

# ROLE OF YOGA IN FALL PREVENTION AMONG ELDERLY POPULATION: A SYSTEMATIC REVIEW

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## ABSTRACT

**INTRODUCTION:** A fall is defined as an occurrence where a person inadvertently comes to rest on the ground or floor. Falls are a growing public health problem in India, the impact of this is expected to increase as the population ages. According to World Health organization (W.H.O.), falls are the second leading causes of unintentional injury deaths worldwide. Yoga as a fall prevention measure thought to be more effective than traditional exercise because yoga is effective not only on physical level also on mental level. Yoga works primarily expand the body consciousness and Proprioception, so that will lead to the improvement of balance, gait, and muscular strength in the elderly. This article reports a systematic review for the evidence as effectiveness of yoga in fall prevention in elderly.

**METHOD:** A PRISMA guideline has been used in this review. A search for systematic review article was done in Pub-Med and Google Scholar by using such key words: 'Fear of fall' and 'yoga' in elderly, 'gait', 'balance', 'physical activity', 'postural balance', 'functional performance', 'feasibility', 'mobility' in old age people. This work included last 10 years studies. Methodological quality of each study selected for review using the Dawns and Black checklist.

**RESULT:** Total 3153 studies were found, in which five articles (n=179) fulfilled the inclusion criteria; Three studies were randomized controlled trail and two studies were pilot studies. According to Dawns and black checklist, four studies were in moderate quality range and there was moderate risk of bias, only one study was found to be in high quality range with less risk of bias. The results of the studies showed that yoga can be used to prevent falls in the geriatric population.

**CONCLUSION:** Yoga is growing in all over the world and well except by the population of all ages. This review provides evidence that yoga is effective in preventing falls by improving parameters like balance, walking, mobility, flexibility, reducing fear of fall and motor task in elderly population. Although studies needed with larger sample size and randomized controlled trial with the high quality to ascertain the clinical significance of yoga as a fall preventive measure in elderly.

**KEY WORDS:** Yoga and fall prevention, Fear of fall, Balance, Mobility, Gait, elder people.

## INTRODUCTION

In India 'senior citizen' or 'older adult' is defined as a person aged 60 years and above.<sup>1</sup> India is the second most populated country in the world as per the census of 2011, the total percentage of elderly people who cross the age of 60 years and estimated to 8.6% rise up to 198 million by 2030.<sup>2</sup>

Aging is an irreversible normal phenomenon that takes place at a cellular level along with the functional, morphological, biochemical, physical and psychological changes.<sup>3</sup> A decline in muscle mass and a

reduction in muscle strength makes individual prone to the risk of fractures, frailty, reduction in the quality of life and increase dependency. Reduced physical activity as well as the ageing process further deteriorates the function of the musculoskeletal system. The muscle squandering in fragile more established people is named 'Sarcopenia'. Sarcopenia leads to a higher incidence of falls and fractures and decrease ability of maintaining balance that is directly related to increase risk of fall related injuries in elderly.<sup>4</sup> The Aging interaction causes decline in bulk, strength and coordination related to decline in equilibrium and walk control. Equilibrium and walk are significant contemplations in the strength of old subjects. According to the study by 'Lowell W. Gerson' in United States of America (USA) Approximately 13% of the older adult's self-report imbalance from ages 65 to 69 and this ratio increases to 46% in individuals over 85 years of age. Impairments of balance and gait have been implicated in increased risks of falls.<sup>5</sup>

Fall is one of the basic problems in the elderly and considered as one of the "Geriatric Giants".<sup>6</sup> Falls are not only related to morbidity and mortality in older individuals, but also major cause for immobility, decreased quality of life, fear of falling, functional dependency, early admission to long-term care facilities and increase financial burden.<sup>7</sup> Decrease in physical activity is a major causal factor for non communicable diseases that one of the leading risk factor for mortality.<sup>8,9</sup>

Studies have recognized such falls in elderly people in India as a major public health issue<sup>10,11</sup> but interventional studies have been neglected to date. In rural Andhra Pradesh, a community survey found that falls are the second most common cause of fatal injuries and the leading cause of non-fatal injuries across all age groups.<sup>12</sup> A people group study of grown-ups more than 60 years old in metropolitan Chandigarh and Haryana tracked down that 52% of the 200 review members had fallen somewhat recently and that fractures occurred in one in every five falls.<sup>13</sup>

