

## Review

# Effects of yogic practices on polypharmacy

Dr. Balaji Pa, Dr. Smitha R Varne

Rajiv Gandhi university of health sciences, Bangalore, India

## ARTICLE INFO

### Article history :

Articles Submission :

3<sup>rd</sup> October, 2023

Revision: 5<sup>th</sup> November, 2023

Accepted: 25<sup>th</sup> November, 2023

Available Online: 22<sup>th</sup> December, 2023

### Keywords :

Yoga, Pranayama, Meditation,  
Poly pharmacy, Medications.

## ABSTRACT

The occurrence and concurrency of Noncommunicable chronic diseases increase with age, and therefore, the number of medications used increases correspondingly. Polypharmacy is a scenario in which five medications or more are consumed concurrently (regardless of dose and duration of consumption), which leads to reduced quality of life, physical problems, increased drug interactions, adverse effects, and medical complications and increases the cost of treatment. Moreover, polypharmacy increases the incidence of falls, frequency of hospital admission, length of stay, and the death rate among patients, especially in the elderly population. This would allow therapies like Yoga, pranayama, and meditation to act as an effective mainstay or adjunctive or alternative therapy for many disorders, as it can be cost-effective, patient-compliant, and clinically efficacious with the most negligible side effects. However, very few studies have focused on the impact of yogic practices on reducing drug dosage or polypharmacy among patients. Hence, a Medline English literature search was planned to review all the studies demonstrating a dose-response effect between yogic practices and the number/dosage of medication reduction in different disorders. Data extracted and analyzed depicted that the practice of Yoga, pranayama, and meditation can result not only in reducing the number of medications but also the dosages in hypertension, type 2 diabetes mellitus, bronchial asthma, arthritis, sleep disorders, obsessive-compulsive disorder (OCD), gastrointestinal disorders like constipation and irritable bowel syndrome.

## Introduction :

The world's population is aging rapidly, especially in developing countries such as Brazil, India, China, Pakistan, Indonesia, and Sri Lanka. With aging, an individual's capacity to adapt and cope with disorders deteriorates and enhances a greater risk of chronic noncommunicable diseases (CNCDs) and, thus, increased requirement for medications such as anti-hypertensives, lipid-lowering agents, antidiabetics, non-steroidal anti-inflammatory drugs, antacids, and antidepressants. In a few circumstances, there is increased exposure to the use of polypharmacy, which is exponentially becoming a

significant public health issue. World Health Organization has described polypharmacy as the routine use of five or more medications. This includes a patient's combined use of over-the-counter, prescription, and traditional and complementary medicines. Polypharmacy or polypill leads to decreased quality of life, physical problems, increased drug interactions, adverse effects, and medical complications and accelerates the cost of treatment. Further, polypharmacy can increase the incidence of falls, frequent hospitalizations, length of hospital stay, and the death rate, particularly in the elderly population.<sup>1,2,3,4</sup>

Email : [drpaba2@gmail.com](mailto:drpaba2@gmail.com)

DOI: <https://doi.org/10.58914/ijyesspe.2023-8.2.1>

Medication overload can be considered as one of the indicators of a multi-organ disease burden. The prevalence of polypharmacy worldwide is heterogeneous, ranging from 10% to 90%. A study involving seventeen European countries and Israel depicted a prevalence between 26.3% and 39.9% of polypharmacy use among people aged 65 and older. In developing countries such as China and Ethiopia, the prevalence was 48% and 33%, respectively, while in Brazil, it was a heterogeneous pattern, with a prevalence of 13.5% among 50-year-olds and 18% among 60-year-olds.<sup>5,6</sup>

Many studies have shown that yoga and pranayama practices produce considerable health benefits, including improved cognition, respiration, reduced cardiovascular risk, BMI (body mass index), blood pressure, and diabetes mellitus, and influenced immunity and improved joint disorders. Lifestyle practices, like pranayama, meditation, and Yoga, can serve as lifelong tools to help patients lead dignified, cost-effective, and healthier lives.<sup>7,8</sup>

However, very few studies have focused on the impact of yogic practices on reducing drug dosage or polypharmacy among patients. Hence, a literature search was planned to review all the studies demonstrating a dose-response effect between yogic practices and reducing the number/dosage of medications.

### **Methodology:**

This is a systematic review of the existing literature to answer the question, "Can the practice of Yoga, pranayama, and meditation reduce the burden of polypharmacy/polypill among adult and Geriatric populations?"

### **Search Strategy**

We searched MEDLINE English literature language from unrestricted past date till September 2023 through PubMed, Embase, PsycINFO, CINAHL, the Allied and Complementary Medicine Database (AMED), IndMED, the Cochrane Database of Systematic Reviews, and PROSPERO. The keywords used were a combination of Yoga, pranayama, meditation, reduction, dosage, polypill, polypharmacy, stress, hypertension, diabetes, obesity, cognition, arthritis, and other health disorders.

