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Sachin Tom
Post Graduate Student,
BCF College of Physiotherapy,
Maravanthuruthu, Kerala, India

KS Sharad
Professor, BCF College of
Physiotherapy,
Maravanthuruthu, Kerala, India

R Rejeesh Kumar
Professor, BCF College of
Physiotherapy,
Maravanthuruthu, Kerala, India

Corresponding Author:
KS Sharad
Professor, BCF College of
Physiotherapy,
Maravanthuruthu, Kerala, India

The effects of tai chi based exercise routine on reducing risk of falls in elderly living at old age home

Sachin Tom, KS Sharad and R Rejeesh Kumar

Abstract

Background: Life expectancy is defined as the average total number of years that a human expects to live. Life expectancy has increased rapidly since the Age of Enlightenment. However, this dramatic increase in life expectancy did not come with a proportionate increase in quality of life in elderly. Generally, increased life expectancy has increased the risk of disease, disability, and dementia and advanced aging prior to death.

Purpose: The purpose of this study is to evaluate the effectiveness of Taichi- based exercise routine in reducing risk of falls in elderly living at old age home.

Method: Pre test, post test experimental study was conducted on 30 old aged individuals. They were divided into 2 groups of 15 each. Informed consent was obtained from all individuals. Group A received Cheng Mang-ching sequences of Taichi which include preparation, beginning, ward off left, ward off right, roll back, squeeze, push, single whip and education about fear of fall. The treatment duration was 20 minutes which was gradually increased. The group B was control group. They did not undergo any Taichi exercise program.

Results: The 4 week Taichi based exercise routine program was effective in reducing risk of falls in elderly living at old age home.

Keywords: life expectancy, balance, Taichi, Cheng Ming-ching sequence of tai chi, risk of fall, fear of fall

Introduction

Life expectancy is defined as the average total number of years that a human expects to live [11]. Life expectancy has increased rapidly since the Age of Enlightenment [12]. "Improvements in medical technology are often taught to be the gatekeeper to healthier, longer life" said Mikko Myrskylä, Director of the Max Planck Institute for Demographic Research, Germany [13]. Globally, Japan is often considered to be a vanguard of life expectancy as its life expectancy is 85 years.

According to the figures that come from the Human Development Index report, published in 2011 by United nations Development Programme (UNDP) India, Kerala has the highest life expectancy (74.9) while Assam has the lowest (63.9) [14]. Generally, increased life expectancy has increased the risk of disease, disability, and dementia and advanced aging prior to death [15].

There is an increase in older population due to high life expectancy and increased life span. Fall related injuries are common, result in considerable health care utilization and are a major cause of long term pain and functional impairments among older adults [16]. The reporting of falls increased with age from 18% in young, 21% in middle aged and 35% in older adults with higher rates in women than men [17]. The risk factors include:

Biological risk factors

Muscle weakness or balance problems
Medication side effects
Chronic health conditions like arthritis and stroke

Behavioral risk factors

Inactivity
Alcohol use

Environmental risk factors

Poor lighting

Lack of stair railing

Lack of grab bars inside and outside the tub or shower

Poor designed public places

Fall related injuries may eventually result in many long term complications like pressure ulcer, hospital acquired pneumonia (HAP), urinary tract infections, and lower extremity venous thromboembolism(VTE) and even disability or deaths, especially in patients with comorbidity^[18].

Physiotherapists who are mobility experts in medical field are expected to implement fall prevention programs to reduce the fear of falling. Physiotherapists prescribe specific exercises, activities and interventions and provide advice on managing environmental risks. In a study by Catherine Sherrington *et al* (2015) "Physiotherapy in the prevention of falls in the older people", some of the balance challenging exercises suitable for prescription to older people are graded reaching in standing, stepping in different directions, sit to stand, heel raises^[19]. Taichi chaun is a type of exercise which can also be used to reduce risk of falls in elderly living at old age home.

Taichi-chaun is a Chinese form of martial arts that involves slow, controlled, and low impact movements that can be easy for seniors even for those with limited movements^[20]. Taichi puts minimum stress on the muscles and joints, making it generally safe for all ages and fitness levels^[21]. In fact, because tai chi is a low impact exercise, it may be especially suitable if you are an older adult who otherwise may not exercise^[11]. Taichi helps improve balance because it targets all the physical components needed to stay upright- leg strength, flexibility, range of motion and reflexes, all of which tend to decline with age^[12].

