

# A Study to Find Out the Correlation Between Physical Activity, Reaction Time, and Fall Risk in the Elderly

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## ABSTRACT

**Background:** Regular physical activity can bring significant health benefits to people of all ages, especially among the elderly. Physical Activity make a person independent for the later stage of life. Reaction time is the time it takes to react to a stimulus which is necessary for many daily activities. Each year 3 million older people are treated in emergency departments for fall injuries. This is a major risk problem that leads to further complications in this population. So the study aims to evaluate the association between physical activity, reaction time, and fall risk among this population.

**Methodology:** A cross-sectional study of 140 elderly of age group between 65-80 years was conducted at various the area of Rajkot city and the around it old age homes and individuals responded to physical activity by physical activity scale for elderly (PASE), reaction time measured by RULAR DROP test and fall risk measured by POMA.

**Result:** Pearson correlation co-efficient was used for analysis which showed that physical activity had a strong correlation with fall risk and also with reaction time . this fall risk and reaction time are also strongly correlated with each other.

**Conclusion:** physical activity is strongly associated with reaction time and fall risk. So the physiotherapy intervention for this group of the population should focus on the improve physical activity which improves the reaction time and this leads to reducing the risk of falls.

**Keywords:** Elderly, Fall Risk, Fall Prevention, Physical Activity, Reaction Time.

## INTRODUCTION

The elderly is a group with the frequent presence of multiple pathologies and atypical ways in which illness can present with confusion, falls, loss of mobility & day to day functioning. as patients age, there is a transition in health care, from primary prevention and curative intervention to secondary prevention and chronic disease management. (1)As populations continue to extend life expectancy, a central concern is whether the added time comprises years of

healthy life and promotes a high health-related quality of life into old age. (2)

Worldwide, the age group of sixty years old and older is growing faster than any other age group. In the 20<sup>th</sup> century, the elderly population represented the fastest-growing segment of the world population. However, these demographic changes were high-flying in developed countries. For example, in the U.K. the number of people over 65 years has increased from 5 % to 16 %.<sup>2</sup>population projections suggest that this trend will be continuing in the 21st century

and the elderly will represent 10.8% of the total world population by 2025. (2)

Physical activity is defined as any bodily movement produced by skeletal muscles that result in energy expenditure. PA encompasses exercise, sports, and physical activities performed as part of daily living, occupation, leisure, or active transportation. Physical function is the capacity of an individual to perform the physical activities of daily living. Physical function reflects motor function and control, physical fitness, and habitual PA. (3)

PA is a protective factor for noncommunicable diseases such as cardiovascular disease, stroke, diabetes, and some types of cancer and PA is associated with improved mental health, delay in the onset of dementia, and improved quality of life and wellbeing.(4) The health benefits of PA are well documented with higher levels and greater frequency of PA being associated with reduced risk and improved health in several key areas.(5)Participation in PA and exercise can contribute to maintaining the quality of life, health, and physical function among older people in general and older people with morbidities in particular.(3)

Reaction time is a measure of the quickness with which an organism responds to some sort of stimulus. RT is defined as the interval of time between the presentation of the stimulus and the appearance of an appropriate voluntary response in the subject. (6) Reaction times (RTs) to stimuli Reaction to moving stimuli is important in many real-life situations. Pronounced increases in RT to moving stimuli may have dangerous consequences for old people. In a previous study by Burr et al.(2012), it was shown that, irrespective of physical stimulus velocity, RT to grating motion onset depends upon the apparent velocity of the stimulus.(7) increase in age-related reaction time leads to many consequences further life which hamper the individual's quality life.

Falls are extremely common among the elderly population approximately 30% of people over the age of 65 falls each year.

(2)There are many risk factors for fall, leading to severe complications for further life and sometimes death. Falls are a major cause of injury and disability in older people and can result in serious health and social consequences such as fractures, poor quality of life, loss of independence, and nursing home admission. (8)They are a cause of substantial rates of mortality and morbidity as well as major contributors to immobility and premature nursing home placement. Unintentional injuries are the fifth leading cause of death in older adults (after cardiovascular disease, cancer, stroke, and pulmonary disorders) and falls constitute two-thirds of these deaths. (9)

Wang-Sheng Lin et al.(2022) conducted a study Correlation analysis of physical fitness and its impact on falls and the finding of research suggested all of the assessments indicated that the participants who had fallen three times exhibited lower levels of physical fitness than did those who had not fallen in the previous year. (10) Thaiba Reinai et al.(2021) research suggested that fall risk or fear of fall is highly correlated with the reaction time in the older population. (11) according to the few studies there was strong need for the study to evaluate the correlation between physical activity , reaction time, and fall risk in the elderly which give an accurate assessment for the fall risk.