The eligibility criteria for screening were that the article should be: 1) Population, including adults and geriatric age groups with some health disorder. 2) Intervention was Yoga, pranayama, and meditation 3) The study demonstrated a reduction of dosage and a reduction in the number of medications used. 4) The outcome was improved signs and symptoms and metabolic parameters.

### **Screening Articles**

After mutual understanding and discussion on the inclusion criteria, two reviewers carried out the process of article screening, first through the title and then with an abstract to identify which articles have the potential to meet the desired eligibility criteria. After that, all articles considered significant were reviewed at the initial screening. Additional articles not found in the initial literature search were obtained by reviewing references in the study. Two reviewers reviewed each title and abstract based on inclusion criteria.

### **Assessment of Quality of Study**

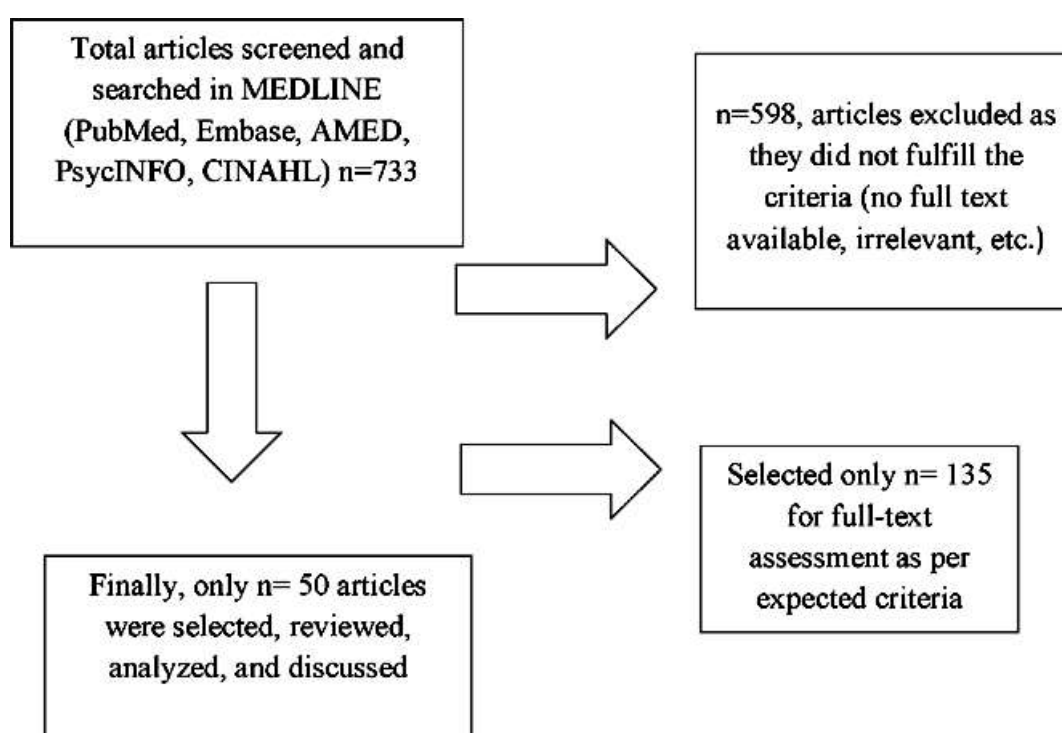
Each article's quality was assessed using the Critical Appraisals Skill Program (CASP). The criteria used to evaluate whether each study is of good quality and a minimum risk of bias consisted of three components: whether the study results are valid. What are the positive and negative outcomes? Will the research outcomes benefit locally and globally?

### **Data Extraction**

Each article was assessed by making a summary of each article, which includes author, year, country of origin of the study, type of study, sample size (including the number of samples and inclusion and exclusion criteria), intervention procedure, results, discussion, conclusion, and limitations of the study.

**Table 1 Search strategy of review**

#1 Yoga[mesh] # pranayama # meditation#practice  
 #2 Yoga OR Yogic OR Pranayam OR Asana OR meditation  
 #3 poly pharmacy #1 OR #2 #adults #older adults # beneficial effects  
 #4 poly pill #systematic review OR systematic overview OR meta-analysis OR meta-analysis OR systematic\*  
 review OR systematic[sb] OR meta-analysis[pt]  
 #5 geriatric #3 AND #4 # adults# heart failure # stress or # anxiety  
 #6 hypertension #type 2 diabetes #obesity  
 #7 dose reduction # usage #number  
 #8 health disorders AND # OR # diseases

**Flow chart of the search strategy****Results:**

A total of 733 records were obtained through database searching. After excluding duplicate records, two authors selected 135 for full-text assessment. Further, after full-text screening, 85 articles were excluded, then only 50 articles that met all search criteria, from where the issues were constructed and discussed.

**Discussion:**

It is well established that regular practice of Yoga, pranayama, and meditation positively impact overall health and diseases. We obtained good quality literature regarding reducing the number of medications and dosages used among patients embracing yogic practices daily. Now, let us focus and insight on the impact of various disorders.

