



The Effectiveness of Providing Yoga Exercises to Reduce the Risk of Falling

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Abstract. The elderly are a group of people who experience the aging process as life goes on and cannot be avoided. The aging process can be a biological factor which occurs continuously and causes anatomical, physiological and biochemical changes in tissues that affect body function. Yoga exercise is one of the interventions that can improve strength, flexibility, endurance, balance, and functional capacity in both healthy and impaired conditions. Yoga exercise has a good effect on individuals who experience musculoskeletal disorders and cognitive impairment. Yoga exercise can be done in any age group and has many variations of movements so that not all movements can be done by the elderly and adjustments are needed. The clinical question arises, "Can yoga exercise reduce the risk of falls in the elderly?" To be able to answer this question, an evidence search was conducted on 3 databases, namely Google Scholar and Scopus. The keywords used were "Elderly OR Older People" AND "Yoga Exercise OR Yoga Asanas" AND "Balance OR Falls Risk" with the inclusion criteria of full text articles, with elderly participants and the provision of yoga exercise. Then a critical appraisal assessment was carried out on 10 published journals, 4 journals were excluded because they did not meet the inclusion criteria, so that 6 journals were obtained that could be synthesized. The journal can be concluded that the provision of yoga exercise is effective in reducing the risk of falls in the elderly. This study uses parameters to measure balance, namely the Tinetti performance Oriented Mobility Assessment (POMA), Berg Balance Scale (BBS), Timed Up and Go (TUG)

Keywords: Elderly, Yoga Exercise, Balance, Falls Risk

1. Introduction

According to WHO data, Southeast Asia has 142 million (8%) elderly people. The elderly population has grown to 28.8 million (11.34%) of the population in 2020, and by 2050 it is expected to triple [1]. Indonesia has an annual population growth rate of 1.48%. Indonesia is currently among the most populous countries in the world. Thus, a portion of the population that has lived longer will experience the aging process [2]. Elderly people over the age of 60 are also increasing in Indonesia, outnumbering the under-five population [3].

The elderly are residents over the age of 60 and are a group of people going through the

aging process and experiencing changes and decreasing the ability of body functions that can have an impact on the elderly themselves [4][5]. Health problems that can occur in the elderly such as high blood pressure or intervention, brain and kidney blood vessel disorders. Decreased organ function in the elderly often occurs, one of which is in the musculoskeletal system, namely reduced muscle mass and tone, myofibril degeneration, tendon shriveling and muscle fiber atrophy [6][7]. Functional muscle changes such as decreased muscle strength and contraction, muscle elasticity and flexibility can result in slowness of movement, shortened footsteps, imbalance and ultimately the risk of falling [5][7].

Imbalance in the elderly is the inability of an individual when standing, so it will increase the risk factors for falls in the elderly [4]. Seniors who experience falls and fractures often have problems with postural balance [8]. Falls are a physical problem that can affect older adults due to decline related to aging in the body, mind and cognitive skills [9]. Extrinsic and intrinsic causes both contribute to falls. Extrinsic factors are factors or causes that are external to the elderly, such as slippery slopes, uneven floors, tripping over bends, poor lighting, and so on. Intrinsic factors are factors that arise from the elderly, such as impaired walking patterns, muscle weakness, joint stiffness, imbalance, viruses, and hearing loss [1].

Imbalance is one of the main factors that cause the elderly to fall easily. The solution and preventing falls in the elderly is by providing training, one of the exercises with yoga [5]. Yoga is a form of exercise and meditation that has been practiced in India for over 2000 years. According to the National Center of Complementary and Integrative Health (NCCIH), yoga is the most popular form of complementary (non-pharmacological) therapy practiced by more than 13 million adults [10]. In addition to physical and mental healing, yoga also has many benefits such as increasing flexibility, increasing muscle strength, improving balance, strengthening bone health, relieving pain, maintaining posture, and so on [11]. In a study conducted by Krejci, et al showed a significant increase in static and dynamic balance in the experimental group using the Yoga in Daily Life System. Krejci, et al also explained the increase in muscle mass in the experimental group after the intervention compared to the control group [12]. Meanwhile, Fronso, et al in their research stated that Hatha Yoga can improve balance function and reduce the risk of falls. Fronso, et al's research concluded that there was a significant increase in balance in Hatha yoga compared to specific balance exercise [13].

