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Project Thesis

The Efficacy of Sudarshan Kriya Yoga (SKY) on Depression

Literature Review

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Abstract

Background: Depression is a significant contributor to the global burden of disease, disability and substantial financial burden. There has been a growing interest in complementary and alternative therapies for depression, driven by a range of factors such as dissatisfaction with conventional treatments or a preference for therapies that are compatible with personal beliefs and philosophies.

Objective: To examine and assess the efficacy of Sudarshan Kriya Yoga (SKY) on depression and depression levels.

Method: The databases PubMed and Google Scholar were searched in October 2022. Inclusion criteria: assessment of the effects of SKY on depression through relevant outcome measures. Exclusion criteria: studies related to specific global events, such as COVID-19, master theses. Well-cited studies published in journals were prioritized.

Results: Eleven studies were included in the review. All studies reported statistically significant reductions in depression levels from baseline to post SKY-intervention, as measured by different outcome measures ($p<0.05$). SKY led to more significant reductions in depression levels compared to the control groups. However, SKY was as effective as partial SKY and imipramine, and less effective than Electroconvulsive Therapy (ECT). The response and remission rates among a few studies that reported on this were also promising.

Conclusion: All the studies in this literature review reported statistically significant reductions in depression levels post-SKY intervention. However, high-quality and robust RCTs with larger sample sizes, longer trial durations, uniform use of both valid subjective and objective outcome measures and uniform SKY-interventions are needed to draw definitive conclusions on the efficacy of SKY on depression, both short-term and long-term.

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Introduction

PREVALENCE AND GLOBAL CONSEQUENCES OF DEPRESSION

According to the World Health Organization (WHO), depression is a commonly prevalent mental illness that affects an estimated 3.8% of the global population, with a higher prevalence among adults (5%) and adults over 60 years of age (5.5%). When depression is recurrent and of moderate or severe intensity, it can develop into a serious medical condition that causes significant suffering and impairs work, school, and home functioning. In severe cases, it can also lead to suicidal ideation and behavior. Depression differs from typical mood swings and transitory emotional responses to everyday stressors. Globally, depression is a leading cause of disability and a major contributor to the global burden of disease (World Health Organization, 2021). Moreover, depression is associated with a substantial financial burden (Wang et al., 2006), highlighting the need for ongoing improvements in depression prevention and treatment.

DEPRESSION – DEFINITION AND DIAGNOSTIC CRITERIA

The International Classification of Diseases, Tenth Revision (ICD-10) outlines specific criteria for diagnosing a depressive episode. The diagnosis requires at least two of the three key symptoms - persistent sadness or low mood, loss of interest or pleasure (anhedonia), and fatigue or low energy - to be present for at least two weeks, and they must not be caused by drugs or an organic psychiatric illness. Other symptoms that are also usually present include low self-esteem, poor concentration or indecisiveness, disturbed sleep, changes in psychomotor activity with agitation or slowing of movements, feelings of guilt, changes in appetite, and even suicidal thoughts. Based on the severity and frequency of these symptoms, a depressive episode can be classified as mild (with at least two key symptoms and a total of four to five symptoms), moderate (with at least two key symptoms and a total of six to seven symptoms), or severe (with three key symptoms and a total of eight to ten symptoms). These diagnostic criteria aid in identifying and treating depressive episodes effectively (World Health Organization, 1993).

According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), the diagnosis of depression requires the presence of at least five symptoms over a minimum period of two weeks, where at least one of the symptoms must be either depressed mood or loss

of interest or pleasure. The remaining symptoms include unintentional weight loss or weight gain, a decrease or increase in appetite, sleep disturbances (insomnia or hypersomnia), psychomotor agitation or retardation noticeable by others, fatigue and low energy, feelings of excessive guilt and worthlessness, reduced ability to think, concentrate and make decisions, recurrent thoughts about death and suicide, and even suicide attempts. The aforementioned symptoms must cause significant distress or impairment in social, occupational, or other critical areas of functioning. Moreover, the symptoms must not be attributable to substance abuse or another medical condition. Physicians must also rule out other mental health disorders that may involve a depressive component, such as bipolar disorder and schizoaffective disorder (American Psychiatric Association, 2013).

DEPRESSION – BRIEF OVERVIEW OF OUTCOME MEASURES

In addition to clinical psychiatric interviews, a variety of outcome measures may be used to assess and monitor depression levels. Two widely recognized outcome measures for assessing depression levels are the Beck Depression Inventory (BDI) and The Hamilton Rating Scale for Depression (HRSD). The HRSD is a 21-item assessment tool that is administered by a healthcare professional before, during, and after treatment (Hamilton, 1960). In contrast, the BDI is a 21-item self-report questionnaire that patients complete themselves (BECK et al., 1961). Other commonly used outcome measures for depression assessment and monitoring are the 10-item Montgomery-Åsberg Depression Rating Scale (MADRS), which is an adaptation of HRSD with greater sensitivity to change over time (Montgomery & Åsberg, 1979), and the Patient Health Questionnaire-9 (PHQ-9), another self-report questionnaire (Sun et al., 2020).

DEPRESSION – BRIEF OVERVIEW OF MANAGEMENT AND CHALLENGES

The management of depression commonly involves pharmacological (antidepressant) therapy, psychotherapy, or a combination of both, all of which have been demonstrated to be effective. However, reviews have also indicated that these therapies exhibit notable limitations such as high dropout rates, low remission rates, and high placebo responses. To address these shortcomings, complementary and alternative therapies have emerged as a promising adjunct in the treatment of depression (Cramer et al., 2017). Moreover, previous research has shown that depression is a primary reason for seeking alternative therapies, which could be due to dissatisfaction with conventional treatments or a preference for

therapies that align with personal beliefs and philosophies (Astin, 1998). One example of an alternative therapy that could meet these criteria is Sudarshan Kriya Yoga (SKY).

SUDARSHAN KRIYA YOGA (SKY)

Sudarshan Kriya Yoga (SKY) is a type of controlled breathing practice that has its roots in traditional yoga. It was developed by Pundit Ravi Shankar, a spiritual guru and the founder of the Art of Living Foundation in Bangalore, India (Janakiramaiah et al., 2000). The Art of Living Foundation is a non-profit organization that teaches SKY and has taught it to over 6 million people in 152 countries worldwide (Zope & Zope, 2013).

In addition to *om chanting*, SKY consists of three essential *pranayama*-based components: *Ujjayi, Bhastrika, and Sudarshan Kriya*. *Pranayama* are voluntary forms of controlled breathing. The first component of *Ujjayi*, also known as "Victorious Breath," involves experiencing the conscious sensation of the breath touching the throat. This technique consists of a slow breathing pattern (2-4 breaths per minute) that increases airway resistance during inspiration and expiration and controls airflow so that each phase of the breath cycle can be prolonged by a precise count. The second component, *Bhastrika* or "Bellows Breath," involves inhaling and exhaling air at a rate of 30 breaths per minute. The third component consists of three repetitions of *"Om"* with a very prolonged exhalation. The fourth component, *Sudarshan Kriya*, is an advanced type of rhythmic, cyclical breathing with slow, medium, and fast cycles (Brown & Gerbarg, 2005a) (Brown & Gerbarg, 2005b).

Apart from the components mentioned above, SKY-courses also include *asanas* (yoga postures), meditation, group processes, and fundamental knowledge of yoga. However, in order to gain wider acceptance from medical practitioners and patients, some of these components were removed, and the modified technique was named *Sudarshan Kriya Yoga*, which only involves the specified breathing rhythms – *Ujjayi, Bhastrika and Sudarshan Kriya* (Janakiramaiah et al., 2000). To acquire the intricate skills involved in SKY, it is necessary to have an experienced instructor who can teach the nuances and ensure that the practices are performed accurately. Furthermore, follow-up sessions are highly recommended to refine the practice. Advanced SKY courses may include alternate nostril breathing, *bandhas*, and advanced meditations (Brown & Gerbarg, 2005a). It is important to note that although all SKY interventions comprise *Ujjayi, Bhastrika, and Sudarshan Kriya*, they may

vary in terms of duration, intensity, and other included components.