**1. Neuropsychological disorders:**

**1.1 Sleep disturbance:** Sleep disturbances are common ailments among older adults.

In a randomized trial conducted by Manjunath and Telles involving geriatric patients, the yoga group that underwent regular yoga exercises for six months depicted a significant reduction in time to fall asleep, decreased sleep disturbance during night time, better sleep quality, decreased use of medications for sleep when compared with the control group.<sup>9</sup>

Cohen et al. 2004 conducted a randomized trial involving thirty-nine lymphoma patients. Tibetan Yoga participants reported significantly lower sleep disturbance scores than patients in the control group (5.8 vs. 8.1;  $P < 0.004$ ). The scores included improved subjective sleep quality ( $P < 0.02$ ), better sleep latency ( $P < 0.01$ ), longer sleep duration ( $P < 0.03$ ), and lesser usage of sleeping pills ( $P < 0.02$ ).<sup>10</sup> Similarly, Reuters et al. found that those cancer patients who did Yoga were able to cut back on sleeping pills and slept better, as measured by a 22 percent increase in sleep quality on a commonly used sleep scale.<sup>11</sup>

A nationwide, multi-site, phase II/III, randomized, controlled clinical trial among 410 cancer survivors revealed that the yoga group reduced sleep medication use (C.S. {change score} = 0.21, SE = 0.09,  $p < 0.05$ ). In contrast, the control group increased medication use (C.S. = 0.04, S.E. = 0.07,  $p = 0.09$ ).<sup>12</sup>

### 1.2 Stress, anxiety, depression:

There is an exponential demand for clinically efficacious, safe, patient-compliant, and cost-effective forms of treatment for psychological illness. Many studies have demonstrated the benefits of Yoga, pranayama, and meditation in specific psychiatric illnesses and a general sense of well-being. There are multiple categories of psychopharmacological drugs available, but the response and tolerability remain unpredictable, inconsistent, and non-compliant.<sup>7,13</sup>

A quasi-experimental study conducted in Iran involving 52 women with a mean age of  $33.5 \pm 6.5$  were included for analysis. Depression, anxiety, and stress decreased significantly in women after 12 sessions of regular hatha yoga practice ( $P < 0.001$ ), and it concluded that yoga practice has an influential role in reducing stress, anxiety, and depression and reducing the cost of treatment by reducing the medications.<sup>14</sup>

A scoping review depicted that Yoga may benefit cognitive functioning, particularly attention and verbal memory. No pharmacological drugs have demonstrated convincing effects in delaying disease progression or conversion of mild cognitive impairment to dementia, and they recommended Yoga to persons with mild cognitive impairment or dementia as a safe and potentially beneficial complementary health approach instead of the usage of medications.<sup>15</sup>

### 1.3 Caregiver stress:

In the last few decades, psychological distress among caregivers of patients with neurological, neurosurgical, and mental disorders has exponentially increased. Noncurable, prolonged hospital stays, poor knowledge about illness, illiteracy, and poverty could be some of the other reasons for stress. The effect of caregiving for someone with illness brings the risks of mental ill health to the carer in the form of emotional stress, mood disturbances, or clinical depression. The practice of Yoga can decrease caregiver stress with a positive impact on the caregiver's physical and mental health. Additionally, Yoga and meditation play an important role in bringing down the caregiver's overall burden and depression.<sup>16</sup> Hence, practice of Yoga, pranayama, and meditation can prevent the initiation of drugs/medications to tackle stress, anxiety, and depression in vulnerable populations.

### 1.4 Obsessive-compulsive disorder (OCD)

In a study conducted to investigate the clinical efficacy of yogic techniques in the treatment of eight adults with obsessive-compulsive disorder (OCD), involving specific yogic breathing patterns for one year course of therapy, five patients improved on the Yale-Brown Obsessive-Compulsive Scale (Y-BOCS) comparing baseline with three, six, nine, & 12 months. Out of Five patients well stabilized on fluoxetine prior to the study, three stopped medication after seven months or less, and two significantly reduced it, one by 25% and the other by 50% of dosage.<sup>17</sup>

## 2. cardiovascular diseases:

### 2.1 Hypertension:

A study conducted among 50 hypertensive patients found that yogic practices combined with anti-hypertensive drugs were effective in reducing blood pressure pulse rate and reduced the requirement of the dose of anti-hypertensive drugs in the majority of the hypertensive patients.<sup>18</sup>

Deepa T et al. conducted a study involving 30 hypertensive patients, found there was a significant fall in mean blood pressure after three months of Yoganidra, and suggested that Yoga can be used as adjunctive therapy with medications, thereby helping in reducing drug dosage and drug combinations among hypertensive patients.<sup>19</sup>

A review on Yoga and hypertension revealed that the long-term use of anti-hypertensive drugs will produce side effects, and may even produce resistance and affect therapeutic efficacy; therefore, seeking an alternate method like

yogic practices can be effective in B.P. control and concluded that Yoga was also effective in reducing anti-hypertensive medication use.<sup>20</sup>