During quite stance balance is defined as the ability to maintain centre of mass (COM) within base of support (BOS).<sup>14</sup> Achieving effective balance is a multi-system task.<sup>15</sup> To keep up with balance, an individual's focal point of mass should remain inside the changing base of help. Postural control relies upon tactile data sources: somatosensory data from muscle and joint proprioceptors, Cutaneous tangible data which recognizes surface qualities, vestibular data for head and trunk direction in space, gravity data from graviceptors within the storage compartment, and visual info. Situational signals and related involvements alter these information sources and add to adjust control.<sup>16</sup> Balance problems in older individuals are generally due to multi factorial condition such as age related issues, disease-related declines in the balance system. The decrease balance in the elderly is often due to reduce the strength of nucleus stabilizer muscles, altered muscle activity, loss of Proprioception and incapacity to regulate normal postural rocking.

Coordination of sensory, neural and musculoskeletal system is needed to maintain the balance.<sup>14,15</sup> These systems undergo deterioration with ageing. This can affect the balance, restrict safe mobility and increase the fall and adversely affect quality of life.<sup>17,18</sup>

In old age, Gait disturbance is a common medical problem, which is associated with falling and immobility that bring downs quality of life.<sup>19</sup> Changes in gait typically occurs with the aging. The reasons may be increased position width, increasing the time spent in the dual support phase (i.e., with both feet above the ground), folded posture and less vigorous force development upon pushing.<sup>20,21,22</sup>

Senile gait disorder is used to describe gait disorders in seniors where no secondary cause can be identified. It is characterized by a slow, broad-based, shifting and careful walking pattern. Generally, the walking speed decreases by approximately 1% a year after age of 60 years.<sup>19,23</sup>

Yoga practices have been associated with increased flexibility, muscle endurance, strength, range of motion, coordination. It is important to emphasize that intervention improves healthy aging, decrease the incidence of disability and improve quality of life. Yoga is one of the scientific and popular lifestyle practices which include integration of body, mind and soul.<sup>24</sup> Yoga has been proven to be extremely effective in maintaining physical, mental and social health since ancient times and it is gaining popularity worldwide very rapidly. Yoga based intervention have shown improvement in fall prevention as reported in many studies. However a systematic review to highlight the benefits of yoga as fall prevention in elderly is not reported yet. Aim of this review is to understand the role of yoga in frailty and fall prevention in elder people.

## **METHODOLOGY**

A Systematic Review was carried out on the available literature on “Role of yoga in fall prevention in elderly”.

## **SEARCH STRATEGY AND STUDY SELECTION CRITERIA**

### **Inclusion criteria**

1. Studies related to yoga as an intervention for population above 60 years of age with fall complaints.
2. Studies between 2010 – 2020.
3. Free full available text.
4. Studies correlating yoga with rehabilitation of fall among the elderly.

### **Exclusion criteria –**

The studies which involved exercise, aquatic exercises, tai-chi, dance, aerobics, zumba as fall preventive measure and studies where full text cannot be obtained were excluded.