By making the practitioner firmer on his feet, Taichi takes away the fear of falling^[22]. Proprioception, ability to sense the position of one's body in space declines with age^[23]. Taichi helps to train this sense. Taichi also improves muscle strength and flexibility, which makes it easier to recover from stumble^[24]. In a study by Dongling Zhong (2019), "Taichi for improving balance and reducing falls", the result showed that the result of this systemic review will provide more reliable evidence of Taichi for improving balance and reducing falls, which may broaden the clinical application of Taichi exercise^[14]. Cheng Mang-ching was notable Chinese expert of Taichi-Chaun^[25]. His style is known as Yang style taichi-chaun. Cheng Mang-ching sequences of Taichi are preparation, beginning, ward off left, ward off right, Roll back, squeeze, push, single whip^[25].

There are large numbers of literatures regarding the effectiveness of reducing risk of falls in elderly living at old age home. But the literatures are not related to Indian population. The purpose of my study is to find the effectiveness of Taichi Chaun in reducing falls in elderly in Indian population. Kerala being a state which has high life expectancy the need for exploring effectiveness of such a program is highly beneficial.

Materials and Methods**1. Study Design**

Experimental Study Design

2. Sampling Method

Simple random sampling

3. Sample Size

30 Subjects

Selection Criteria**Inclusion Criteria**

- Age between 60 and 75 years
- Intact neuromuscular ability to do exercise
- Who have reported history of falls or fear of fall in past one year

Exclusion criteria

- History of Neurologic diseases.
- History of Recent (6 months) Trauma or orthopedic surgery
- History of visual and hearing impairments
- History of cardiac conditions.
- Reduced mental abilities

Materials Used

1. Locally available furniture
2. Audiovisual aids
3. Informative handouts and flyer
4. A laptop computer with audio visual aids for education using power point presentations, showing videos about various aspects of fall and Taichi yang style exercises

Study Setting

1. Old age home run by Anjaneya charitable trust old age home at Chembu, Vaikom Taluk.
2. Santhwanam old age home, Astamichira, Mukundapuram Taluk, Mala, Trissur.

Study Duration

1 year (24/6/2019 to 23/6/2020)

Outcome Measures

It is done by asking the subject to accomplish various balanced related task and scoring. After scoring, the final measure is calculated which is the sum of all the scores.

1. Berg Balance Scale

- The berg balance scale was developed in 1989 to provide clinicians with a standardized measurement tool to assess balance in elderly individuals
- The test takes 15-20 minutes and has 14 simple balance related tasks.
- The degree of success in achieving each task is given a score of zero (unable) to four (independent) and final measure is the sum of all the scores.
- The berg balance has acceptable reliability and validity.

2. Fall Efficacy Scale

- The fall efficacy scale is a short, easy to administer tool that measures the level of concern about falling social and physical activities inside and outside the home whether or not the patient does the activity.
- The level of concern is measured on a four point likert scale (1=not all concerned to 4=very concerned) (Yardleg *et al* 2005).
- This tool was developed to expand on the initial falls efficacy scale(FES) (Tinetti *et al* 1990) to include activities that may be considered more challenging by more active people, thereby potentially causing more concerns about falling than the basic activities presented in the initial FES.

Variables

- Independent variable is the Taichi based exercise routine.
- Dependent variable is the balance as measured by Berg
- Balance Scale.

Study Procedure

The population included 30 subjects fulfilling both inclusion and exclusion criteria. Subjects for experimental group (n=15) were randomly selected from Anjaneya Charitable old age home, Chembu, Vaikom taluk, Kottayam. Subjects for the control group (n=15) were randomly selected from Santhwanam old age home, Astamichira, Trissur. Informed consent was obtained from each subject prior to participation. A description about the procedures was given to the subjects before commencing the study. A total of 30 subjects was divided into two groups by random sampling method, Group A (n=15) & Group B (n=15).

Group A: Experimental Group

Fifteen subjects randomly selected from willing participants formed experimental group.