To assess balance as well as gait in the elderly, the Tinetti Balance and Gait assessment parameters can be used. Tinetti gait and balance assessment can be known as Performance Oriented Mobility Assessment (POMA). POMA can assess each individual's balance and gait using a standardized scoring system [14]. This test covers many factors, such as standing balance, balance while moving, walking, walking patterns and more [15]. Other parameters that can measure both static and dynamic balance can also be used such as Timed up and Go (TUG) and Berg Balance Scale

(BBS). In the research of Krecji, et al and Fronso, et al have proven that Tinetti Balance and Gait Assessment can be used to measure the risk of falling in the elderly. In these 2 journals, it can be concluded that there is an increase and positive effect obtained on static and dynamic balance values.

Physiotherapists, especially in Indonesia, have not really recognized yoga and the benefits of yoga on the body of an elderly person. So based on the background above, the authors are interested in discussing the effectiveness of providing yoga exercise to reduce the risk of falls in the elderly. This research uses the Literature Review method, by collecting various journals through several databases.

2. Research Methods

The preparation of this report was carried out by the author using the literature review method in the search period from February - May 2023. Boolean operators (AND, OR, NOT or AND NOT) was used in the search on 3 databases, namely Pubmed, Scopus, Google Scholar. Literature review was conducted by collecting articles or journals that were in accordance with the cases raised. Articles were also screened using inclusion and exclusion criteria.

Inclusion criteria in this study, namely: (1) Elderly or late adults (2) Intervention yoga exercise or yoga asanas (3) Measuring balance or risk of falling (4) Study design Randomized Controlled Trial (RCT), Cohort Study, Quasi Experimental, Cross Sectional (5) Year published after 2018 (6) Articles using English and Indonesian.

Exclusion criteria, (1) not the elderly population (2) Not using interventions other than Yoga exercise (3) The results or outcomes of the article do not match the research topic (4) Literature review, Systematic review, Meta analysis (5) Articles or journals published before 2018 (6) Articles using languages other than English and Indonesian. The keywords used to search for articles use the PICO framework, with the following details:

1. **Population**, i.e. elderly
2. **Intervention**, i.e. yoga exercise or yoga asanas.
3. **Comparison**, not done
4. **Outcome**, i.e. balance or risk fall

In this literature review, using a simplified approach by Aveyard, which is a method to summarize journals or articles that have been found by the author after extracting and synthesizing more detailed literature. The following stages need to be carried out in the simplified approach method by Aveyard, namely (1) summarizing articles, (2) identifying themes, (3) developing themes, (4) close monitoring of themes, and (5) dealing with themes that do not support.

Using the keywords "Elderly OR Older People" AND "Yoga Exercise OR Yoga Asanas" AND "Balance OR Falls Risk". There were 17,464 articles that matched these keywords. The research articles were then screened for titles and abstracts, researchers found 42 articles. The eligibility assessment contained 10 articles, published articles and

articles that did not meet the inclusion criteria were excluded. So that 6 journals were synthesized.

3. Result

Based on literature search results through Pubmed, Scopus, Google Scholar publications using the keywords "Elderly OR Older People" AND "Yoga Exercise OR Yoga Asanas" AND "Balance OR Falls Risk". There were 17,464 articles that matched these keywords. The research articles were then screened for titles and abstracts, and researchers found 42 articles. The article was then screened again according to the topic to be discussed and obtained 10 articles. Furthermore, researchers conducted a critical appraisal assessment of 10 articles. So that 4 journals were obtained on the exclusion criteria and 6 journals on the inclusion criteria. The process of collecting articles can be illustrated using the PRISMA method (PreferreReposting Items for Systematics Review and Meta Analysis) PRISMA Cahrt can be seen in Figure 1.