EARLIER RESEARCH ON SKY AND DEPRESSION

Previous reviews have investigated the impact of Sudarshan Kriya Yoga (SKY) on a diverse range of mental health disorders and physical health. These reviews have indicated that there is an increasing body of evidence suggesting that SKY is an effective and cost-efficient adjunctive therapy for a variety of mental health disorders, including depression (Brown & Gerbarg, 2005b) (Zope & Zope, 2013). However, these reviews have not exclusively examined the effectiveness of SKY on depression or depression levels, and they have not comprehensively discussed the methodologies or limitations of the studies included in their analyses. While other more comprehensive literature reviews, systematic reviews, and meta-analyses have explored the effects of yoga in general on depression, incorporating some studies on SKY, as far as my knowledge goes, there is currently no literature review that primarily focuses on the efficacy of SKY on depression or levels of depression.

THE AIM AND PURPOSE OF THIS PROJECT THESIS

Depression is a significant contributor to the global burden of disease and is considered a leading cause of disability. The financial burden associated with depression is substantial. Consequently, there has been a growing interest in complementary and alternative therapies for depression, driven by a range of factors such as dissatisfaction with conventional treatments or a preference for therapies that are compatible with personal beliefs and philosophies. In this context, the purpose of this literature review is to examine and assess the effectiveness of Sudarshan Kriya Yoga (SKY) on depression and depression levels.

Method

The databases used for this literature review were PubMed and Google Scholar. The search was conducted on October 23rd, 2022.

In PubMed, the search terms used were "kriya depression" and "Sudarshan kriya depression." The search for "kriya depression" yielded 13 results, while "Sudarshan kriya depression" yielded nine. The limitation applied for both search terms was that the article type had to be a clinical trial and/or a randomized controlled trial. After reviewing the titles and abstracts of these results and reading some in full, six articles were included in the literature review.

In Google Scholar, the search terms used were "Sudarshan Kriya Depression" and "Sudarshan Kriya AND Depression." This resulted in 2,710 results. After reviewing the titles and abstracts of the first ten pages of results, it was determined that this method was difficult to reproduce and unclear. Therefore, the search was refined to "Sudarshan Kriya Depression", "Sudarshan Kriya Antidepressant" and "Sudarshan Kriya Depressive" using the advanced search function, where the search terms had to be in the title.

The advanced search for "Sudarshan Kriya Depression" yielded 13 results in Google Scholar. After reviewing the titles and abstracts, and reading some in full, three articles were included in the literature review. The advanced search for "Sudarshan Kriya Antidepressant" yielded six results. After reviewing the titles, abstracts and reading some in full, one article was included in the literature review. Lastly, the advanced search for "Sudarshan Kriya Depressive" yielded one single result. After reading the paper in full, it was included in this literature review.

The main inclusion criteria for the literature review were that the articles had to assess the effects of Sudarshan Kriya as an intervention for depression and that the instruments used to measure depression were valid. Studies that did not measure depression through valid instruments or studies that assessed the effects of Sudarshan Kriya in relation to a specific global event, such as COVID-19, were excluded. Master theses were also excluded, while studies published in journals were prioritized. Given the narrow field of research, strict inclusion and exclusion criteria were not applied to ensure a sufficient number of studies for the literature review. A total of 11 studies were included.

Results

Eleven studies met the eligibility criteria and were included in this project thesis. All the studies assess the efficacy of Sudarshan Kriya Yoga in treating depression and depression levels in some way. Tables 1 and 2 provide a detailed summary of the study characteristics and results for each study.

STUDY CHARACTERISTICS

STUDY DESIGN AND SETTING CHARACTERISTICS

This Project Thesis includes a variety of study designs. It includes five randomized controlled trials (RCTs) (Janakiramaiah et al., 2000), (Rohini et al., 2000), (Vedamurthachar et al., 2006), (Sureka et al., 2014), (Sharma et al., 2017), one uncontrolled open trial (Naga Venkatesha Murthy et al., 1998), and a retrospective study analyzing the data from an intervention program for NHS patients with mild to moderate depression and anxiety disorders in South East England (Hamilton-West et al., 2019). Additionally, it includes four prospective pre-post interventional studies, with two having a comparison group (Kjellgren et al., 2007), (Toschi-Dias et al., 2017), and two without a comparison group (Doria et al., 2015), (Shiju et al., 2019).

Five studies originated from India (Naga Venkatesha Murthy et al., 1998), (Janakiramaiah et al., 2000), (Rohini et al., 2000), (Vedamurthachar et al., 2006), (Sureka et al., 2014), two studies originated from Italy (Doria et al., 2015), (Toschi-Dias et al., 2017), while the US, Kuwait and England were represented by one study each (See table 1). The studies range from 1998 to 2019, with the majority published after 2000.

The duration of the studies varied greatly, with the shortest being a five-day study (Shiju et al., 2019) and the longest being a study that analyzed data collected over a period of three to four years (Hamilton-West et al., 2019). Other studies had durations of two weeks (Vedamurthachar et al., 2006) (Toschi-Dias et al., 2017), four weeks (Janakiramaiah et al., 2000), (Rohini et al., 2000), six weeks (Kjellgren et al., 2007), eight weeks (Sharma et al., 2017), three months (Naga Venkatesha Murthy et al., 1998), and six months (Sureka et al., 2014), (Doria et al., 2015).

PARTICIPANT CHARACTERISTICS

The sample sizes ranged from 25 (Sharma et al., 2017) to 991 (Hamilton-West et al., 2019), with the majority having sample sizes below 100.

All participants in the included studies were above 18 years old, except for (Hamilton-West et al., 2019), where there is some uncertainty regarding the age range of participants. The paper mentions that the age range of participants was 14-80 years, with a mean age of 46 years. However, it also states that ages below 16 years were a part of the exclusion criteria. Two papers, (Vedamurthachar et al., 2006) and (Sureka et al., 2014) only included male participants. The remaining studies included both male and female participants, with a predominance of females in most cases. However, one study (Janakiramaiah et al., 2000) had more males than females. The studies (Rohini et al., 2000) and (Shiju et al., 2019) had an equal number of male and female participants.

The study participants were recruited from various sources, including psychiatric inpatient and outpatient services, prisons, diabetes institutes, local physicians, mental health professionals, self-referral, press releases, and fliers.

Five papers included patients with a DSM-IV diagnosis of a depressive disorder, including DSM-IV Melancholic Depression (Janakiramaiah et al., 2000), DSM-IV Major Depressive Disorder (Rohini et al., 2000), (Doria et al., 2015), (Sharma et al., 2017), DSM-IV Dysthymic Disorder (Doria et al., 2015), (Toschi-Dias et al., 2017) and other unspecified DMS-IV depressive disorders (Doria et al., 2015), (Toschi-Dias et al., 2017). Two papers had participants with ICD-10 psychiatric diagnosis, including ICD-10 dysthymia and melancholia (Naga Venkatesha Murthy et al., 1998), ICD-10 depressive/recurrent depressive episode and other psychiatric disorders excluding psychosis and bipolar disorder (Sureka et al., 2014). Two papers had participants with DSM-IV GAD, (Doria et al., 2015) and (Toschi-Dias et al., 2017). Other diagnoses of participants in some of these studies were DSM-IV Alcohol Dependence (Vedamurthachar et al., 2006), mild to severe depression and anxiety as defined by PHQ-9 and GAD-7, respectively (Hamilton-West et al., 2019). Two papers had participants without any specific psychiatric diagnosis, (Kjellgren et al., 2007) and (Shiju et al., 2019).