After taking the baseline values on the outcome tools they were initiated into the Taichi based exercises routine. The final scores were taken after 4 weeks training in Taichi. The education included information about the Taichi exercise, causes of recurrent falls, consequence of a fall and strategies to avoid recurrent falls which was provided before the commencement of the exercise routine. The training period consists of education regarding the fear of falls and tai-chi based exercise routine.

The Taichi exercise includes warm-up exercise, lifting the sky, Taichi Cheng Ming sequence like preparation, beginning, ward off left, ward off right, roll back and single whip; it took 20 minutes per session in the first week. The time was gradually increased up to 40 minutes per session as per the capacity of participants. The Taichi program was conducted as 2 session of training in each week for 4 weeks.



Fig 2: Lifting the sky



Fig 3: Preparatory



Fig 1: Taichi warm up



Fig 4: Beginning



Fig 5: Ward off left



Fig 6: Ward off right



Fig 7: Roll Back

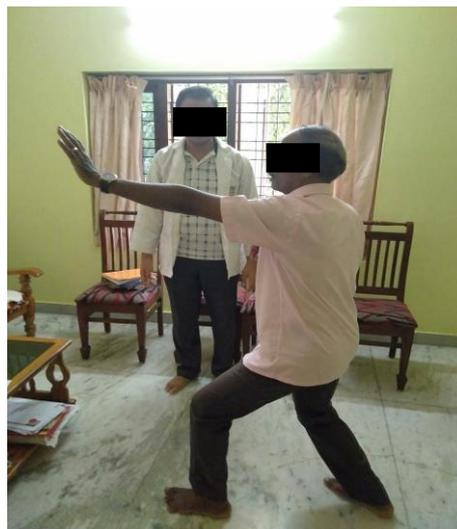


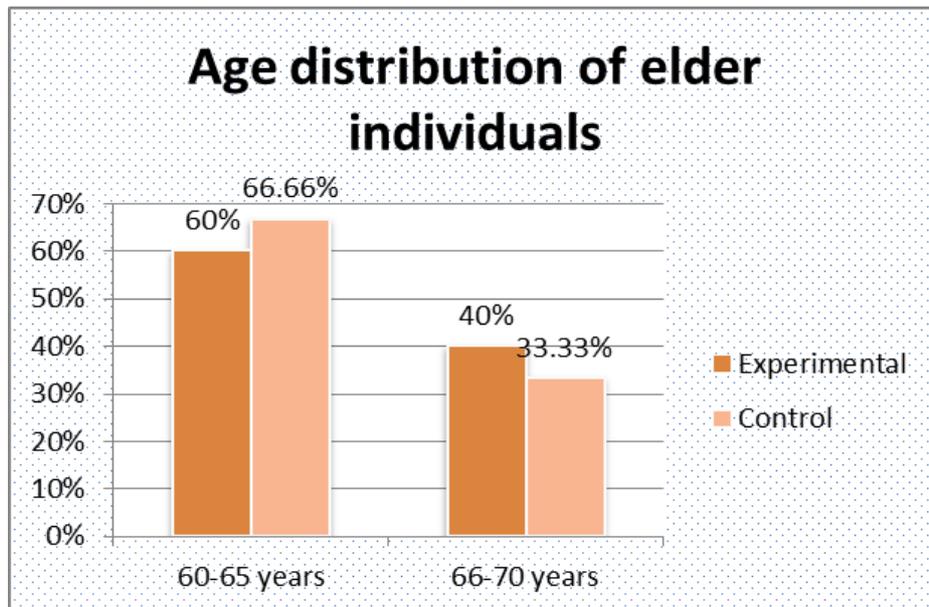
Fig 8: Single Whip

Group 2 - Control Group

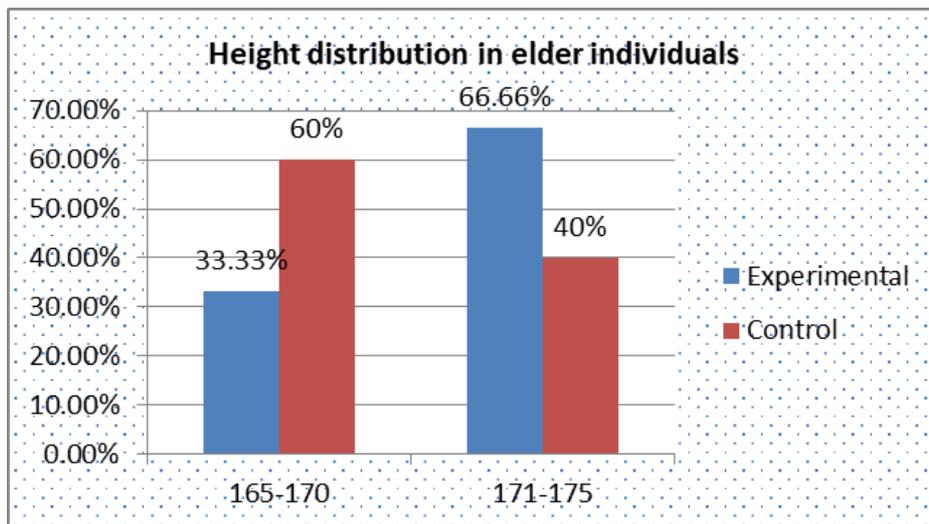
Fifteen subjects randomly selected from the willing participants formed the control group. These subjects

continued with their usual activity and they were trained in any exercise program. Baseline values on the outcome tools were taken on day 1 and finally on completion of 4 weeks.