A randomized clinical trial involving 40 hypertensive patients found that regular practice of Yoga and pranayama may reduce the dose requirement of anti-hypertensive drugs or help to withdraw the pharmacological therapies.<sup>21</sup> The mechanism by which yoga and pranayama/meditation reduce B.P. is by the reduction in sympathetic activity, facilitating autonomic balance, enhancing baroreflex sensitivity, and alteration of chemoreceptor responses. Yogic practices not only can reduce elevated blood pressure, but they also can significantly arrest the course of pathogenesis.<sup>8, 22,23</sup>

## 2.2 Arrhythmia, heart failure:

Pranayama can reduce the indices of ventricular repolarization dispersion in patients with arrhythmia.<sup>24</sup> Yogic practices can improve the electrical stability of the cardiac tissue by maintaining autonomic nervous system balance and decreasing the episodes of atrial fibrillation (A.F.). Atrial fibrillation symptoms like palpitations, shortness of breath, dizziness, fatigue), stress, depression, and anxiety get ameliorated, thus improving the health-related QOL (quality of life).<sup>25</sup> Yogasana practice for three months demonstrated a significant improvement in the left ventricular relaxation period, resulting in the normalization of diastolic dysfunction and effective in reducing heart rate and rate pressure product (RPP).<sup>26</sup> The effects of yoga exercises on heart failure patients included reduced cardiac inflammatory markers, blood pressure, chest pain, discomfort, and decreased implantable cardioverter defibrillator firings.<sup>27</sup>

The above data suggest the beneficial effects of yogic practices among heart diseases. However, we could not retrieve any yoga-related research demonstrating a directly reduced dosage of cardiovascular medications among heart failure and arrhythmia patients.

## 3. Type 2 Diabetes:

In a prospective two-armed interventional randomized control study involving 277 types, two diabetics of both genders aged above 28 years from 5 zones in and around Bengaluru, India, were allocated to a yoga-based lifestyle modification program (yoga group) or exercise-based lifestyle modification program (control group). Medication score, blood glucose, HbA1c, and lipid profile were assessed at baseline and after nine months. Intention to treat analysis showed better reduction ( $P < 0.05$ , Mann-Whitney test) in the dose of oral hypoglycemic medication required (Yoga - 12.8 %) (Yoga-12.3 %) and an increase in HDL (Yoga-7 %) in Yoga as compared to the control group; FBG reduced (7.2 %,  $P = 0.016$ ) only in the Yoga group. There was significant reduction within groups ( $P < 0.01$ ) in PPBG (Yoga-14.6 %, Control-9 %), HbA1c (Yoga-14.1 %, Control-0.5 %), Triglycerides (Yoga-15.4 %, Control-16.3 %), VLDL (Yoga-21.5 %, Control-5.2 %) and total cholesterol (Yoga-11.3 %, Control-8.6 %).<sup>28</sup>

In a study, 44 types two diabetic patients were taught Yoga ( $n = 22$ ) and pranayama for three continuous months, 1 hour per day in the morning by a yoga instructor had a significant decrease in FBS, Postprandial blood sugar (PPBS), glycosylated hemoglobin (HbA1c), triglycerides and LDL among yoga group with  $P < 0.001$ , compared with the control group ( $n = 22$ ). The daily requirement of insulin among the yoga group was also significantly reduced.<sup>29</sup>

Jain S C et al. found a significant decrease in hyperglycemia with a significant reduction in oral hypoglycemic drug dosage for maintenance of normoglycemia in response to yoga therapy, possibly due to improved insulin sensitivity following yoga and pranayama practices.<sup>30</sup>

Similarly, Sahay et al. and Dang et al. reported decreased drug requirements to control blood sugar levels among type 2 diabetic patients who regularly practiced Yoga, pranayama, and meditation.<sup>31,32</sup> In patients with type 2 diabetes mellitus, routine yogic practice causes reduced drug dose, mentally and physically person become strong and decreases complications.<sup>33</sup> There was a lowering of drug requirement, and the incidence of acute complications like infection and ketosis was significantly reduced.<sup>34</sup> There was a significant fall in the fasting and postprandial blood glucose levels decreased after 40 days of Yoga asanas), along with the subjects developing a sense of well-being within ten days, and there was a lowering of the dosage of the oral anti-diabetic drugs.<sup>35</sup> ICMR guidelines suggested yogic practices may beneficially impact several aspects of diabetes management, such as glycemic control, serum lipid levels, body fat content, reduced oxidative stress and blood pressure, improved pulmonary and autonomic function, mood, sleep, and quality of life; and reduction in doses of anti-diabetic medication.<sup>36</sup>

#### 4. Thyroid disorders:

The mainstay of treatment for people with hypothyroidism is replacing their thyroid hormone with levothyroxine (LT4). However, a significant number of patients treated with levothyroxine have persistent symptoms such as lack of energy, fatigue, cognitive problems, musculoskeletal pain, weight gain, irregular menstrual cycles, constipation, etc., despite achieving biochemical euthyroidism.