## **DATA EXTRACTION AND ANALYSIS**

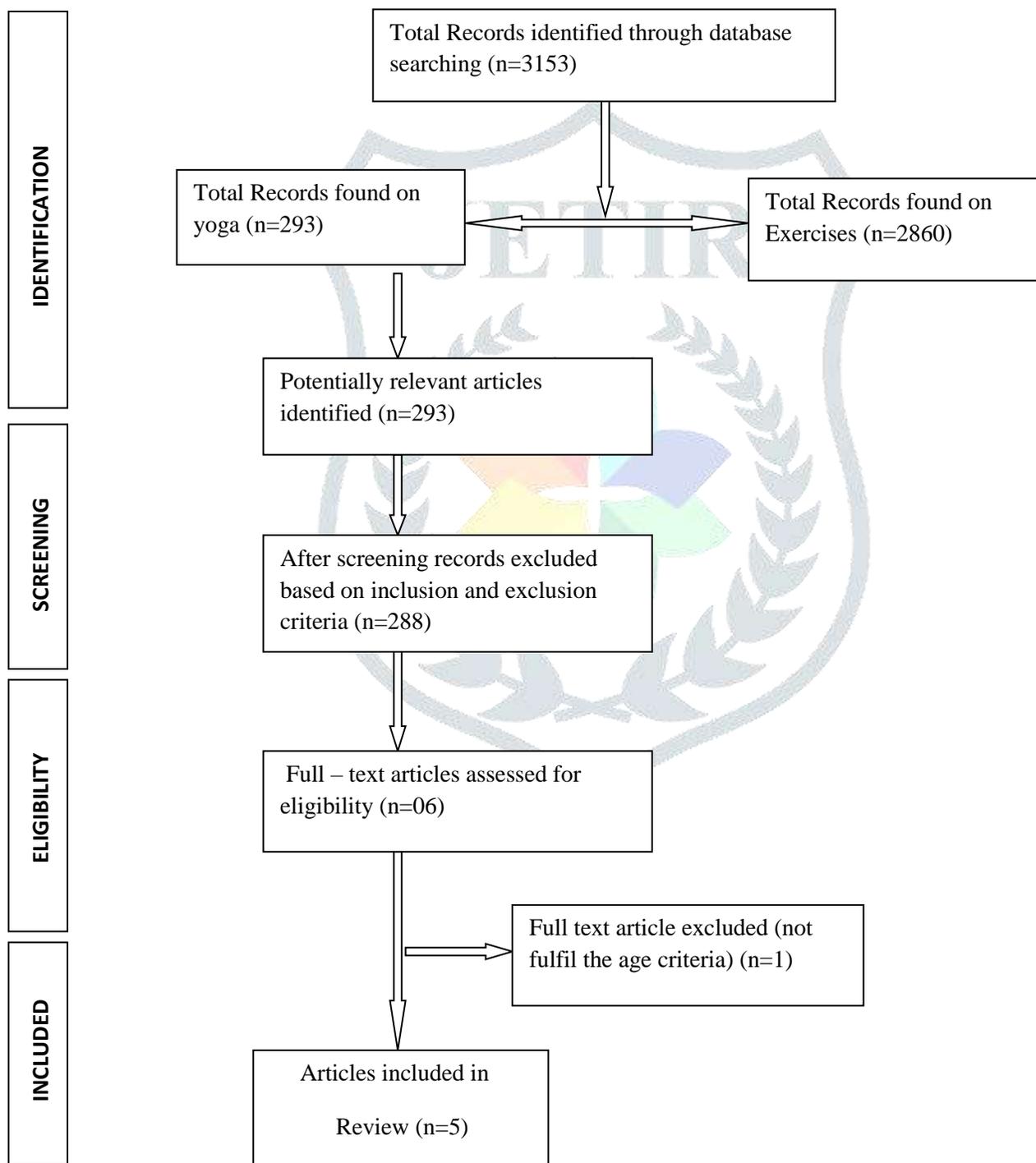
Data was extracted by Boolean search strategy, by advanced search and using different keywords ‘Fear of fall’ and ‘yoga’ in elderly, ‘gait’, ‘balance’, ‘physical activity’, ‘postural balance’, ‘functional performance’, ‘feasibility’, ‘mobility’ in old age people, The entire Data was reviewed by both the authors.

No risk of bias assessment was carried out. There was no grouping or any criteria modification done for reporting of the study.

## RESULTS

### DISCRIPTION OF INCLUDED STUDIES

Total of 3153 studies were identified. After screening, 5 eligible randomized controlled trail and pilot studies were included in this review. A flowchart outlining the eligibility assessment process for included education is provided. In figure 1 –



**Figure 1 : Flowchart of Record Eligibility Assessment and Literature Included for review**

## CHARACTERISTICS OF INCLUDED TRIALS

The Five studies included in the primary analysis involved a total 179 participants. Studies from India, Iran, Europe, Hamden (United States of America)(Table-1).

## PARTICIPANTS

Total 179 participants, both male and female above 60 years of age were included in the study from India, Iran, Europe and Hamden (USA). The following table shows the study criterias in detail.

S. no.	Author name	Type of study	Participants	Yoga intervention	Duration of practice	Control group	Outcome measure	Findings
1	Lisa Keya, Devarsetty Praveen, Abdul Salam et al. <sup>25</sup> May (2018)	Mixed method pilot study	N= 50, age 60 years and above , female- 29, male - 13, others - not attended session due to poor health, household work )	Each yoga class included- warm-up 10 minutes, postures - 50 minutes, Breathing exercises - 5 mins., Meditation 5 mins.	1 hour per week for 3 months		Short physical performance battery, short interview and short fall efficacy scales- international	Yoga was well accepted and resulted in improved ability to rise from a chair, weight loss, increased step length and reduced fear of falling
2	Narjes Nick et al. <sup>27</sup> (February 2016)	RCT	n=40, Male - 17, Women - 23, age 60-74 years	Hath yoga, Pranayama- 10 mins. Warm up- 10 mins. Asanas - 30 mins. Relaxation - 10 mins.	duration- 1 hour twice a week for 8 weeks		Modified Falls efficacy scale, Demographic data questionnaires and berg balance scale	yoga is a potential intervention to reduce fear of falling and improve balance in older adults