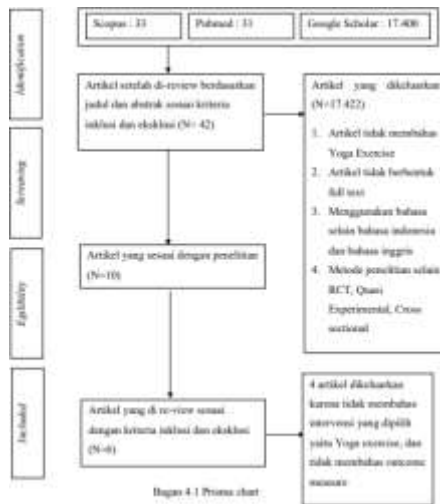


Figure 1. PRISMA Chart (Internal data, processed)

Measurement Tools. This study uses 3 measuring instruments, namely Tinetti Performance Oriented Mobility Assessment (POMA), Berg Balance Test (BBS), Timed Up and Go (TUG) to measure balance and fall risk in the elderly. Tinetti Performance Oriented Mobility Assessment (POMA) or Tinetti Mobility Test is a parameter to measure balance and walking ability in each individual. The Total POMA Scale (POMA-T) has 2 different components: balance subscale (POMA-B) and gait subscale (POMA-G) [16]. There are 16 items in total, 9 balance items (POMA-B) and 7 gait items (POMA-G). Each item has a score of 0,1,2 where the higher the score, the more independent the item [17]. After the test, the results are summed to obtain the POMA-T score. If the score is less than 18, it is classified as a high risk of falls and dependence, a score between 19-23 is classified as a moderate risk of falls, a score of more than 24 is classified as a minimal risk of falls [18].

The Berg Balance Test (BBS) is a measurement tool to objectively determine a patient's ability to maintain balance. This test contains 14 tasks, which consist of standing from a sitting position, standing unaided, sitting upright, sitting from a standing position, moving, standing with eyes closed, standing with feet together, standing with eyes closed, reaching forward, picking up objects from the floor, looking back, rotating 360 degrees, placing the feet alternately on small supports, standing with one foot in front of the other, and standing on one foot [19].

Timed Up and Go (TUG) aims to assess functional abilities such as mobility, balance, walking ability, and fall risk in the elderly [20]. Timed up and go test (TUG) is categorized into 4 groups, namely:

- 1) < 10 seconds indicates full independence(normal).
- 2) 20 - 29 seconds indicates moderate fall risk.
- 3) >30 seconds indicates high fall risk.

Intervention. Yoga consists of various body movements or positions and can be practiced over a period of time. Yoga is done gently and with slow movement from one posture to the next [21]. Although there are various types and movements of yoga, yoga can combine stretching in a movement holding various positions (asanas) and combined with breathing (pranayama), with the aim of increasing physical flexibility and body strength. Older people or seniors who are more regular and frequent yoga programs have the potential for increased flexibility, balance, muscle strength, and fall protection and reduce the incidence of muscle weakness. Yoga has also been shown to improve cognition, help manage chronic conditions, reduce osteoarthritis pain, improve sleep, and improve quality of life [22]. Nowadays, yoga has evolved to focus on exercise, strength, flexibility and breathing. There are 11 types of yoga namely, Astanga Yoga, Bikram Yoga, Hatha Yoga, Iyengar Yoga, Jivamukti Yoga, Vinyasa Yoga, Kripalu Yoga, Kundalini Yoga, Yin Yoga, Anusara Yoga, Vinyoga [11].