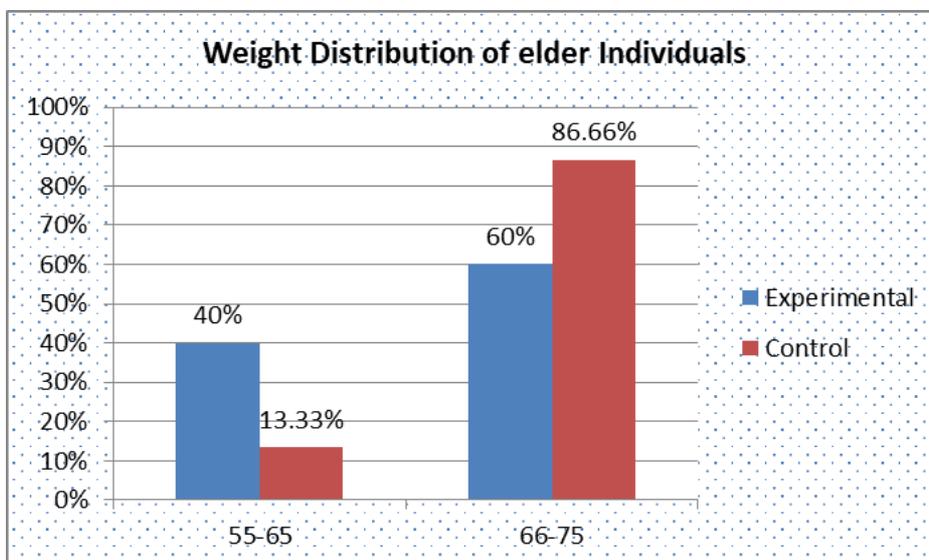
Statistical Analysis



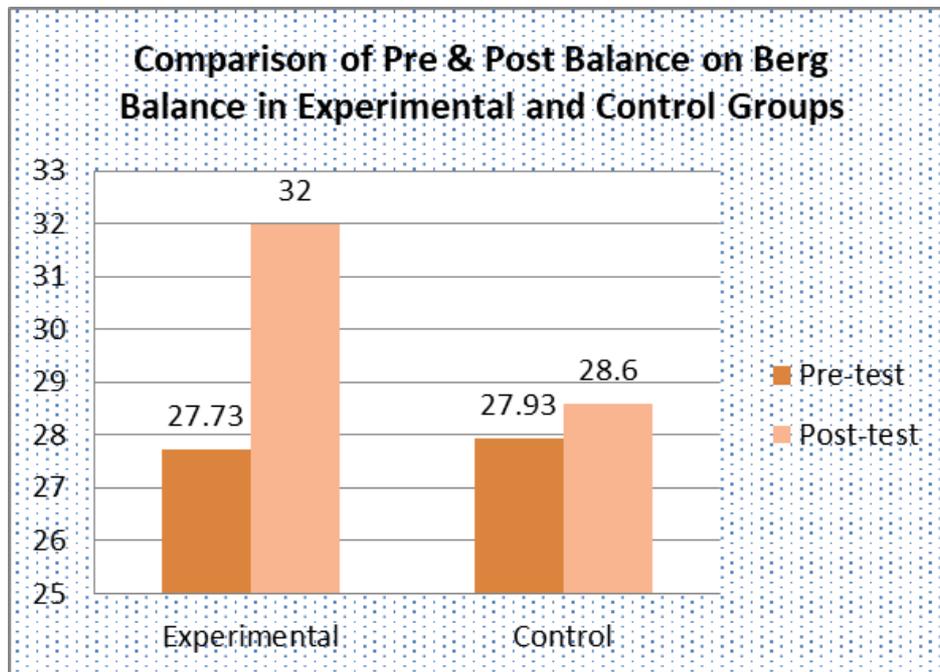
Age distribution of elder individuals



Height distribution of elder individuals



Weight distribution of elder individuals

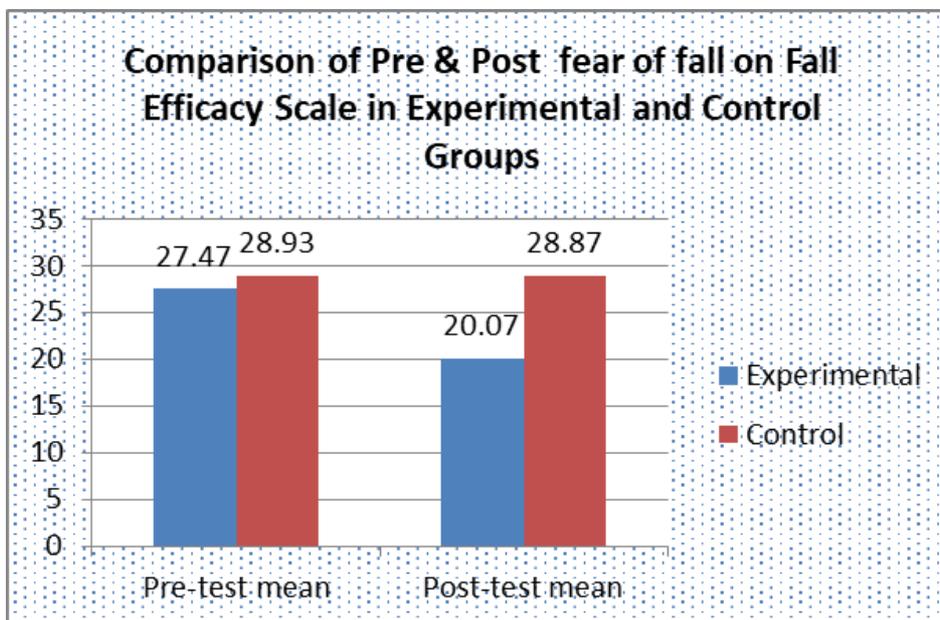


Statically analysis of berg balance scale using T tests

Statistical analysis of fear of fall on fall efficacy scale using T test

Comparison of Pre-test Post-test fear of fall in Experimental and Control Groups

Group	Pre-test mean	SD	Post-test mean	SD
Experimental	27.47	4.44	20.07	3.69
Control	28.93	4.08	28.87	4.56



Comparison of Pre-test Post-test fear of fall in Experimental and Control Groups

Results

Experimental group

1. Evaluation of Berg-Balance Scale

By comparing the pre-test and post-test Balance scores in older adults in the experimental group Mean change 4.27 is the difference between pre-test and post-test (27.73 units & 32 units). Since the *t-value*, 11.29 units is greater than the table value is greater than the *table value* 2.624 units, $p < 0.01$, there is a significant difference existing between the pre-test and post-test balance scores among elder individuals in the experimental group. This proves the effect of Taichi-chaun in

reducing risk of falls.

2. Evaluation of Fall Efficacy Scale

By comparing pre-test and post-test fall efficacy score in older adults in the experimental group Mean change 7.4 units is the difference between pre-test and post-test (27.47 units & 20.07 units). Since the *t-value*, 19.08 units is greater than the *table value* 2.624 units, $p > 0.01$, there is significant difference existing between the pre-test and post-test fall efficacy scores among elder individuals in the experimental group. It can be assumed that the effect of education in fall prevention and

Taichi-Chaun helps to reduce the fear of fall. Overall it proves that the Taichi-Chaun contributes to reduce the risk of falls among elderly.