A pilot study involving Twenty-two household women suffering from hypothyroidism between the age range of 30 and 40 years, subjected to six months of practice of Yoga, demonstrated improvement in cholesterol level serum TSH and reduced the thyroxine medication requirement.<sup>37</sup>

In a study protocol for a teleyoga randomized controlled trial, it was found that in settings of long-term induced side effects of treatment such as acute myocardial infarction, angina pectoris, change in thyroid hormone requirements, or hypo responsiveness to hormonal therapy, yoga intervention could be effective in dose reductions in levothyroxine administration to maintain euthyroidism and thereby aid in reducing drug-related side effects as well.<sup>38</sup>

Similarly, a regular practice of yoga, pranayama, and meditation results in increased parasympathetic activity and decreased sympathetic discharges, which can effectively reduce the dose of beta-blockers required to control the increased heart rate and anxiety among thyrotoxic patients.<sup>39</sup>

#### 5. Obesity and dyslipidemia:

The sequential slow and non-strenuous movements of Yoga positively affect the hypothalamic-pituitary axis response to stress, which could be the primary basis for reducing weight among obese individuals. The improvement in the lipid profile among obese patients could be due to increased hepatic lipase and lipoprotein lipase at the cellular level, which alters the metabolism of lipoprotein and thus further increases the uptake of triglycerides by adipose tissues. Meditation also promotes a balanced metabolic state and decreases stress-induced sympathetic overactivity.<sup>7,8,39</sup> This lipid-lowering impact of Yoga and pranayama can, by and large, reduce the dose and combinations of statins and fibrate group of medications among dyslipidemia and hypertriglyceridemia patients.

In an online survey conducted by Moliver et al. involving 211 female yoga practitioners aged 45 to 80, regression analyses showed a dose-response effect, with increased yoga experience predicting lower body mass index (BMI) and reduced medication use.<sup>40</sup>

#### 6. Reproduction and pregnancy:

Yoga can significantly lower polycystic ovarian syndrome (PCOS) symptoms, especially those that affect fertility, and reduce the requirement for hormone-regulatory medicines or tablets. However, no research articles documented such a reduction of drug dosage requirement.<sup>41</sup>

Yoga and pranayama significantly decreased blood glucose levels, which can prevent adverse maternal and fetal outcomes of Gestational diabetes mellitus. Safety during pregnancy is paramount, and exercises such as exerting forces like Yoga and pranayama could be the best therapeutic remedy.<sup>42</sup>

This beneficial effect of Yoga in Gestational diabetes can prevent the initiation of medications and reduction of insulin requirements in controlling blood sugar levels. Hence preventing the harmful effects of medications on the growing fetus.

#### 7. Respiratory system:

A randomized controlled trial (RCT) conducted on 57 adult subjects with mild or moderate bronchial asthma, allocated randomly to either the yoga (intervention) group (n = 29) or the wait-listed control group (n = 28) demonstrated that the frequency of rescue medication use showed a significant decrease over the study period in both the groups and the decrease was achieved much earlier and was more visible among the yoga group.<sup>43</sup>

In an interventional study involving 300 patients with mild to moderate persistent asthma (FEV1 > 60%) aged between 12 to 60 years, the yoga group practiced Yoga and pranayama for six months and found that the rescue medication and inhalation therapy needed significantly reduced.<sup>44</sup> Another study involving thirty-two patients with bronchial asthma who underwent training for 16 weeks of yoga exercises showed a significant reduction in the number of asthma attacks and, consequently, a reduction of usage and lesser dependency on inhalers.<sup>45</sup>

In a Randomized, waitlist-controlled, single-blind clinical trial involving eighty-one coal miners (36 to 60 years) with stable Stages II and III chronic obstructive pulmonary disease (COPD), the yoga group received an Integrated

Approach of Yoga Therapy (IAYT) module for COPD that included asanas, loosening exercises, breathing practices, pranayama study, reduced ventilator requirements at the end of 6MWT (6minute walk test).<sup>46</sup>

### 8. Gastrointestinal system:

In a study involving 28 male elderly patients with chronic constipation, the yoga group (N=14) offered selected yogic practices. It depicted that yoga practices effectively decreased drug requirements and improved the constipation assessment scale (CAS) score.<sup>47</sup>

A 12-week remedial yoga module (RYM) intervention among 97 patients with irritable bowel syndrome found that the medicine and Supplement usage decreased significantly in the Yoga and Combination groups compared to the Control group ( $p < 0.001$ ).<sup>48</sup>

