga can have a beneficial effect on subjects with AN as a result of the calming effect on the mind, the energetic rebalancing, and the modulation of different biological systems. Future research will have to clarify how this approach can integrate with traditional treatments and whether specific techniques or sequencing can have a greater impact on these patients. Finally, it will be important to understand what is the advantage of yoga in comparison with other complementary medicine strategies to better outline the role of this practice in the management of patients with AN.^[31]

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Conflicts of interest

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