The following is a table of the six articles that have been reviewed by the authors (Table.1)

Table 1. Result

Study	Sample	Aged	Gender	Intervention	Outcome
Krejci, et al	T = 500 I = 262 C = 238	>65 age	Male and Female	Intervention Group: Yoga in Daily System with no indication of Sarvahita asanas by sitting on a chair or standing on a chair. Exercises included pulling arm up, turning the shoulders, leg stretch, hamstring stretch, shoulder stretch, finger stretch, bottom lift, knee bends, forward bend, balance exercises	Tinetti Balance

				standing behind the chair, standing on one leg, breathing, modified "cat pose", "lion grimace" breathing, exercise for muscle relaxation on the face and neck, vibration exercise on the diaphragm and brain area 4 Weeks/1 workout per week, 90 minutes.
				Control group: no intervention
Fronso, et al	T = 26 I = 12 C = 14	78-82 aged	Male and Female	Intervention Group: POMA tools Exercise in the form of Hatha Yoga lasting 1 hour with a long warm up of 20 minutes including breathing exercise slow dynamic, slow movements such as rotating shoulders, arms, wrists, neck. The exercise included walking and physical exercises (asanas) for 25 minutes followed by breathing exercises (pranayama) and relaxation for 15 minutes. It has 20 training sessions done 2x/week.
				Control group: Exercise in the form of Specific Balance Exercise lasting for ± 1 hour which includes warm up with slow movements such as rotating shoulders, arms, wrists, neck and stretching exercise gently for 20 minutes followed by dynamic balance exercises. Exercises included

heel/toe rising, standing on one leg, walking backwards or sideways, walking heel to toe in a straight line for 25 minutes. There was stretching exercise performed again after the exercise for 15 minutes.

Krejci, et al	T = 234 I = 122 C = 112	67-80 age	Male	<p>Intervention Group: Exercise in the form of Yoga in Daily Life System without contraindications for the elderly (Sarvahiita Asanas) by sitting on a chair or standing on a chair. Performed for 4 weeks/1 exercise per week with the main exercise of 90 minutes. Yoga was practiced daily for 10-15 minutes. with 90 minutes of main exercise. After a week, participants repeated the exercises that had been practiced. Meanwhile, the control group was not given the intervention.</p>	Tinetti Balance
Mutnawasitoh	T = 28 I = 14 C = 14	60-65 age	Male and Female	<p>Control group: no intervention</p> <p>Intervention Group: Exercise in the form of 12 balance exercises with hatha yoga at a dose of 3 times a week exercise time 12 balance exercise 30 minutes then continued hatha yoga 40 minutes</p> <p>The control group was given hatha yoga exercises</p>	

Krejci, et al	T= 266 I= 140 C= 126	>65 age	Female	<p>Intervention Group: Exercise in the form of Yoga in Daily Life System without contraindications for the elderly (Sarvahiita Asanas) by sitting on a chair or standing on a chair. Performed for 4 weeks/1 exercise per week with the main exercise of 90 minutes. Yoga was practiced daily for 10-15 minutes. with 90 minutes of main exercise. After a week, participants repeated the exercises that had been practiced. Meanwhile, the control group was not given the intervention.</p> <p>Control group: no intervention</p>
Patel, et al	T= 38 I= 18 C= 20	60-75 age	Male and Female	<p>Intervention Group: Exercise in the form of yogasanas consisting of:</p> <ul style="list-style-type: none"> • Week 1: Modified Sun salutations on chair, Core strengthener and leg lifts on chair, Kneeto chest pose on chair. • Week 2: Tadasana (mountain pose) with chair support, Adho mukho svanasana (downward dog pose) with chair support, Virabhadrasana (warrior pose) with chair support, Utkatasana (chair pose) with chair

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- Week 3:
 - Tadasana (mountain pose),
 - Adho mukho svanasana (downward dog pose),
 - Virabhadrasana (warrior pose),
 - Utkatasana (chair pose),
 - Vrikshasana (tree pose) with chair support,
 - Trikonasana (triangle pose) with chair support.
 - Week 4:
 - Vrikshasana (tree pose),
 - Trikonasana (triangle pose)
- Control group: No Intervention
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4. Discussion