3.	Albertas Skurvydas, et al. <sup>26</sup> (September 2020)	RCT	n=33, age 60-79 years, female-30, male - 3	Warm-up 15 mins. Asanas- 45 mins. Himalay an kriya Breathin g excercise s- 25 mins., Relaxati on in shavasana 15 mins.	Duration - 90 mins. Twice a week for 10 weeks		Brunel Mood Scale, Heart rate Variability , Perceived stress scale, Automate d Neuropsyc hological Assessme nt Metrics version 4, Dynamic Parameter Analyzer, postural sway activity was measured by a posturogra phy method using single piezoelectr ic force plate. serum concentrat ion of free BDNF(enz yme linked immunoos say)	Thus, 10 weeks of yoga practice resulted in improved balance and learning in the speed-accuracy motor task that were mediated by increased BDNF (Brain derived neuro-trophic factor level) levels, but had no impact on cognition in older adults.
4.	Krishna Ketan Patel, et al. <sup>29</sup> (April 2019)	RCT	n=40(Male - 21\Female - 17), age - 60-75 years,	warm up- 10 mins., asanas - 25-30 mins., Pranaya ma and	5 times in a week for four weeks		Clinical Test of Sensory Interaction in Balance (CTSIB-M), Timed Up and	The study conducted concludes that yogasanas are effective in improving balance in elderly individuals at the end of four weeks compared to

				relaxation			GO test (TUG) was recorded before and after the intervention	control group. Thus, it can be used clinically to improve balance in geriatric population.
5.	Zettergren, et al. <sup>28</sup> June 2011	Pilot Study	n= 16 (females) age- 65 and above	kripalu yoga Pranayama and Body awareness 10 mins., warm up activities 10 mins., asanas- supine and standing position 50 mins., shavasana and meditation in 10 mins.	duration=80 minutes twice a week for 8weeks		postural control (Berg Balance Scale), mobility (time to rise from the floor to standing, Time Up to Go), Gait (usual and fast speed), balance confidence (Activities -Specific Balance Scale)	This study concluded that postural control and gait has improved in Yoga group.

**TABLE 1: SUMMARY OF STUDIES INCLUDED**

## YOGA INTERVENTION

In all studies, the experimental group received Asanas, pranayamas, warm up, Meditation and relaxation as intervention. The studies included in this particular work employed Hatha yoga,<sup>27</sup> kripalu yoga<sup>28</sup> and Himalayan breathing exercise<sup>26</sup> as primary intervention but there were studies which did not specify the style of yoga. The use of props (chair, blocks) in some studies was also noted.<sup>28,29</sup> Participants undertook 50-90 min of yoga, 2-5 times per week for 8-12 weeks in total.<sup>25-29</sup> The control group in all the studies received no intervention or wait list.<sup>26-29</sup>

Yoga interventions included Warm up , Asanas (Utkatasana, Vriksasana, Trikonasana, ardh chandrasana, Virbhadrasana 1,2,3, UttanaPadasana, Chakra Padasana, Sanchalanasana , Lurhakanasana, Shava Udharkarssanasana, Naukasana, Namaskarasana, Vyagrasana, Ushtrasana, Hasta Uttanasana, Tadasana, Tiryaka Tadasana, Tiryaka kati chakrasana, Dhruva Utkatasana, Dwikonasana, Bhujangasana, Ardha shalabasana, Eka Pada Pranamasana, Eka padasana, Sarvangasana, pavanmuktasana, shavasana).<sup>25,26,27,268,29</sup>

## OUTCOME MEASUREMENT TOOLS

- Fear was measured in two studies by using Modified Fall Efficacy Scale and Short Fall Efficacy Scale- International.<sup>25,27</sup>
- Balance was measured in five studies by using Berg Balance Scale, Short Physical Performance Battery, Clinical Test of Sensory Interaction in Balance, and a posturography method using a single piezoelectric force plate.<sup>25-29</sup>
- Gait was measured by Short Physical Performance Battery, usual and fast speed.<sup>25,28,29</sup>
- Mobility was measured in three studies by Short Physical Performance Battery, Time to rise from the floor to standing, Time Up to Go Test, Dynamic Analyzer<sup>25,28,29</sup>