INTERVENTION CHARACTERISTICS

All the studies included in this project thesis employed Sudarshan Kriya Yoga (SKY) as the primary intervention. A crucial common denominator among all studies was the utilization of certified SKY instructors and the incorporation of the three fundamental components of SKY: *ujjayi, bhastrika, and Sudarshan Kriya* (cyclical breathing). Despite these similarities, variations existed in the specific SKY interventions employed across the studies, where some described the incorporation of techniques such as *om chanting*, alternate nostril breathing, and *yoga nidra*. Furthermore, the frequency and duration of the interventions also varied among the studies, with some starting with intensive SKY programs and transitioning to daily practice at home. In contrast, others were conducted entirely with the guidance of a yoga instructor. Some studies incorporated stress management and education in addition to SKY, and some allowed participants to continue their current pharmacological treatment and routine care. Control interventions implemented in some of the studies were Electroconvulsive therapy (ECT), Imipramine (IMN), partial SKY (cyclical breathing replaced with regular breathing), routine detoxification cure, sitting in an armchair with eyes closed and paying gentle attention to the breath for 15 minutes, waitlist control, and instructions on adherence to pharmacological and psychotherapeutic treatment.
A comprehensive description of the SKY and control interventions used in each study can be found in Table 1.

OUTCOME MEASURES

The outcome measures used to assess the severity of depression were Hamilton Rating Scale for Depression (Naga Venkatesha Murthy et al., 1998) (Doria et al., 2015) (Toschi-Dias et al., 2017), 17-item Hamilton Rating Scale for Depression (Naga Venkatesha Murthy et al., 1998) (Janakiramaiah et al., 2000) (Sharma et al., 2017), the six-item subscale HRSD (Janakiramaiah et al., 2000), Beck Depression Inventory (Naga Venkatesha Murthy et al., 1998) (Janakiramaiah et al., 2000) (Rohini et al., 2000) (Vedamurthachar et al., 2006) (Sharma et al., 2017), Patient Health Questionnaire-9 (Shiju et al., 2019) (Hamilton-West et al., 2019), Hospital Anxiety and Depression Scale (Kjellgren et al., 2007) (Shiju et al., 2019), Clinical Global Impression (Naga Venkatesha Murthy et al., 1998), Zung Self-Rating Depression Scale (Doria et al., 2015), and the subgroup Depressed Mood of The Psychological General Well-Being-scale (Sureka et al., 2014).

Table 1: Study Characteristics can be found on the next page.

Citation	Year	Country	Study Design	Intervention	Sample Size	Study Population	Duration	Outcome Measures
(Naga Venkate-sha Murthy et al., 1998)	1998	India	Uncontrolled open trial	Monotherapy w/SKY. 3 fundamental components: Ujjayi, bhastrika, SK (cyclical breathing). 30 min/day, 3 months. Instructed by SKY-instructor first 3 months.	30	**Dysthymic group (n=15):** **Age:** 30.6 (mean) **Sex:** 8M, 7F **Diagnose:** ICD-10 Dysthymia Mean duration of condition: 35.6 months. Mean baseline HDRS score: 12.3 Mean baseline BDI score: 27.5. **Melancholic group(n=15):** **Age:** 35.7 **Sex:** 6M, 9F **Diagnose:** ICD-10 Melancholia Mean duration of condition: 2.4 months. Mean baseline HDRS score: 24.6 Mean baseline BDI score: 40.2 **Note:** *Duration and severity of depression is significantly different between the groups at baseline.* **Exclusion:** *Bipolarity, psychotic symptoms, substance use, current drug treatment, major physical illnesses and audiological dysfunction.* ***All participants were consenting.***	3 months	**17-HRSD** **BDI** **(CGI)** Measured at pretreatment, 1 month and 3 months.
(Janakiramaia h et al., 2000)	2000	India	Randomized Controlled Trial	**3 groups.** **Group 1:** SKY (ujjayi+bhastrika+SK) + yoga nidra (10-15 min relaxation). 45 min/day, 6 days/week, 4 weeks. Certified SKY-instructor. **Group 2:** ECT. Modified ECT 3x/week. **Group 3:** IMN (imipramine). 150 mg of IMN as single oral dose at night daily.	45	45 consenting inpatients. Randomized into ECT(n=15), IMN(n=15), SKY(n=15). **Age:** 18+ **Sex:** 25M, 20F **Diagnose:** DMS-IV Melancholic Depression. Never treated for current episode. Total 17-HRSD score ≥ 17. **All** participants were medically fit. *Exclusion criteria not specifically stated.*	4 weeks	**HRSD (17-HRSD,six-item subscale HRSD), BDI** Measured pre-treatment, weekly thereafter (weeks 1-4). Assessments done by psychiatrist uninvolved in treatment assignments.

Citation	Year	Country	Study Design	Intervention	Sample Size	Study Population	Duration	Outcome Measures
(Rohini et al., 2000)	2000	India	Randomized Controlled Trial	**2 groups.** **Group 1:** Full SKY (ujjayi, bhastrika, SK) + yogan nidra. **Group 2:** Partial SKY (ujjayi, bhastrika, regular breathing) + yoga nidra. Session duration same for both groups. Practiced 1x/day, 4 weeks. Supervised by Yoga teacher (information about certifications not provided). *Participants not given any drugs during trial period, except for tablet lorazepam (4mg/day) or zopiclone (7.5mg/day) if reported significant distress on account of insomnia.*	30	30 consenting patients attending psychiatric services at NIMHANS Hospital. Randomized into full SKY(n=15), partial SKY(n=15). **Age:** 18-60. **Sex:** 15M, 15F **Diagnose:** DSM-IV Major Depressive Disorder. Total 17-HRSD score ≥18. Drug-free/off antidepressants. **Note:** *Illness duration significantly longer in full SKY-group (6 mths full SKY vs. 3.5 mths partial SKY).* **Exclusion:** *Conditions requiring alternative treatment (e.g.ECT), psychotic, catatonic, high suicide risk (score 4 on suicide item of HRSD), uncooperative, contraindications to SKY; cardiac and pulmonary disorders, epilepsy, pregnancy.*	4 weeks	**BDI** Measured weekly.
(Vedamurthachar et al., 2006)	2006	India	Randomized Controlled Trial	All participants received standard detoxification (Benzodiazepines + B-complex vitamins) before random assignment to therapy or control group. **Therapy group:** SKY(ujjayi, bhastrika, SK) + yoga nidra. 45-60 min/alternating days, 2 weeks. Certified SKY-instructor. Also received routine care. **Control group:** Routine detoxification cure.	60	60 consenting male patients. Admitted to NIMHANS for detoxification for first time. Randomized into SKY(n=30), Control(n=30). **Age:** 18-55. **Sex:** 60M. **Diagnose:** DSM-IV Alcohol Dependence. Each subject underwent psychiatric, medical assessments + measurement of illness severity by qualified psychiatrists. **Exclusion:** *Severe physical illness (cardiac illness, hypertension, etc.), organic mental illness, high suicidal risk, drug-dependence other than tobacco/alcohol, history of mania, schizophrenia, mental retardation.*	2 weeks	**BDI** Measured before (pre, day 7) and two weeks after the intervention (post, day 21).

Citation	Year	Country	Study Design	Intervention	Sample Size	Study Population	Duration	Outcome Measures
(Kjellgren et al., 2007)	2007	Sweden	Prospective Pre-Post Interventional Study (with control group)	**Therapy group:** SK&P (ujjayi, bhastrika, SK). Started w/ Intensive 6-day course (3h/day), followed by home practice (1h/day, 5 weeks). Course included cognitive stress management strategies/techniques. Certified SK&P-teachers. **Home practice** was tracked with written self-report at post-test session. Only participants who practiced > 3x/week were included in the analysis. **Control group:** Sit in armchair with eyes closed + gentle attention to breath. 15 min/day, 6 weeks. *Control group had meetings with the experimenter for the same duration as the SK&P-group during initial 6 days.*	103	103 healthy, consenting participants. Divided into SK&P(n=48), Control(n=55). Both groups recruited via. Ads, fliers. SK&P-group: attended a beginner course at a yoga center in 2004. Control group: yoga naïve and interested students from Karlstad University. **Age:** 31.92 (mean). **Sex:** SK&P(13M,35F), control(12M,43F) **Note:** *Control group had lower baseline degrees of anxiety + higher baseline degree of optimism vs. SK&P-group.* **Exclusion:** *Pregnancy, current psychiatric disease, <18yrs, clinical depression, anxiety problems.*	6 weeks	**HADS**
(Sureka et al., 2014)	2014	India	Randomized Controlled Trial	**Therapy group:** SK&P (ujjayi, bhastrika, SK) + Om chanting before SK and ANB (alternate nostril breathing) after SK. 30 min/day, 6 weeks. Certified SK&P-teachers on all sessions. Teachers corrected participants' flaws an hour after each session (optional). **Control group:** Sit in armchair with eyes closed + gentle attention to breath. 1x/day, 6 weeks. **Patients** continued to receive pharmacological treatment during the study.	232	232 consenting male prisoners. Admitted to Central Jail Hospital, New Delhi >6 weeks in previous year. Randomized into SK&P(n=116), Control(n=116). **Age:** 18-65. **Sex:** M **Diagnose:** ICD-10 Psychiatric Disorder, excluding psychosis + bipolar disorder. Depressive episode/RDD and adjustment disorder most common disorders. **Education level:** most undermatric or below, **occupational skill:** most unskilled or below + unemployed, **civil status:** most married. **Exclusion:** *substance dependence past 1 year, severe physical illness(hepatic encephalopathy, severe debilitating illness), severe cognitive deficits, MMSE-score<23.*	6 months	**PGWB(relevant subgroup:DEP)** (SCAN), (GAF) Assessed before the start of intervention and six weeks after intervention.