### 9. Arthritis:

Non-steroidal anti-inflammatory drugs (NSAIDs) like diclofenac sodium and Disease-modifying agents like hydroxychloroquine are commonly used in treating arthritis. They reduce both pain and inflammation effectively, but their long-term use can be associated with an increased risk of gastrointestinal bleeding, retinal damage, hypertension, heart failure, renal dysfunction, and other adverse effects. In a randomized controlled trial involving 120 Patients of knee Osteoarthritis (O.A.), Group A with Conventional treatment of O.A. with added Yoga and Group B with conventional treatment of Osteoarthritis Knee only, found that the use of yoga therapy for Knee Osteoarthritis, the requirement of analgesic drugs significantly decreased and among some patients, could be withdrawn altogether.<sup>49</sup> A systematic literature review found that Mind-body therapies (MBTs), including meditation, Yoga, and mindfulness, had added value in rheumatoid arthritis (R.A.) management, especially for patients with depressive symptoms. These non-pharmacological approaches, when used in addition to medication, might diminish polypharmacy in specific R.A. patients.<sup>50</sup>

### Conclusion:

We have outlined the systematic review evidence, provided the insight, and concluded that the practice of Yoga, pranayama, and meditation could result not only in reducing the number of medications but also the dosages in hypertension, type 2 diabetes mellitus, bronchial asthma, arthritis, sleep disorders, obsessive-compulsive disorder (OCD), gastrointestinal disorders like constipation and irritable bowel syndrome. We recommend future studies on Yoga and pranayama to depict health benefits and parallelly demonstrate quantitative dosage reduction or reduction of the number of pill consumption by the patients.

### Limitations:

1. We could not highlight the exact dosage reductions (in mg or gms) of various medications, as most reviewed articles had yet to describe the full details of dosage reduction.

**Conflict of interest:** none

**Funding:** none

**Ethical clearance:** This is a review article, and no humans/animals are experimented with, so ethical clearance is not required.

### References:

1. Masnoon N, Shakib S, Kalisch-Ellett L, Caughey GE. What is polypharmacy? A systematic review of definitions. *BMC Geriatr.* 2017 Oct 10;17(1):230. doi: 10.1186/s12877-017-0621-2. PMID: 29017448; PMCID: PMC5635569.
2. Vitorino LM, Lopes Mendes JH, de Souza Santos G, Oliveira C, José H, Sousa L. Prevalence of Polypharmacy of Older People in a Large Brazilian Urban Center, and its Associated Factors. *Int J Environ Res Public Health.* 2023 May 5;20(9):5730. doi: 10.3390/ijerph20095730. PMID: 37174248; PMCID: PMC10177927.
3. Davies LE, Spiers G, Kingston A, Todd A, Adamson J, Hanratty B. Adverse Outcomes of Polypharmacy in Older People: Systematic Review of Reviews. *J Am Med Dir Assoc.* 2020 Feb;21(2):181-187. doi: 10.1016/j.jamda.2019.10.022. Epub 2020 Jan 8. PMID: 31926797.