## **MATERIALS AND METHODS**

The study was an observational cross-sectional study conducted in 2023. Data were collected from different old age homes of in and around Rajkot. participants aged between 65-85 years old. A total of 140 subjects were included according to the inclusion and exclusion criteria. Both male and female subjects were included, and subjects with any neurological problem, chronic illness or musculoskeletal problems , or any recent injuries were excluded. The written Consent form was signed by the participants after explaining to them the procedure to be done.

## PROCEDURE:

**PHYSICAL ACTIVITY:** physical activity was assessed by PASE (physical activity scale for the Elderly) and easily scored survey designed specifically to assess physical activity in epidemiological studies of persons aged 65 years and older. The PASE score combines information on leisure, household, and occupational activity. The PASE assesses the types of activities typically chosen by older adults over a one-week period these activities were walking, recreational activities, exercise, housework, yard work, and caring for others. It uses frequency, duration, and intensity level of activity over the previous week to assign a score, ranging from 0 to 793, with higher scores indicating greater physical activity. Participants answered the interview-based questions to the therapist.

**REACTION TIME:** It was assessed by the RULAR DROP TEST. Before starting the procedure, participants were instructed about the whole test. after explaining the test participants to be tested sits near the edge of a table, resting their elbow on the table so that their wrist extends over the side. The assessor holds the ruler vertically in the air between the participant's thumb and index finger, but not touching. Align the zero mark with the participant's fingers. The participant should indicate when they are ready. Without warning, the assessor release the ruler and let it drop - the subject must catch it as quickly as possible as soon as they see it fall. Record in meters the distance the ruler fell. Repeat this procedure 3 times and take the average score of three trials.

**FALL RISK :** fall risk is assessed by the POMA (Tinetti Performance Oriented

Mobility Assessment) assessment tool which is a highly reliable and valid tool is an easily administered task-oriented test that measures an older adult's gait and balance abilities. Participants asked to perform a different task for balance there were sitting balance, arises , attempts to arise, standing balance, etc. and for gait there were initiation gait , step length, step symmetry, etc. There is a scoring of 24 (16 Balance + 12 Gait) higher the score indicates a low risk of falls in participants.

## STATISTICAL ANALYSIS

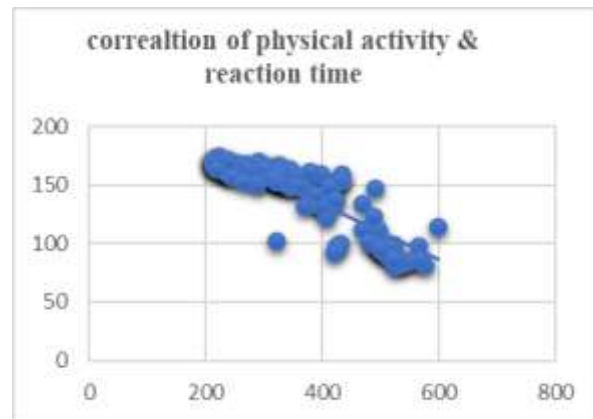
The statistical analysis was done using SPSS software version 26. The normality of the data was checked using Kolmogorov-Smirnov and data did not follow the normal distribution, so the Spearman Correlation coefficient was used to find the correlation between physical activity and fall risk, physical activity and reaction time & fall risk and reaction time.

## RESULTS

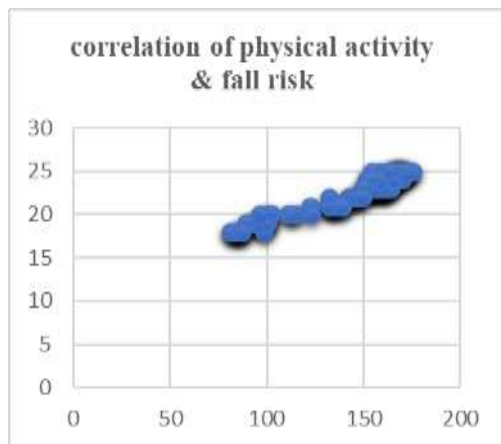
The results were derived from the analysis of data from 140 subjects. The mean and standard deviation of variables are given in Table 1.1. The results suggest that physical fitness has a negative correlation with reaction time which means that as physical activity increases the reaction time reduces shown in graph 1.1 . Physical activity is strongly negatively correlated with fall as the physical activity increases fall risk is also reduced as shown in graph 1.2.reaction time and fall risk is strongly correlated with reaction time it suggested if the reaction time increases the chance of fall is also increases as shown in graph 1.3.so, the elderly with high reaction time, lower physical activity are more prone to fall.