Citation	Year	Country	Study Design	Intervention	Sample Size	Study Population	Duration	Outcome Measures
(Doria et al., 2015)	2015	Italy	Pre-Post Interventional Study	**SKY**(ujjayi, bhastrika, SK) + alternate nostril breathing and kapalabati (fast diaphragmatic breathing) before bhastrika + om chanting between bhastrika and SK + yoga nidra at end of session. Started with intensive 10-session workshop for 2 weeks, followed by weekly follow-up classes for 6 months. Session duration 2h. Certified/trained SKY-teachers. A short version protocol was also taught for home practice (practiced 6 days/week). **All** participants were receiving SKY-treatment + participating in weekly self-help groups.	69	69 consenting, caucasian outpatient adults. Sample divided into two groups (see below). **Age:** 25-64. **Sex:** 28M, 41F. **Diagnose:** DSM-IV GAD(n=39), DMS-IV Mood disorder (MDD, dysthymic disorder, other, n=18), DSM-IV GAD+dysthymic disorder(n=12). **Group 1:** Undergone ≥ 6mth standard pharma-treatment w/fixed dosage antidepressant/anxiolytic at baseline. Stable. **Group 2:** Undergone ≥ 6mth participation in self-help groups at baseline. Stable. Low efficacy of psychotropic drug/discontinued prescribed med.	6 months	**HRSD** **ZSDS** Assessed at recruitment, after 2 weeks, after 3 months and after 6 months.
(Sharma et al., 2017)	2017	USA	Randomized Controlled Trial	**Therapy group:** SKY(ujjayi, bhastrika, SK) + om chanting between bhastrika and SK. Intervention consisted of two phases. Phase 1(Week 1): 6-session program w/ SKY + yoga postures + sitting meditation + stress education. (3.5 hours/day). Phase 2 (Week 2-8): weekly SKY-follow up sessions (1.5 h/session) + SKY home practice (20-25 min). Certified SKY-teachers. **Home practice** and follow-up compliance recorded in participant log sheets. **Control group:** Waitlist. Offered SKY after completing study.	25	25 consenting adult outpatients enrolled at MADTRP. Randomized into SKY(n=13), Control(n=12). **Age:** 18-67. **Sex:** 7M, 18F. **Diagnose:** DSM-IV MDD (single or recurrent episode). Total 17-HRSD score ≥ at screening and baseline. Mean 17-HRSD score = 20.4(severe depression). Participants were on stable antidepressant regimen (no dose changes) ≥ 8 weeks. Had to continue this regimen during study period. **Exclusion:** *bipolar disorder, psychosis, substance abuse, ADHD, pregnancy, epilepsy, initiating psychotherapy, participating in other yoga/meditation programs.*	8 weeks	**HDRS-17, BDI** Assessed by MADTRP clinical raters at baseline (1 week prior to SKY-intervention), after 1 month and after 2 months.

Citation	Year	Country	Study Design	Intervention	Sample Size	Study Population	Duration	Outcome Measures
(Toschi-Dias et al., 2017)	2017	Italy	Pre-Post Interventional Study	**Treatment group: SKY**(ujjayi, bhastrika, SK) + alternate nostril breathing and kapalabati (fast diaphragmatic breathing) before bhastrika + om chanting between bhastrika and SK + yoga nidra at end of session. Intensive 10-session workshop 2h/day for 2 weeks. **Control group:** Instructed on importance of adherence to pharmacological and psychotherapeutic treatment.	46	46 consenting adult patients. Divided into Conventional therapy w/SKY (n=24) and Conventional therapy/control-group (n=22). **Age:** 44 (mean) **Sex:** 17M, 29F **Diagnose:** DSM-IV Anxiety and/or Mood Disorders (54% GAD, 22% dysthymic disorder/unspecified mood disorder, 24% GAD+dysthymic disorder). **Note:** *Control group had significantly higher HRSD and amount of patients using benzodiazepines.* **All** patients underwent stable pharma-treatment >6 months. **Exclusion:** *Not responding to pharma-treatment, metabolic, respiratory and cardiac illness.*	15 days	**HRSD** Assessed by clinical psychologist at T0 and T1-periods.
(Shiju et al., 2019)	2019	Kuwait	Prospective Pre-Post Intervention al Study (no control group)	**SKY (**ujjayi, bhastrika, SK) + alternate nostril breathing and yoga nidra. The SKY-course also included warm-up, sun salutation, yoga poses and guided meditation. Duration: 5 days. Certified SKY-teachers. Participants received instructions on SKY-practice at home (20 min/day). **Home practice** compliance recorded in participant log sheets.	26	26 T2DM-outpatients visiting DDI. 13 kuwaiti, 6 egyptian, 5 indian, 2 iranian/other. **Age:** >30. **Sex:** 13M, 13F **Diagnosis:** T2DM > 1 year. HAM-A score>15. **Exclusion:** *T1DM, on antidepressants, bipolar disorder, pregnant, acute coronary events past 6 months, artificial pacemaker, spiritual meditation practice/SKY last 6 months.*	5 days	**PHQ- 9** **HADS** Assessed before and after 5 days of SKY-intervention.

Citation	Year	Country	Study Design	Intervention	Sample Size	Study Population	Duration	Outcome Measures
(Hamilton-West et al., 2019)	2019	England	Retrospectiv e Study	**SKY** (ujjayi, bhastrika, SK). Taught at weekend intensive workshop (2.5 days). Workshop also included cognitive coping + stress-evaluation strategies. Certified SKY-teachers. Participants were also offered 4 weekly follow-up sessions to practice and receive feedback from instructors (90 min). **Before** the weekend workshop, participants received 4 weekly "stress buster sessions" (1h/session). These covered basic breathing techniques for stress/tension, guided meditations, mind-calming processes, skills for handling negative emotions, everyday situations, improving work and interpersonal relationships.	991	991 participants attending NHS-intervention program for patients w/mild to moderate depression/anxiety disorders. 70.4% accessed program via self-referral, 18% by GP, 11.5% by councellor/healthcare professional. All 3 groups similar at baseline. **Age:** 14-80. **Sex:** 254M, 737F. **Diagnose:** 54% mild/moderate depression + 25% moderately severe/severe depression (def. by PHQ-9, see *Outcome Measures*). 59% mild/moderate anxiety + 29% severe anxiety (def. by GAD-7). 20.8% taking med. for depression/anxiety. 79.2% were not. **Exclusion:** *age <16 years, pregnant, suicide risk, psychosis, drug/alcohol addiction, lithium/tranquilizing medication to manage severe mental illness .*	Data collected between 04/01/13-02/07/17. *Info on duration of SKY-interventio n not provided.*	**PHQ-9** 0-4 (no depression), 5-9 (mild depression), 10-14 (moderate depression), 15-19 (moderately severe depression), 20-27 (severe depression). Scores ≥ 10 = clinically significant/ "caseness".