4. Lima-Costa MF, de Andrade FB, de Souza PRB Jr, Neri AL, Duarte YAO, Castro-Costa E, de Oliveira C. The Brazilian Longitudinal Study of Aging (ELSI-Brazil): Objectives and Design. *Am J Epidemiol.* 2018 Jul 1;187(7):1345-1353. doi: 10.1093/aje/kwx387. PMID: 29394304; PMCID: PMC6031009.
5. Seixas, B.V.; Freitas, G.R. Polypharmacy among older Brazilians: Prevalence, factors associated, and sociodemographic disparities (ELSI-Brazil). *Pharm. Pract.* 2021; 19: 2168. [Google Scholar] [CrossRef].
6. Ramos, L.R.; Tavares, N.U.; Bertoldi, A.D.; Farias, M.R.; Oliveira, M.A.; Luiza, V.L.; Pizzol, T.D.; Arrais, P.S.; Mengue, S.S. Polypharmacy and Polymorbidity in Older Adults in Brazil: A public health challenge. *Rev. Saude Publica* 2016;50: 9s. [Google Scholar] [CrossRef].
7. Balaji PA, Varne SR, Ali SS. Physiological effects of yogic practices and transcendental meditation in health and disease. *N Am J Med Sci.* 2012 Oct;4(10):442-8. doi: 10.4103/1947-2714.101980. PMID: 23112963; PMCID: PMC3482773.
8. Varne SR, Balaji PA. Physiological Effects of Yoga and Pranayama on Serum Adipokines, Lipoprotein (a), Thyrotropin Levels, and Blood Pressure among Obese Hypothyroid Patients with Hypertension. *IRJAY.* [online] 2023;6(8);9-14. DOI: 10.47223/IRJAY.2023.6802.
9. Manjunath NK, Telles S. Influence of Yoga and Ayurveda on self-rated sleep in a geriatric population. *Indian J Med Res.* 2005 May;121(5):683-90. PMID: 15937373.
10. Cohen, L., Warneke, C., Fouladi, R. T., Rodriguez, M. A., and Chaoul-Reich, A. (2004). Psychological adjustment and sleep quality in a randomized trial of the effects of a Tibetan yoga intervention in patients with lymphoma. *Cancer* 100: 2253–2260.
11. <https://www.reuters.com/article/us-cancer-yoga-idINTRE64K0SB20100521>. (Last accessed 19/09/2023).
12. K. M. Mustian, O. Palesh, L. Sprod, L. J. Peppone, C. E. Heckler, J. S. Yates, P. S. Reddy, M. Melnik, J. K. Giguere, and G. R. Morrow. Effect of YOCAS yoga on sleep, fatigue, and quality of life: A URCC CCOP randomized, controlled clinical trial among 410 cancer survivors. *Journal of Clinical Oncology* 2010;28: 15\_suppl, 9013-9013.
13. Balasubramaniam et al. Yoga on our minds: a systematic review of yoga for neuropsychiatric disorders. *Frontiers in Psychiatry* January 2013;3: Article 117.
14. Shohani Mosumeha, Badfar G, Nasirkandy MP, Kaikhavani S, Rahmati S, Modmeli Y, Soleymani A, Azami M. The Effect of Yoga on Stress, Anxiety, and Depression in Women. *Int J Prev Med.* 2018 Feb 21;9: 21. doi: 10.4103/ijpvm.IJPVM\_242\_16. PMID: 29541436; PMCID: PMC5843960.
15. Gretchen Brenes et al. The effects of yoga on patients with mild cognitive impairment and dementia: A scoping review. *Am J Geriatr Psychiatry.* 2019 February ; 27(2): 188–197. doi:10.1016/j.jagp.2018.10.013.
16. Clarita S. Martis et al. The effectiveness of yoga therapy on caregivers of people living with dementia: A systematic review and meta-analysis of randomized controlled trials *Clinical Epidemiology and Global Health* 2023;19: 101192.
17. Shannahoff-Khalsa DS, Beckett LR. Clinical case report: efficacy of yogic techniques in the treatment of obsessive-compulsive disorders. *Int J Neurosci.* 1996 Mar;85(1-2):1-17. doi: 10.3109/00207459608986347. PMID: 8727678.
18. Prashant K J, V Malhotra, N Goel, S Gupta. Effects of 40 days of Pranayama Training in Hypertensive Subjects. *International Journal of Physiology*, April-June 2019;7(2). Doi. Number: 10.5958/2320-608X.2019.00041.6.
19. Deepa T, Gowri Sethu, N. Thirrunavukkarasu. Effect of Yoga and Meditation on Mild to Moderate Essential Hypertensives. *Journal of clinical and diagnostic research* 2012;6(1):21–26.
20. Sunita T, Arvind K Pal. Non-pharmacological treatment of hypertension. *Hypertension Journal*, October-December 2017;3(4):189-192.
21. Ram Kumar Agarwal & Neeru Nathani: Clinical Evaluation Of The Effect Of Certain Yogic Practices On Hypertension. *IAMJ* 2015; 3(9).
22. Balaji PA, Varne SR. High-sensitive CRP levels, Plasma renin activity and blood pressure among Hypertensive patients practicing Yoga exercises. *Indian J Clin Anat Physiol* 2017; 4:431-4. DOI: 10.18231/2394-2126.2017.0109.
23. Balaji PA, Smitha RV. Integrated review of management of hypertension by lifestyle changes, yoga, exercise, acupressure, plant/herbal and allopathic medications, and newer interventions. *Indian J Integr Med* 2023; 3:1-8.