Control Group

1. Evaluation of Berg Balance Scale

While comparing the pre-test and post-test fall efficacy scale Mean change 0.06 units is the difference between pre-test and post-test (28.93 units & 28.87 units). Since the *t-value* 1.32 units is less than 2.624 units, $p < 0.01$, there is no significant difference existing between the pre-test and post-test balance scores among elder individuals in the control group.

So we have seen that there is significant change in balance score among the elder individuals in experimental group whereas there is no significant change in balance among individuals in control group.

Hence, it can be concluded that 4 week Taichi-Chaun based exercise routine is very much effective in improving balance among elder individuals.

2. Evaluation of Fall Efficacy Scale

By comparing pre-test and post-test fall efficacy scale Mean change 0.06 units is the difference between pre-test and post-test (28.93 units & 28.87 units). Since the *t-value* 0.174 units is less than *table value* 2.624 units, $p < 0.01$, there is no significant difference existing between the pre-test and post-test fall efficacy scores among elder individuals in the control group.

So we have seen that there is significant change in fall efficacy score among the elder individuals in experimental group whereas there is no significant change in fall efficacy among individuals in control group. Hence, it can be concluded that 4-weeks fall prevention program is very much effective in reducing fear of fall among elder individuals.

Discussion

The purpose of the study was to find out the effectiveness of Taichi-chaun based exercise routine in reducing risk of falls in elderly living at old age home. The Taichi-chaun based exercise routine includes Taichi warm ups, lifting the sky, basic Taichi-chaun sequences like preparation, beginning, ward off left, ward off right, roll back and single whip and education about various aspects leading to fall and the fear of falling.

In this study institutional living older adults were taken into consideration. Subjects were selected after screening for the fulfilment of the Inclusion and Exclusion criteria. 30 elder individuals were selected randomly and equally divided into two groups-Control group and Experimental Group.

Control group continued with the usual activities without the fall prevention program and experimental group underwent Taichi-based exercise routine program. The treatment was 20 minutes per session in the first week. The time was gradually increased up to 40 minutes per session as per the capacity of participants. The education included information about the causes of recurrent falls, the results of recurrent falls, introduction to Taichi-chaun exercises and strategies to avoid recurrent fall. The Taichi-chaun based exercise routine program was for 4 weeks duration with 2 sessions each week.

On Statistical analysis, the mean pre-treatment balance scores of experimental and control group are 27.73 units and 27.93 units and mean post- test treatment balance scores of experimental and control group are 32 units and 28.6 units respectively. This result shows that there is an increase of 4.27 units in the experimental group and 0.67 units in the

control group, which indicates that there is a considerable increase in experimental group.

On statistical analysis, the mean pre-treatment fall efficacy scores of control and experimental group are 28.93 units and 27.47 units and mean post treatment fall efficacy scores of control and experimental group are 28.87 units and 20.07 units respectively. The result shows that there is an increase of 7.4 units in the experimental group and 0.06 units in the control group, which indicates that there is a considerable increase in experimental group. This proves that the Taichi-chaun is effective in reducing the fear of falls in the elderly individuals living at old age home.

Statistically, significant improvement in function is seen in both the groups and between the groups. However, the improvement in experimental group is greater than that of control group. Improvement in function may be attributed to the improvement of balance and the reduced fear of fall.

Taichi helps to improve balance because it targets all the physical components needed to stay upright-leg strength, flexibility, range of motion and reflexes-all of which tend to decline with age. By making the practitioner firmer on his feet, tai chi takes away the fear of fall and thereby reduces the risk of falls. Hence the study concludes that the tai-chi based exercise routine has a significant role in reducing risk of falls, reducing fear of fall and improving balance in institutional living older adults

Conclusion

It is observed that, 4week Tai-chi based exercise routine leads to a significant improvement in balance and reducing fear of fall in the elder individuals living in old age home. This observation is supported by statistical analysis. Based on the outcomes of the study, it can be concluded that tai chi chaun based exercise routine can be performed as a mandatory routine to improve balance, reducing fear of fall and thus decreases the frequency of falls which leads to mortality and morbidity of old age people living in institutions.

The Taichi-chaun based exercise routine including educational sessions conducted among elderly living at an old age home in a rural community in Kottayam district of Kerala has been found to be effective in reducing risk of falls and changing the perception about fall among those participating in such a program.

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