Effect of Yoga exercise to improve balance in the elderly. Based on 6 articles that have been reviewed, showing the effect of yoga exercise in improving balance in the elderly [12][13][23][24][25][26]. 2 articles state that to improve balance and reduce the risk of falls in the elderly can be given hatha yoga while other articles use yoga methods that have been adapted to the conditions of the elderly. Although each article uses different parameters, these parameters can measure balance in the elderly, especially for the risk of falls. In a study conducted by Krejci, et al on 500 participants elderly male and female with an experimental group of 266 participants using the Yoga in Daily Life System without contraindications for the elderly (Sarvahita Asanas) and in the control group with 238 participants with no intervention or activities in the same care center. Krejci, et al in their study used Tinetti Balance parameters to measure dynamic and static balance in the elderly. The results showed a positive increase in the total balance value with pre-therapy 23.1 (23, 23.2) to 23.9 (23.8, 24) with a p value of 0.0001 in male participants from the experimental and control groups, while in female participants from the experimental and control groups there were significant results 23.8 (23.7, 23.8) to 24.3 (24.3, 24.4) with a p value of 0.0001. So it can be concluded that both women and men experienced a positive increase in total balance values both dynamic and static, but male participants responded more quickly related to increased muscle mass and reduced body fat [12].

In another study Krejci, et al used the same parameters and interventions as before, with

an experimental group of 122 participants and a control group of 112 male participants. In Krejci's research, et al found the results of a significant increase in the total balance value in the experimental group 23.1 (23.0, 23.2) to 23.9 (23.8, 24.0) with a p value $<.001$ compared to the control group with a total balance value of 24.1 (24.0, 24.3) to 24.2 (24.1, 24.3) with a p value $<.001$. So it can be concluded that the experimental group has a significant difference for improving static and dynamic balance compared to the control group [23].

The last study by Krejci, et al still used the same outcome measure and intervention with participants divided into two groups where the experimental group was 140 participants and the control group was 126 participants. The results of this study showed that there was a significant difference where the experimental group experienced an increase and the control group experienced a slight increase with the results of both groups p value = 0.906; Stage: $F = 11.5$; $p < 0.001$; Group \times Stage: $F = 4.9$; $p = 0.027$; Subj (Group): $F = 38.4$, $p < 0.001$.²⁴ This is because elderly women are more clearly visible in their balance abilities because the physical activity of the elderly in the study affects balance [24].

In contrast to the three studies of Krejci, et al, Fronso, et al, in his study 12 participants in the experimental group using hatha yoga and 14 participants in the control group using specific balance exercise, showed changes at each examination. Participants at baseline (T0), 1.5 months while doing therapy (T1), one week after therapy (T2) [13]. Results after the intervention showed a significant improvement in the experimental group compared to the control group on the POMA tool for total balance score between T0 and T1 ($p < 0.001$, $d = 0.890$) and between T0 and T2 ($p < 0.001$, $d = 1.129$) with an increase in balance score associated with a lower risk of falling. Participants who underwent SBE resulted in a significant comparison between T0 and T2 ($p = 0.033$, $d = 0.310$) with a decrease in balance score leading to a higher fall risk. In addition, there was a significant difference between T1 ($p = 0.029$, $d = 0.902$) and T2 ($p = 0.033$, $d = 1.185$) with $HY > SBE$ [13].