SKY – Sudarshan Kriya Yoga, SK – Sudarshan Kriya (cyclical breathing), SK&P – Sudarshan Kriya & Related Practices, ECT – Electroconvulsive Therapy, M/F – male/female, HRSD – Hamilton Rating Scale for Depression, BDI – Beck's Depression Inventory, PHQ-9 – Patient Health Questionnaire-9, ZSDS – Zung Self-Rating Depression Scale, HADS – Hospital Anxiety and Depression Scale, HAM-A – Hamilton Anxiety Rating Scale, GAD-7 – General Anxiety Disorder 7, CGI – Clinical Global Impression of Improvement Scale, PGWB – Psychological General Well-Being Index, DEP – Depressed Mood, GAF – Global Assessment of Functioning, SCAN – Schedules for Clinical Assessment in Neuropsychiatry, MMSE – Mini Mental Status Evaluation, GAD – Generalized Anxiety Disorder, MDD – Major Depressive Disorder, RDD – Recurrent Depressive Disorder, ADHD – Attention Deficit/Hyperactivity Disorder, T2DM – Type 2 Diabetes Mellitus, T1DM – Type 1 Diabetes Mellitus, DDI – Dasman Diabetes Institute, NIMHANS – National Institute of Mental Health and Neurosciences, MADTRP – University of Pennsylvania Mood and Anxiety Disorders Treatment and Research Program, NHS – National Health Service

SUMMARY OF COMPLETION RATES AND STUDY FINDINGS

COMPLETION RATES

The completion rates among the papers that provided information on this were primarily high. (Rohini et al., 2000) reported a completion rate of 100%, (Kjellgren et al., 2007) reported a rate of 97.9% in the SKY-group and 91.6% in the control group, (Sureka et al., 2014) reported a rate of 99% for both the SKY and control groups, (Doria et al., 2015) reported a rate of 96%, (Sharma et al., 2017) reported a rate of 77% in the SKY-group and 100% in the waitlist control group, and (Hamilton-West et al., 2019) reported a rate of 17.1%. The remaining five papers did not provide explicit information on completion rates or attrition.

THE EFFICACY OF SUDARSHAN KRIYA YOGA ON DEPRESSION

All the studies included in this project thesis reported statistically significant reductions in depression levels from baseline to post SKY-intervention, as measured by different outcome measures. Among the studies that had control and comparison groups, the general finding was that the SKY intervention led to more significant reductions in depression levels compared to the control groups. However, one study (Rohini et al., 2000) reported that full and partial SKY led to equally significant reductions in depression levels. The full SKY- group had a higher response rate than the partial SKY-group, but this difference was not statistically significant. Another study, (Janakiramaiah et al., 2000), reported that ECT (Electroconvulsive Therapy) led to significantly lower depression levels at some assessment points compared to SKY and Imipramine, which were similar. A comprehensive summary of the results and completion rates for each study can be found in Table 2.

(Naga Venkatesha Murthy et al., 1998) reported a response rate of 73.33%, where responders were defined as having a CGI-score below two after SKY-intervention at one and three months. (Rohini et al., 2000) reported a response rate of 80% in the SKY-group and 46.7% in the partial SKY-group, where responders were defined as having an over 50% reduction in their total BDI-score. (Sharma et al., 2017) reported a response rate of 46.15% for the SKY Intention to Treat sample (SKY ITT), and 54.54% for the participants that completed the program (SKY completer sample). The study also reported that 30.77% of the SKY ITT-sample remitted, while 36.36% of the SKY-completer sample remitted.

Responders were defined as having an over 50% reduction in the HDRS-17 total score from baseline, while remitters were defined as having an HDRS-17 total score below seven and an over 50% reduction in the HDRS-17 total score from baseline. (Janakiramaiah et al., 2000) reported a remission rate of 67% for the SKY-group, compared to the remission rates of 93% and 73% for ECT and Imipramine, respectively. Remitters were defined as having an HDRS-score below seven. Additionally, (Hamilton-West et al., 2019) reported information on response rates in the form of percentages of participants who had reliable improvement, movement to recovery and reliable recovery. This is explained in detail in the table below.

Table 2: Results can be found on the next page.

Citation	Completion Rate	Summary of Results
Naga Venkatesha Murthy et al., 1998)	*Paper has not explicitly mentioned completion rate. No information on attrition has been provided.* No adverse events were reported.	**SKY therapy led to statistically significant reductions in HRSD and BDI scores.** 22 subjects (73.33%) (10 dysthymics, 12 melancholics) were responders/demonstrated a positive response to the SKY-treatment. (Responders = CGI ≤ 2 at 1 and 3 months). The responders (n=22) and non-responders (n=8) were similar in all variables, including depression-scores at baseline. At one month, responders had significantly lower mean HRSD total scores (3.8±2.5) and BDI total scores (11.1±9.6) compared to non- responders (13.6±5.2 and 30.5±13.9 respectively, P<0.001). <u>Patients with low and normal P300-amplitude prior to treatment had comparable antidepressant response to SKY over time:</u> Occasion effect strongly significant (P=0.00). The reduction in HDRS and BDI from baseline to 1 month and 3 months was statistically significant. Group effect (P=0.2) and Group x Ocassion-effect (P=0.5) not statistically significant.
(Janakiramaia h et al., 2000).	*Paper has not explicitly mentioned completion rate. No information on attrition has been provided.* *No adverse events were reported.*	**There were statistically significant reductions in total BDI, 17-HRSD and six-item HRSD-subscale-scores on successive occasions in all three groups (ECT, SKY and IMN).** There were no overall statistically significant differences between the groups. However, there were statistically significant group x occasion-interactions at week 3 and 4, where the ECT-group had significantly lower mean BDI and mean HRSD-scores, compared to the SKY and IMN-groups, which were similar. At the end of the trial, remission rates were 67% for SKY, 73% for IMN and 93% for ECT. In this context, remission was defined as total HRSD-score ≤ 7. <u>BDI-scores:</u> - *Occasion effect (over 5 assessments in 4 weeks): F=50.8, df=4,168, P=0.0001, power=1.0.* - Group-effect: F=1.25, df=2,42, P=0.3, power=0.26. - Group x Occasion effect: F=3.04, df=8,168, P=0.003, power=0.95 <u>17-HRSD-scores:</u> - O*ccasion effect F=97.5, df=4,168, P=0.0001, power=1.0.* - Group effect F=0.55, df=2,42, P=0.6, power=0.14 - Group×Occasion interaction F=2.5, df=8,168, P=0.02, power=0.62 <u>Total six-item HRSD subscale:</u> - O*ccasion effect F=90.7, df=4,168, P=0.0001, power=1.0* - Group effect F=0.70, df=2,42, P=0.49, power=0.16 - Group×Occasion interaction F=2.7, df=8,168, P=0.009, power=0.92

Citation	Completion Rate	Summary of Results
(Rohini et al., 2000)	*Paper has not explicitly mentioned completion rate. No information on attrition has been provided.* No adverse events were reported	**There was a statistically significant reduction in total BDI-scores for both the full SKY and partial SKY-group (p<0.05).** **There was no statistically significant difference between the BDI-scores of the two groups at baseline, week 1, week 2, week 3 and week 4.** 12 from the full SKY-group and 7 from the partial SKY-group responded to the treatment (Responders = ≥ 50% reduction in total BDI- score). This difference almost reached statistical significance (p=0.058, OR=4.6, 95%CI =0.9-23). BDI: Group effect p>0.05, Occasion effect p<0.001, Interaction effect p>0.05.
(Vedamurthachar et al., 2006)	100% No adverse events were reported	**Both groups had a significant decrease in total BDI-scores, but the reduction was more significant for the SKY-group.** The reduction in BDI-scores significantly correlated with the reduction in plasma cortisol levels, but this was only the case for the SKY-group (r = 0.52, p = 0.003) SKY-group details: BDI-pre = 39.7 (SD 5.8), BDI-post: 9.6 (3.7) Control-group details: BDI-pre = 39.8 (5.4), BDI-post: 16.4 (4.2) *Group effect = 10.28, p<0.001, Occasion effect = 1654.33, p<0.001, Interaction =7.24, p<0.001. (Both groups had a significant decrease in BDI, but the drop in the SKY-group was more significant at post-assessment).*