VARIABLE	MEAN	SD
Physical activity	145.66	27.669
Ruler drop test	349.09	103.178
Fall risk	22.71	2.522

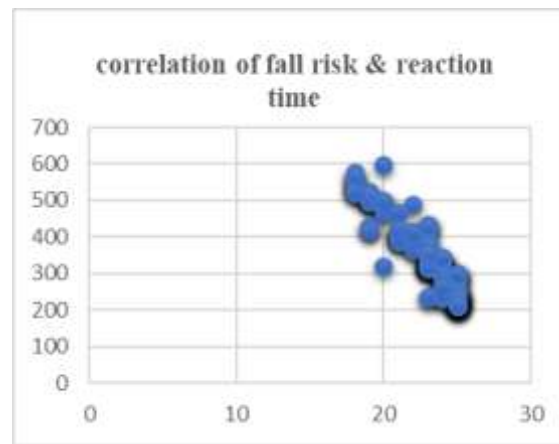
Table 1.1



Graph 1.1  $r = -0.890$ ,  $p < 0.001$



Graph 1.2.  $r = -0.938$ ,  $p < 0.001$



Graph 1.3.  $r = 0.916$ ,  $p < 0.001$

## DISCUSSION

The result of the study suggested that physical activity is negatively correlated with fall risk and reaction time and fall risk and reaction time is positively correlated with each other which showed that if physical activity improves the risk of fall and delay reaction time is reduced which protect elderly individuals to recurrent fall and related those complications. A one recent study, by Pijnappels M. examined how physical, cognitive, medical or medication risk factors were correlated and contribute to falls in a healthy older population. Their model also result in a physiological and cognitive path led to falls and explained 11% of the variance of retrospective falls. (12)

Physical activity is one of the most common causes for fall risk. Inactivity and aging increase the risk of chronic disease, and they often have multiple chronic condition. The exercise recommendations from WHO

include both aerobic exercise and strength exercise as well as balance exercises which would reduce the risk of falls. If older adults cannot follow the guidelines because of chronic conditions, than they should be as active as their ability and conditions allow . It is important to note that the recommended amount of PA is in addition to routine activities of daily living like self-care, cooking, and shopping, to mention a few. (3)

Jeoung BJ et al. reported a very strong correlation between muscle strength and balance with fall.(13) Correlation between fall risk and reaction time is due to Muscle strength being an important factor in standing posture and balance. So it is, balance ability and falling will decide by how the body copes with a sudden postural disturbance in which an individual maintains a correlation between the instant reaction and the balance ability of the trunk and lower body. (14)For that reasons will be

, muscle strength declines, and the incidence of falling becomes more frequent as aging progresses. The results of the study also verified that muscle strength, cardiovascular endurance, and agility are highly associated with a fear of falling as shown in past studies. This result suggests that improving physical fitness can help to prevent fall in older population. (13)

Older subjects performed very bad than younger subjects in the reaction time test. This was evident in both the pronounced differences in the Reaction time Test between the young and older sample and the significant correlation between the age and reaction time within the older group. This kind result suggested mostly 3 components that are significantly associated with each other there are neuropsychological, sensorimotor, and balance measures and performance in the reaction time test suggesting that all these factors may play important roles in the initiation and control of quick, accurate response. This is consistent with the findings of Patla and colleagues, they found that both central (initiation time) and peripheral factors (weight transfer time) were important in a single-leg CSRT(choice step reaction time) test and that both of these factors showed age-related changes. (15)

Richardson JK, et al. evaluated a large group of older subjects concerning their ability to perform a Stroop-like stepping test on a computer-controlled mat. for choice reaction time which provided cues. Findings of study suggests, subjects with prolonged and/or inaccurate stepping responses were more likely to report a history of accidental falls. (16)

There are well-known that the aetiology of falling is multifactorial and those fall risk factors are may numerous. Many researchers had attempted to determine the risk factors and their relative impact on actual falls and fall risk. the combination of these risk factors will lead to predict the degree of risk of falls in older people. Among them, there are potential protective factors are present which are such as

physical activity and detrimental factors such as sedentary behaviour recurrently appear . Therefore, prevention and rehabilitation programs should consider these modifiable factors and thereby help to reduce the magnitude of fall risk. (17)

Results of the correlation of reaction time and physical activity with fall risk help to assess the people earlier for further fall risk related to this injury. also helpful to build protocols for physical exercise training which reduce the fall risk related to this complication and improve their quality of life through physical activity by improving their fitness.

The limitation of the study is the reaction time test is a manual conduct test there are many standardized instruments available for these components in the future with different reaction time instruments and different tests for reaction time can use to more appropriate evaluation of same.

## CONCLUSION

Thus, the study concludes that fall risk, physical activity, and reaction time are strongly correlated with each other in the older population. so, the fall prevention program can be made to improve physical fitness which is helpful to improve the reaction time and reduce the fall risk in the older population.

### *Declaration by Authors*

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**Conflict of Interest:** The authors declare no conflict of interest.

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