## METHODOLOGICAL QUALITY

All reviewed studies were assessed for methodological quality using the Downs and Black Checklist for Measuring Study quality<sup>30</sup> (Annexure: 1) 0 to 32 points possible,

- a score of  $\leq 12$  indicates a poor-quality article with high risk of bias,
- a score of 13 to 22 indicates a moderate-quality article with moderate risk of bias,
- a score of  $\geq 23$  indicates a good-quality article with low risk of bias

Four studies were assigned a moderate quality rating with moderate risk of bias<sup>25- 28</sup> Quality and bias rating from 16-17 (pilot studies) and 15-16 (RCT). One randomized control trial study fulfilled the criteria for high methodological quality and low risk of bias.<sup>29</sup> Five of the failed to blind both participants and experimenters<sup>25,26,27,29</sup> except one author who reported blinding<sup>28</sup>. In two studies, the distribution of main confounders for each treatment group was not described<sup>25-29</sup> or only partially described.<sup>25</sup> The greatest methodological strengths were quality of reporting and internal validity with regard to selection bias. Power and external validity were the areas of greatest methodological weakness. Appropriate statistical analysis to determine power report the outcome was used in all the studies,<sup>25-29</sup> but only one study was report statistically significant results,<sup>29</sup> No study made adjustments for confounding in statistical analyses.<sup>25-27</sup> (Annexure 1- Quality index for yoga intervention on fall prevention)

## IMPACT OF YOGA ON FALL PREVENTION

Yoga intervention was associated with significant improvement in fall prevention including balance, gait, mobility, fear of fall, postural control and gait speed was reported. In this assessment, some are good quality studies and some are moderate quality studies.

Studies included 4- 10 weeks yoga program. Fear of falling was measured by two studies and significant improvement was reported. Study by Keay et al. measured acceptability and feasibility of yoga as fall prevention have shown improvement in short fall efficacy scale- international, in sit and stand test, 4- m walk and took less steps to walk 4- m distance and there was no change in performance on the test of standing balance.<sup>25</sup> Improvement in Gait was reported and assessed by usual and fast walking speed.<sup>29</sup> Significant improvement in balance and postural control on Modified Clinical Test of Sensory Interaction in Balance (CTSIB-M),<sup>27</sup> Timed Up and GO test (TUG),<sup>28,29</sup> Berg Balance Scale (BBB),<sup>27,29</sup> reported among various studies.

Keay et al. reported a focused group discussion after the completion of intervention. Group discussion audio recorded and focused on questions about barrier, perception of yoga, benefits of yoga and understanding fall injuries/ reporting fall. Several participants reported that they had enjoyed yoga program, some compared yoga with exercise and yoga program considered yoga superior, they could even walk freely and have improved balance, and their fear of fall alleviated by yoga. Improvements in other parameters like diabetes, blood pressure also had been reported.<sup>25</sup> Albertas Skurvydas et al. reported that yoga had no effect on cognition but had shown positive effect on balance and learning of the speed–accuracy motor task under single - dual task conditions and motor learning in geriatric population. Faster reaction time and shorter movement time had been observed in this study. Brain Derived Neurotrophic Factor (BDNF) was also found to increase in yoga group.<sup>26</sup> Yoga improves postural balance and reduces fear of fall in elderly. But these improvements were not above the minimal detectable change.<sup>27</sup> Studies concluded that yoga was effective in reducing fear of fall by improving balance, improvement in several measures of postural control, mobility, walking and time to rise from the floor was also reported.<sup>28,29</sup> The participants in yoga group reported positive experiences.<sup>28</sup> KK Patel et al. assessed the effect of 4 weeks yoga on balance had shown that Yogasana are effective in improving balance in elderly and it can be used clinically to improve balance and the data was statically significant.<sup>29</sup>

Among the five studies, one study confined to urban community and had no comparative group.<sup>25</sup> There was no appropriate and satisfactory blinding of the participants which does raise issue of bias.<sup>25,26,27,29</sup> Except one study made an attempt to blind assessment of main outcome measure.<sup>28</sup> Most of the study power to determine difference in function on posttest were likely insufficient due to small sample size and short time duration.<sup>28</sup> Small sample size was the greatest limitation of this work as the results could have been more pronounced if the sample size was bigger. Long duration studies and follow-up usually showed significant difference, which was lacking in this studies.<sup>25-29</sup> Area of the study mostly unspecified which poses a lack of comparative analysis. Author reported that the participants behavior in long term yoga studies or follow-up up to 3-6 months was needed.