24. Abhijeet Madhukar Dabhade, Bharatsingh H. Pawar, Manoj S. Ghunage, Valshali M. Ghunage. Effect of Pranayama (Breathing Exercise) on Arrhythmias in the Human Heart EXPLORE2012;8(1):12-15.ISSN1550-8307 <https://doi.org/10.1016/j.explore.2011.10.004>.
25. Toise, stefanie, sears, S.F., Schoenfeld, M.H., Blitzer, M.L., Marieb, M.A., Drury, J.H., Slade, M.D. and Donohue, T.J. Psychosocial and Cardiac Outcomes of Yoga for ICD Patients: A Randomized Clinical Control Trial. Pacing and Clinical Electrophysiology 2014; 37: 48-62. <https://doi.org/10.1111/pace.12252>.
26. S.G. Patil et al. Comparison of yoga and walking-exercise on cardiac time intervals as a measure of cardiac function in elderly with increased pulse pressure. Indian Heart Journal 2017;69: 485–490.
27. Pullen PR, Seffens WS, Thompson WR. Yoga for heart failure: A review and future research. Int J Yoga 2018;11: 91-8.
28. R Nagarathna et al. Efficacy of yoga-based life style modification program on Medication score and lipid profile in type 2 diabetes – A randomized control study. International Journal of Diabetes in Developing Countries September 2012; 32(3):122-130.
29. Balaji PA, Varne SR, Sadat-Ali S. Effects of yoga - pranayama practices on metabolic parameters and anthropometry in type 2 diabetes. International Multidisciplinary Research Journal 2011;1: 1-4.
30. Jain SC, Uppal A, Bhatnagar SO, Talukdar B. A study of response pattern of non-insulin dependent diabetics to yoga therapy. Diabetes Res Clin Pract. 1993 Jan;19(1):69-74. doi: 10.1016/0168-8227(93)90146-v. PMID: 8472621.
31. Sahay BK and Murthy KJR, Long term follow up studies on effect of yoga in diabetes, Diab Res Clin Pract 1988; 5(suppl.1): S655.
32. Dang KK and Sahay BK, Yoga and Meditation, Medicine update. The Association of Physicians of India ed MM. Singh. APICON, The Association of Physicians of India conference, New Delhi.1999;9(1) chapters 57 and 58, p502- 512.
33. Damor DR, Varlekar MD, Upaadhya HR, Suvera MS, Thakore NR. Yoga-asanas and pranayama: Is it helpful in management non-insulin-dependent diabetes mellitus. Int J Med Sci Public Health 2020;9(9):540-543.
34. Savita Singh, Tenzin Kyizom, K P Singh, O P Tandon and S V Madhu. Influence of pranayamas and yoga-asanas on serum insulin, blood glucose and lipid profile in type 2 diabetes. Indian Journal of Clinical Biochemistry 2008; 23 (4): 365-368.
35. Malhotra V, Singh S, Sharma S B, Gupta P, Prasad A, Prasad A, Tandon O P, Madhu S V, Jai Ganga R. The Status of NIDDM Patients After Yoga Asanas: Assessment of Important Parameters. Journal of Clinical and Diagnostic Research [serial online] June 2010; 4:2652-2667.
36. ICMR guidelines for management of type 2 diabetes 2018. (online, last accessed on august 1 2023). Pages 22-23, 69.
37. Nilakanthan S, Metri K, Raghuram N, Hongasandra N. Effect of 6 months intense Yoga practice on lipid profile, thyroxine medication and serum TSH level in women suffering from hypothyroidism: A pilot study. J Complement Integr Med 2016;13: 189-93.
38. Nilkantham S, Majumdar V, Singh A. Scientific yoga module for hypothyroidism: A study protocol for tele-yoga RCT. Contemp Clin Trials Commun. 2023 Jun 10;33: 101157. doi: 10.1016/j.conctc.2023.101157. PMID: 37342177; PMCID: PMC10277449.
39. Varne SR, Balaji PA. A systematic review on molecular, bio-chemical, and pathophysiological mechanisms of yoga, pranayama and meditation causing beneficial effects in various health disorders. Indian J Integr Med October - December2023. (Ahead of print).
40. Moliver N, Mika E, Chartrand M, Burrus S, Hausmann R, Khalsa S. Increased Hatha yoga experience predicts lower body mass index and reduced medication use in women over 45 years. Int J Yoga. 2011 Jul;4(2):77-86. doi: 10.4103/0973-6131.85490. PMID: 22022126; PMCID: PMC3193658.
41. <https://veerahealth.com/5-easy-asanas-that-work-great-for-people-with-pcos/>. (Last accessed 19/09/2023).
42. Balaji P A, Smitha R Varne. Physiological effects of yoga asanas and pranayama on metabolic parameters, maternal, and fetal outcome in gestational diabetes. Natl J Physiol Pharm Pharmacol. 2017; 7(7): 724-728. doi:10.5455/njppp.2017.7.0306713032017.

43. Vempati, R., Bijlani, R.L. & Deepak, K.K. The efficacy of a comprehensive lifestyle modification programme based on yoga in the management of bronchial asthma: a randomized controlled trial. *BMC Pulm Med* 2009; 9(37). <https://doi.org/10.1186/1471-2466-9-37>.
44. Shruti Agnihotri, Surya Kant, SK Mishra, RK Mishra. Efficacy of Yoga on requirement of rescue inhaled medication in asthma patients. *Indian Journal of Traditional Knowledge* October 2016; 15 (4): 675-679.
45. Bhatt et al. The role of yoga therapy in the management of bronchial asthma (tamaka shwasa). *Asian J Pharm Clin Res* 2019;12(12): 27-33.
46. R. Ranjita et al. Yoga-based pulmonary rehabilitation for the management of dyspnea in coal miners with chronic obstructive pulmonary disease: A randomized controlled trial. *Journal of Ayurveda and Integrative Medicine* 2016;7: 158e166.
47. Tiwari VK, Mishra R, Chaudhary S, Niharika. Does Yoga Decreases Need of Pharmacotherapy in Elderly Patients of Chronic Constipation? *International Journal of Contemporary Medical Research* December 2016;3(12): ICV (2015): 77.83.
48. V. Kavuri et al. Remedial yoga module remarkably improves symptoms in irritable bowel syndrome patients: A 12-week randomized controlled trial. *European Journal of Integrative Medicine* 2015;7: 595–608.
49. Awasthi V, Singh A, Srivastava RN et. al. A randomized controlled trial: evaluation of yoga with il6 as biomarker in the management of knee osteoarthritis. *Int J Health SciRes.* 2015;5(1):73-79.
50. Slagter, L.; Demyttenaere, K.; Verschueren, P.; De Cock, D. The Effect of Meditation, Mindfulness, and Yoga in Patients with Rheumatoid Arthritis. *J. Pers. Med.* 2022;12: 1905. <https://doi.org/10.3390/jpm12111905>.