Research conducted by Fronso, et al can be supported by research conducted by Mutnawasitoh on 14 participants in the control group and 14 participants in the experimental group. The experimental group was given 12 balance exercises with hatha yoga, while the control group only used hatha yoga [25]. The results showed that there was a significant increase in the value of balance before and after in the control group with $p = 0.000$ ($p < 0.05$) and the t-test value before 38.29 ± 1.38 to 42.79 ± 1.31 after training, while in the experimental group there was also a significant difference with a value of $p = 0.000$ ($p < 0.05$) with a t-test value which means there is a significant difference in dynamic balance, while in the group given 12 balance exercises with hatha yoga found with a t-test value of 38.57 ± 1.22 to 45.43 ± 1.31 these results indicate that the experimental group has more effect on balance than the control group [25]. This is because the hatha yoga method can increase lower limb and body muscle strength. It can also activate movement reflexes by activating the feedforward system which will form a sensory integration system [25].

Another study conducted by Patel, et al on 18 participants in the experimental group and

20 participants in the control group. The experimental group was given yogasanas for 4 weeks and the control group was not given exercise. In Patel's research, et al showed a slight decrease with a p value <0.05 in the TUG value of the experimental group, while in the control group there was an increase with a p value <0.05 . This was due to the use of a modified yoga chair and found an increase in functional mobility with a decrease in TUG scores [26].

Yoga practice can help individuals with their balance and reduce the risk of falls. In her 2017 study, Maitisa showed that yoga incorporates synchronized muscle movements to achieve strong stabilization and flexibility and to improve balance. This is because regular yoga practice causes modifications and changes to occur [27]. In Mutnawasitoh's research in 2022 also explained that hatha yoga can have the effect of processing the posture of the feet, hands and head so that it can strengthen postural muscles, improve flexibility, increase muscle tone, improve the vestibular system, and proprioceptive system. This makes the elderly experience an improvement in dynamic balance [28]. When performing standing asana movements consisting of Surya Namaskara: Tadasana, Tadasanaurdhya, Uttansama, Lunge, will activate the antigravity muscles Standing asana: Vrksasana, Vimasana, Natarajasan, Ekapada Angusthasana, Virabhadrasana, Prasyakonasana, Utkatasana. Sitting Asana: Utakatasana, rajakapotasana, Anjaneyasana, anjaneyasana, spinal twisting postures. The movement creates a linear acceleration of the body that will be detected by the sensory organ utriculus macula which plays an important role in adjusting the orientation of the head when in an upright position [28]. The macular utriculus organ contains hair cells with basic endings that synapse with the sensory endings of the vestibular nerve. When vestibular nerve signals are sent to the brainstem for processing, the body responds by activating antigravity muscles, mobilizing more muscle motor units, activating the golgi bodies, and performing movement feedback, such as corrections or body movements that occur to create a stable body balance as a result of disturbances or changes in foundation [28].

Effective yoga dosage and methods to improve balance. Of the six articles included, it was found that the average dose was more effective for 4 weeks with a frequency of training once a week and carried out for 90 minutes. Based on the inclusion article, it can be concluded that the type of hatha yoga and yoga in daily system is the most effective type to improve balance in the elderly. This is in line with the three studies conducted by Krejci, et al who used yoga in daily systems and research by Fronso, et al who used Hatha Yoga. Hatha yoga can also be combined with 12 balance exercises so that the effect produced is even better.

5. Limitations

There are limitations in this literature review, namely the difficulty of obtaining articles such as Cohort studies and others that match the inclusion criteria, the five articles reviewed have high heterogeneity. This literature review took a general sample of elderly people, so researchers did not know in general the disorders experienced by the elderly in detail.

6. Conclusion

From the 6 articles that have been reviewed, it can be concluded that giving yoga exercise is effective for improving balance ability in the elderly. Yoga exercise is one of the effective interventions and has many benefits in addition to improving balance skills such as strengthening lower limb muscles and can also provide relaxation to the elderly. Yoga can also be done at home so that it can be done every day and can be done at any time by adjusting the condition of the elderly. Things that need to be considered when giving yoga exercise are the dose of exercise given according to the condition of the elderly, so that the elderly who do yoga exercise do not experience complications. The dose of yoga exercise that can be given is about 4 weeks with a 90-minute exercise duration. Patient discipline in doing exercises is also a factor in the success of the intervention provided.

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