Citation	Completion Rate	Summary of Results
(Kjellgren et al., 2007)	97.9% SK&P-group (47/48), 91.6% control group (55/60) *The study had 109 subjects to start with, but 5 from the control group and 1 from the SK&P-group dropped out.*	**The SK&P-group saw a 33% reduction in their degree of depression as measured by the HAD scale after 6 weeks, while the control group did not experience a significant change during the treatment period.** **More detailed:** There was a statistically significant decrease in the degree of depression from 3.67 (SD = 2.56) to 2.97 (SD = 2.02) during the treatment period. *[F (1,91) = 13.47, p < 0.001, Eta2 = 0.13, power = 0.95].* There was a statistically significant Group x Time-interaction, where the yoga group significantly reduced the degree of depression from 4.11 (SD = 2.99) at pre- treatment to 2.73 (SD = 2.19) at post-treatment, while the control group did not show a significant change. *[F (1,91) = 11.24, p = 0.001, Eta2 = 0.11, power = 0.91].*
(Sureka et al., 2014)	99% completion rate in both SK&P group and control group. One dropout occurred in each group, because both participants got released from prison. There were no safety issues and no adverse events were reported.	**The paper reports that the SK&P-intervention led to a statistically significant reduction in depression levels.** **SK&P-group had a much greater increase in total PGWB and subgroups such as Depressed Mood, compared to the control group:** *- Total PGWB mean+SD: 44.22 ± 27.58 at baseline to 59.9 ± 28.06 post SK&P (SK&P-group) vs. 41.11 ± 28.01 at baseline to 40.91 ± 27.44 (Control-group)* *- DEP mean + SD: 7.74 ± 4.57 to 9.45 ± 4.00 (SK&P) vs. 7.39 ± 4.46 to 7.43 ± 4.50 (Control).* *The SK&P group had a statistically significant reduction in Depressed Mood (DEP) (p<0.01, Cohen's d' 0.37), compared to the control group.* Further results that may be of relevance: Mean GAF-scores in the SK&P increased from 48.1 ± 18.33 to 59.67 ± 21.10 after 6 weeks. Mean GAF-scores in the control group decreased from 53.42 ± 19.13 to 52.28 ± 19.81.

Citation	Completion Rate	Summary of Results
(Doria et al., 2015)	96%. (Out of the 69 patients, there were 12 withdrawals). No adverse events were reported.	HRSD-scores: Significantly decreased in all four groups after the SKY-intervention (Depression pharmaceutically treated/Not treated, Anxiety pharmaceutically treated/Not treated). ($p<0.001$). There were no statistically significant differences between the groups when it came to their effect on HRSD-scores. Post-hoc comparisons showed a significant reduction in HRSD-scores between baseline and 15 days post-SKY-intervention ($p<0.001$). However, there were no statistically significant differences among subsequent time points (between 15 days and 3 months post-SKY $p>0.1$, between 3 months and 6 months post-SKY $p=0.38$). ZSDS drug-group: Significant reduction in Depression scores from baseline to subsequent time-points (post SKY-intervention). ($p<0.001$, moderate effect size $\eta 2 = 0.09$). ZSDS no drug group: Significant reduction in Depression scores from baseline to subsequent time-points (post SKY-intervention). ($p=0.006$, moderate effect size $\eta 2 = 0.12$). Highly significant correlation between HRSD and ZSDS-scores; convergent outcomes are seen in the assessments done by the psychiatrist (HRSD) and the perceptions of the patients (ZSDS). ($p=0.001$ 15 days post-SKY, $p<0.001$ 3 and 6 months post-SKY).
(Sharma et al., 2017)	77% in SKY group (10/13), 100% in waitlist control group (12/12). Two of the patients in SKY-group left during the first study-week due to factors unrelated to the study protocol, while the last one left during the seventh study- week due to a change in outpatient medication. No adverse events were reported.	**The SKY-group had a greater, statistically significant reduction in total HDRS-17 compared to the waitlist control group. (−9.77 vs. 0.50, P=.0032)** **The SKY-group had a greater, statistically significant reduction in total BDI-scores compared to the waitlist control group. (−17.23 vs.−1.75, P= .0101)** 46.15% of the SKY ITT-sample were responders, while 30.77% remitted. 54.54% of the SKY completer sample were responders, while 36.36% remitted. **MORE DETAILED:** HDRS-17: Mean difference = −10.27; 95% CI −5.04 to −15.50; P =.0032. (SKY ITT vs. waitlist control) Mean difference: −12.05; 95% CI −6.71 to −17.38; P =.0014 (SKY completer sample vs. waitlist control) BDI: Mean difference: −15.48; 95% CI −8.34 to −22.62; P = .0101 (SKY ITT vs. waitlist control) Mean difference: −18.61; 95% CI −11.81 to −25.42; P = .0043 (SKY completer sample vs. waitlist control). *Responder = >50% reduction from baseline HDRS-17 total score, remitters = HDRS-17 total score ≤ 7 and >50% reduction in HDRS-17 total score from baseline.*

Citation	Completion Rate	Summary of Results
(Toschi-Dias et al., 2017)	*Paper has not explicitly mentioned completion rate. No information on attrition has been provided.* *No adverse events were reported.*	**In the treatment group, SKY significantly reduced the HRSD-scores compared to baseline (T0: 13[10(min)-16(max)], T1: 9[6-11], p<0.05).** The HRSD-scores were significantly lower in the treatment-group compared to the control group after 15 days (p<0.05). However, this was also the case at T0, before the SKY-intervention.
(Shiju et al., 2019)	*Paper has not explicitly mentioned completion rate. No information on attrition has been provided.* No adverse events were reported.	**PHQ-9 total score significantly reduced post-SKY intervention. (p<0.001).** **HADS total score significantly reduced post-SKY intervention. (p=0.002).** Furthermore, "Depressed Mood" (as part of HAM-A) reported as severe or very severe pre-SKY, reduced to "moderate" or "not present" post-SKY. Overall, significant improvements in depression were observed (p=0.029).

Citation	Completion Rate	Summary of Results
(Hamilton-West et al., 2019)	17.1% (Out of the 991 participants assessed at baseline, only 169 participants had complete data at all assessment visits). <u>More detailed:</u> - Baseline (n=991) - Assessment 2 (completed 3 weekly sessions n=557, not completed 3 weekly sessions n=434) - Assessment 3 (completed weekend workshop n=216, not completed weekend workshop n=775) - Assessment 4 (completed all assessments n=169, not completed all assessments n=822)	**The paper presented various results based on different statistical analyses, but all of them indicate a significant reduction in depression as measured by PHQ-9 following the SKY-intervention. (p<0.05).** <u>Based on ITT LOCF *(this analysis counts for missing data in the study):*</u> - The median and mean PHQ-9 values decreased from assessment 1(baseline) to assessments 2, 3 and 4. - At the final assessment (assessment 4), only 17% of participants had scores indicating moderately severe or severe depression. Additionally, almost twice as many participants had scores < 5, indicating a decrease in depression symptoms compared to pre-treatment. - *ITT LOCF = Intention-to-treat Last Observation Carried Forward. An analytic method that imputes missing data using the last observation collected.* <u>Based on ITT non-parametric analysis (*this analysis counts for missing data in the study):*</u> - Statistically significant decrease in PHQ-9-scores from baseline to assessments 2, 3 and 4. (p<0.001). - At the final assessment, median depression scores were significantly reduced by 22% (P<0.001). - The median change from baseline on GAD-7 and PHQ-9 at all post-intervention assessments was zero, indicating that at least half of the participants' anxiety and depression scores did not improve or may have worsened after the treatment. This suggests that the intervention may not be effective for all participants. - *Non-parametric analysis: An analytic method used on data that is not normally distributed.* <u>Based on Per-protocol non-parametric analysis of PHQ-9 *(This method only includes data from participants who completed the entire program):*</u> - Statistically significant decrease in PHQ-9-scores from baseline to assessments 2, 3 and 4. (p<0.001). - At the final assessment, median depression scores for those who completed the whole program, significantly reduced by 78% (P<0.001). The ITT-analysis reported 72.1% caseness at baseline, 32.4% reliable improvement, 23.3% movement to recovery and 22% reliable recovery at last assessment. The group who completed the entire program saw more than double the amount of reliable improvement, movement to recovery, and reliable recovery compared to the analysis including all participants (ITT). The significant differences observed in the data remained consistent when analyzed separately by gender, medication status, and age group (18–35, 36–64, > 65 years), indicating that the effects of the intervention are consistent across these factors. *Caseness = PHQ-9 >10, reliable improvement = improvement in PHQ-9 scores between pre and post-treatment exceeds measurement error of PHQ- 9 (≥ 6 p), movement to recovery = PHQ-9 < 10 + GAD-7 <8 for an individual regarded as "caseness", reliable recovery = reliable improvement + movement to recovery.*