## DISCUSSION

The aim of this review was to assess the evidence for role of yoga in frailty and fall prevention in elderly population. Improvement had been seen amongst all the studies on fear of fall, balance, improved speed, gait, flexibility and strength.<sup>25-29</sup> Albertas Skurvydas et al. reported improvement in reaction time, speed and Brain derived neurotrophic factor.<sup>26</sup> Positive correlation related to duration found among all the studies, but three studies emphasize that longer duration interventions needed. Yoga was extremely well received by participants and no study reported adverse event in yoga group.

Yoga is not like physical exercises; yoga works on body as well as on mind. It aims at improving neuromuscular coordination, the failure of which is major cause in most falls. In addition, Yogic practices have proven beneficial in many managing psycho-physiological issues imparting an overall improvement. They also help to reduce anxiety, stress, pain and other types of distress making the individual more alert and aware. This manifests as better control on posture, gait and confidence thereby reducing incidences of fall. In this review it was seen that most of the studies were western base so there is a need for more yoga interventional studies in geriatric population related to fall prevention in India.

## CONCLUSION

This Review concluded that yoga is most effective intervention for tackling with the problem of risk of fall in elderly population. In this work, owing to the limitations mentioned above, the results may not be very significant but if the study can be repeated with larger sample, longer duration and proper blinding methods, it can be proved statistically significant too.

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## ANNEXURE: 1

### QUALITY INDEX FOR YOGA INTERVENTION ON FALL PREVENTION

S. no.	Measures	Lisa Keay <sup>(25)</sup> (2018)	Narjes nick <sup>(27)</sup> (2016)	Albertas Skurvydas <sup>(26)</sup> (2020)	Krishna Ketan Patel <sup>(29)</sup> (2019)	Zettergren <sup>(28)</sup> (2011)
	<b>Were the following clearly reported?</b>					
1.	Hypothesis/aim/Objective	1	1	1	1	1
2.	Main outcomes	1	1	1	1	1
3.	Participant characteristics	1	1	0	0	1
4.	Interventions	1	1	1	1	1
5.	Distribution of principal confounders	0	0	0	0	0
6.	Main findings	1	1	1	1	1
7.	Estimates of random variability regarding main outcomes	1	1	1	1	0
8.	Adverse events consequent to intervention	0	0	0	0	0
9.	Characteristics of participants lost to follow-up	1	0	0	0	0
10.	Actual probability values	1	1	1	1	1
	<b>External validity</b>					
11.	Were those invited to participate and representative of the recruitment population?	0	0	0	0	0
12.	Were participants representative of the recruitment population?	1	0	1	1	1
13.	Were intervention factors representative of the treatment the majority of participants received?	1	1	1	1	1
	<b>Internal validity, bias</b>					
14.	Was an attempt made to	0	0	0	0	1

	blind participants to the intervention?					
15.	Was an attempt made to blind those measuring outcomes?	0	0	0	0	0
16.	Was it made clear if any results were based on “data dredging?”	1	1	1	1	1
17.	For trials and cohort studies, were analyses adjusted for length of follow-up? For case-control studies, was the time between intervention and outcome consistent among cases and controls?	1	1	1	1	1
18.	Were appropriate statistical tests utilized?	1	1	1	1	1
19.	Was intervention compliance reliable?	1	1	1	1	1
20.	Were main outcome measures valid and reliable?	1	1	1	1	1
	<b>Internal validity, confounding</b>					
21.	For trials and cohort studies, were participants in different interventions? For case-control studies, were all participants recruited from the same population?	1	1	1	1	1
22.	For trials and cohort studies, were subjects in different intervention groups? For case-control studies, were all subjects recruited over the same time period?	1	1	1	1	1
23.	Were participants randomized into intervention groups?	0	1	1	1	1
24.	Was randomization irrevocable and concealed from participants and investigators until completion of recruitment?	0	0	0	0	1
25.	Was adjustment made for confounding in main finding analysis?	0	0	0	0	0
26.	Were participants lost to	1	0	0	0	0

	follow-up taken into account?					
	<b>Power</b>					
27.	Was there sufficient power to detect a clinically significant effect when $p < .05$ ?	0	0	0	0	5
	<b>Total score</b>	17	15	16	16	23