Discussion

SUMMARY OF RESULTS

All eleven studies included in this literature review demonstrated statistically significant reductions in depression levels from pre-intervention to post-intervention, as measured by a variety of outcome measures ($p<0.05$). In the studies with control and comparison groups, SKY appeared to be more effective than control interventions in reducing depression levels. However, SKY was as effective as partial SKY and imipramine, but less effective than electroconvulsive therapy (ECT). The completion rates among the papers that provided information on this were primarily high. The response and remission rates among the few studies that reported on this were also promising, as described in detail in the results section.

AGREEMENTS WITH PRIOR REVIEWS

The findings of this literature review are consistent with previous qualitative literature reviews and systematic reviews in the field. A study conducted by (Brown & Gerbarg, 2005b) evaluated clinical studies and their own clinical observations across various clinical conditions. It concluded that although more clinical studies are necessary to establish the benefits of programs combining *pranayama* (yogic breathing), *asanas* (yoga postures), and meditation, there is sufficient evidence to consider Sudarshan Kriya Yoga (SKY) as a beneficial, low-risk, and low-cost supplementary treatment for various mental health diseases, including depression. Another review by (Zope & Zope, 2013) stated that there is increasing evidence to suggest that SKY can be a beneficial, low-risk, and low-cost supplementary treatment for many mental health disorders, including depression. Other systematic reviews investigating the efficacy of yoga on depression, which also included studies of SKY, mentioned that the effects of SKY on depression appear promising, but that the interpretation of the results is limited due to the low methodological quality of the included studies. It is worth mentioning that these three systematic reviews on the effects of yoga on depression only included one to two randomized controlled trials (RCTs) on SKY and depression (Pilkington et al., 2005) (Cramer et al., 2013) (Cramer et al., 2017).

LIMITATIONS OF INCLUDED STUDIES

The studies included in this literature review have several limitations that should be considered when interpreting the results.

An important limitation of the majority of the included studies and the literature review is the limited number of randomized controlled trials, with only five out of eleven studies being RCTs. The remaining studies include an uncontrolled open trial (Naga Venkatesha Murthy et al., 1998), a retrospective study (Hamilton-West et al., 2019), and four prospective pre-post interventional studies, two of which have a comparison group (Kjellgren et al., 2007) (Toschi-Dias et al., 2017) and two without (Doria et al., 2015) (Shiju et al., 2019). The retrospective study also lacked a control group. These study designs, especially the ones lacking control groups, are less rigorous than RCTs in establishing causality between the SKY intervention and depression.

The prospective pre-post interventional studies with control groups, although stronger than uncontrolled trials, still do not provide the level of rigor and reliability of RCTs. For example, the study by (Kjellgren et al., 2007) acknowledges the potential for selection bias in the absence of a RCT design and the need for a full-scale trial with proper randomization to mitigate this. Other limitations of this study include a lack of control for differences in interaction between the SK&P group and the instructor, absence of power estimation prior to sampling, inability to blind participants, and the potential for co-intervention effects.

To address these limitations, larger and longer-term RCTs with a randomized protocol are required.

As for the five RCTs, they also had some specific limitations that should be considered when interpreting the result. In (Janakiramaiah et al., 2000), the study design did not allow for double-blind conditions, and ethical constraints limited the use of a placebo group, resulting in potential rater bias. (Rohini et al., 2000) lacked a placebo control group and had differences in illness duration between the SKY groups. (Vedamurthachar et al., 2006) had no control treatment procedure, and the effects of the SKY intervention on lowering depression scores are uncertain due to the benefits of abstinence and relief from withdrawal symptoms. It is therefore suggested to test SKY as an antidepressant for patients with ongoing clinical depression after longer periods of abstinence. (Sureka et al., 2014) discussed that their results potentially could not be applied to the general population as it was a prison-based study with only male participants. (Sharma et al., 2017) lacked an active comparator group, and subjects were not blind. Additionally, substantial clinical contact and group support for the SKY group may have

also influenced outcomes. Despite these factors, the study discusses that they are unlikely to account for the significant improvement observed in the severely depressed patient population following the SKY intervention.

Another notable limitation of the majority of studies included in this literature review is the low sample size, which can restrict the generalizability of the results to larger populations. To validate the results found, studies with larger sample sizes would be advantageous.

Only one of the eleven included studies had a large sample size of 991 participants at baseline (Hamilton-West et al., 2019). However, this study faced challenges related to high attrition rates, which also pose challenges in evaluating the results. The per-protocol analysis, which only includes participants who completed the study, represented only 17.1% of the 991 baseline participants, which could result in biased results. On the other hand, the ITT LOCF-analysis, which accounts for missing data in the study, was saturated with estimated values. The authors thus caution that the results of both analyses should be interpreted with caution. Furthermore, the study by (Hamilton-West et al., 2019) had a limitation in that the authors were unaware of why the participants chose to participate in the program and lacked data on the participants' previous or concurrent therapies, making it impossible to consider the impact of concurrent or earlier therapies on the results.

Additionally, the included studies had low trial durations, which only provides short-term insights into the effects and efficacy of SKY on depression levels. To gain a complete understanding of the potential benefits of SKY for depression, it is important to assess the sustainability of its effects over time, as well as the potential for relapse or recurrence of depression. This underscores the need for long-term follow-up studies.

The use of self-report questionnaires as the sole outcome measure for depression in some studies, such as BDI (Rohini et al., 2000) (Vedamurthachar et al., 2006), HADS (Kjellgren et al., 2007) (Shiju et al., 2019), PHQ-9 (Hamilton-West et al., 2019) (Shiju et al., 2019) and PGWB (Sureka et al., 2014) is a limitation. Self-report questionnaires rely on self-reported data, which can be subject to bias. Participants may not be entirely honest about their symptoms or may have difficulty accurately reporting them, leading to limitations in the validity of the findings. Additionally, self-report questionnaires only measure the subjective experience of depression and may not reflect the actual severity of symptoms. For instance, a participant might report mild symptoms on the BDI, but display significant functional

impairments or observable signs of depression. Social desirability bias can also impact the validity of the data, as participants may feel compelled to answer questions in a socially acceptable manner (Demetriou et al., 2015).

The sole use of an objective outcome measure for depression, such as the Hamilton Rating Scale for Depression (HRSD), as seen in the study by (Toschi-Dias et al., 2017), also has limitations. The HRSD is a clinician-administered rating scale, relying on the clinician's observations and assessments of the patient's symptoms, which can result in rater bias. Additionally, as an objective measure, it does not take into account the patient's subjective experience of their symptoms, potentially missing the impact of depression on their daily life, such as quality of life, functioning, and personal relationships.
A more comprehensive understanding of a patient's depression levels can be gained through the use of both objective and subjective outcome measures, such as the combination of HRSD and Beck Depression Inventory (BDI) as seen in studies by (Naga Venkatesha Murthy et al., 1998), (Janakiramaiah et al., 2000), and (Sharma et al., 2017), or HRSD and Zung Self-Rating Depression Scale (ZSDS) as seen in the study by (Doria et al., 2015). This approach captures both the objective measures of depression as well as the patient's subjective experience.

The lack of consistency in the use of outcome measures for depression across some of the studies makes it challenging to compare the results. For instance, comparing the results of a study that only used the Depressed Mood section of PGWB (Sureka et al., 2014) with a study that only used HRSD (Toschi-Dias et al., 2017), or comparing the results of a study that used HRSD-17 with another study that only used HRSD presents difficulties.
To enhance the comparability of future research, it would be advisable to strive for consistency in the choice of outcome measures. Incorporating both objective measures, such as HRSD, and subjective measures, such as BDI, as well as additional assessment methods, such as video interviews, could provide a more comprehensive view of the patient's symptoms and progress.

It is also worth mentioning that some of the studies with control and comparison groups showed disparities between the intervention and control groups at baseline. For example, the study by (Naga Venkatesha Murthy et al., 1998) revealed significant differences in depression severity and duration between the two groups. In the study by (Rohini et al., 2000), the full SKY group had a longer illness duration compared to the other group. The control group in the study by (Kjellgren et al., 2007) had lower levels of anxiety and higher levels of optimism at baseline. Additionally, the control group in the study by (Toschi-Dias et al., 2017) had a

significantly higher HRSD score and a higher number of participants taking benzodiazepines. To minimize potential confounding factors, it is important for future studies to ensure that participants are fully randomized and have similar baseline characteristics.

Finally, it is crucial to mention that only five of the eleven studies included in this literature review provided information on completion rates and attrition, leaving questions about the potential for attrition bias in the results. Furthermore, this literature review did not conduct a systematic quality assessment of the studies, which would have provided a more comprehensive evaluation of their quality, particularly with regards to selection bias, performance bias, reporting bias, and attrition bias. This lack of a systematic assessment constitutes a limitation of the review and underscores the importance of interpreting the results with caution. Previous systematic reviews on yoga and depression, such as the one by (Cramer et al., 2013), have reported low methodological quality and reporting in the studies within this field. Thus, the results of this literature review must be approached with caution.

VALIDITY OF THE METHODOLOGY

The methodology employed in this literature review holds a variety of flaws.
Firstly, it is important to note that this literature review is not a systematic review. Systematic reviews are known to be more comprehensive as they include a more thorough search of the literature and employ a more rigorous methodology.

The literature search was conducted by a single individual, which increases the likelihood of missing relevant studies. To reduce this risk, it would be ideal to have at least two people conduct identical searches applying the same inclusion and exclusion criteria, and later discuss their findings. Additionally, as previously mentioned, the literature review lacks a systematic quality assessment of the included studies. Ideally, at least two individuals should have performed a systematic quality assessment of the included studies, to reduce bias and ensure the validity of the results.

The literature search relied on credible databases, primarily PubMed, to gather studies. Through the utilization of broad search terms, such as "Kriya Depression," as well as more specific search terms like "Sudarshan Kriya Depression," and by restricting the results to clinical trials and randomized controlled trials, the search was able to yield highly relevant results. Additionally, the literature search was conducted in Google Scholar to find more relevant studies. However, the search methodology used in Google Scholar was less robust

than the one used in PubMed. Initially, using the search terms "Sudarshan Kriya Depression" and "Sudarshan Kriya AND Depression" in Google Scholar produced a large number of both relevant and irrelevant results, making the method unclear and difficult to replicate. To address this, the advanced search function was utilized in Google Scholar, requiring the search terms to be present in the title. This approach helped to identify relevant studies but might also have excluded a number of relevant studies.

It is important to note that this is a narrow field of research, which comes with its own limitations. For instance, too strict inclusion and exclusion criteria could not be applied to ensure a sufficient number of studies for the literature review. This may have increased the risk of including studies of lower quality with less robust study designs and small sample sizes. The lack of high-quality studies with large sample sizes may also be a consequence of the narrow research field.

A potential strength of this literature review lies in its prioritization of well-cited, peer-reviewed studies and its disregard for master theses and studies not published in academic journals.

Although each study in this literature review is limited by a somewhat narrow study population, the literature review as a whole represents diverse population characteristics. The majority of participants were 18 and above, and represented a diverse spectrum of health conditions, from being totally healthy to those with specific DSM-IV and ICD-10 psychiatric diagnoses. They were recruited from a wide range of sources such as psychiatric inpatient and outpatient services, prisons, diabetes institutes, local physicians, universities, mental health professionals, and through self-referral. The results of this review article as a whole can thus potentially seem to be applicable to the vast majority of patients with depressive disorders or elevated depression levels in clinical practice.

Another advantage of this literature review is its inclusion of studies conducted in various countries beyond India, the birthplace of SKY, where yoga and related practices may not be as prevalent. The review encompasses studies conducted in countries such as the US, UK, Italy, Sweden, and Kuwait, demonstrating the effects of SKY on diverse populations beyond South Asia.

IMPLICATIONS FOR FUTURE RESEARCH

For future research, conducting high-quality randomized controlled trials (RCTs) with large sample sizes and long trial durations would be valuable in determining the efficacy of SKY on depression. The studies should include both valid subjective and objective outcome measures, such as the Hamilton Rating Scale for Depression (HRSD), Beck Depression Inventory (BDI), and even video interviews or personal diaries. This approach would provide a more comprehensive evaluation of the effects of SKY on the participants, including both short-term and long-term outcomes.

As previously reported in the results section, the included studies all incorporated the essential components of Sudarshan Kriya Yoga, yet varied in terms of additional elements, frequency, intensity, and duration of practice. Some studies incorporated stress management and education components, while others did not. Despite these variations, all the studies produced comparable outcomes. However, in order to advance the field and facilitate comparability between studies, it would be advisable for future studies to strive for greater uniformity in their interventions.

Furthermore, in one of the studies, the effects of the complete Sudarshan Kriya Yoga (SKY) intervention on depression were compared to the effects of a partial SKY intervention, in which the *Sudarshan Kriya*-component (cyclical breathing) was substituted with regular breathing. Both the full SKY and partial SKY groups showed significant reductions in depression levels, and no significant difference was observed between the partial SKY and full SKY-group in terms of these reductions (Rohini et al., 2000). Although the study acknowledges the possibility of a type 2 error, further research with larger sample sizes would be interesting to determine the most effective components of Sudarshan Kriya Yoga in reducing depression levels. For example, if it were to be discovered that a limited number of components could lead to the same reductions in depression levels as the full SKY intervention, this could lead to a simplified SKY practice that is easier to implement and prescribe, potentially resulting in greater adherence among patients.

As previously reported by (Doria et al., 2015) and (Hamilton-West et al., 2019), the majority of participants in yoga and SKY studies are typically female. This literature review identified two studies with exclusively male participants (Sureka et al., 2014; Vedamurthachar et al., 2006) and one study with a higher representation of males compared to females (Janakiramaiah et al., 2000). These three studies arrived at the same conclusions as the majority of studies dominated by females, which demonstrated that SKY has a significant effect on reducing depression

levels. Through their data analysis, (Hamilton-West et al., 2019) also reported that the effects of SKY did not vary by gender. Thus, future research should investigate strategies for increasing male participation in SKY-related interventions and evaluate their acceptability.

Finally, the limited sample sizes and narrow study populations of many of the studies included in this literature review make it difficult to generalize their results to the broader population. It would be beneficial for future research to include studies with larger sample sizes and more diverse population characteristics, in order to enhance the generalizability of the results.

CONCLUSION

All eleven studies in this literature review reported significant reductions in depression levels post-SKY intervention, as measured by different outcome measures. The results are in line with earlier systematic reviews and literature reviews in this field, stating that Sudarshan Kriya Yoga can be viewed as an effective, low-cost adjunctive therapy for depression. However, high-quality and robust RCTs with larger sample sizes, longer trial durations, uniform use of both valid subjective and objective outcome measures and uniform SKY-interventions are needed to draw definitive conclusions on the efficacy of SKY on depression, both short-term and long-term. In addition, future studies would benefit from determining which components of Sudarshan Kriya Yoga (SKY) are most effective in reducing depression, in order to potentially simplify the SKY intervention and improve adherence. Furthermore, it is important for future research to examine ways to increase male participation in SKY-related interventions and assess their acceptability.

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