

# Effectiveness of Forward Walking Versus Retro Walking on Balance, Gait Speed and Lower Body Functional Strength among the Elderly Population - A Comparative Study

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## ABSTRACT

**Background:** Aging is a fundamental process that affects all of our systems and tissues. Muscle strength, balance and gait speed are decreased due to aging. Walking on regular basis improves the quality of life in older adults and breaks down the cycle of disablement by interrupting the progression of disability.

**Aim:** To find out and compare the Effectiveness of Forward walking versus Retro walking on Balance, Gait Speed and Lower Body Functional Strength among the Elderly Population.

**Methodology:** 48 subjects were selected and randomly divided into two groups. All participants of both groups performed Warm-up and cool-down exercises for 5 minutes. Group A performed Forward walking and Group B performed Retro walking for 20 minutes. Both interventions were given for 30 minutes, 3 days/week for 4 weeks. Balance, Gait speed and Lower body functional strength were assessed by Performance oriented mobility assessment (POMA) and Multi-directional Reach Test (MDRT), 10-Meter Walk Test and 30 sec Sit to Stand Test respectively. All outcome measures were assessed before and after intervention.

**Result and Conclusion:** Within Group analysis showed statistically significant difference in POMA, MDRT, 10-meter walk test and 30-Sec Sit to Stand test in both Groups except POMA scale in Group A. Between Groups analysis showed statistically significant improvement in POMA T(Total), MDRT, 10-Meter walk test and 30 Sec Sit to Stand Test in Group B. Hence, both groups were effective in improving Balance, Gait Speed and Lower Body Functional Strength among the Elderly Population. Even Retro-walking was found superior to Forward walking.

**Key Words:** Retro walking, Performance oriented mobility assessment (POMA), Multi-directional reach test (MDRT), 10-Meter Walk Test, 30 sec Sit to Stand Test, elderly

## INTRODUCTION

Aging is a dynamic process which continue until death.<sup>1</sup> The old age group is classified into three groups.<sup>2</sup> The group consists of the population between 65-75 years considered as young-old.<sup>2</sup> The group consists of the 75-85 years considered as

middle old and group consists of older than 85 considered as old-old.<sup>2</sup>

According to the State of world population 2019 report by the United Nations population fund, India's population in 2019 stood at 1.36 billion, growing from 942.2 million in 1994 and 6% of India's population was of the age 65 and above.<sup>3</sup>

Aging is a fundamental process that affects all of our systems and tissues.<sup>4</sup> Balance can be largely divided into static balance and dynamic balance.<sup>5,6</sup> Reactive postural control occurs in response to external forces acting on the body (e.g. perturbation) displacing the COM or moving the BOS.<sup>5</sup> Feedback systems provide the sensory inputs required to initiate corrective responses.<sup>5</sup> Proactive or Anticipatory postural control occurs in anticipation of internally generated, destabilizing forces imposed on body's own movements.<sup>5</sup>

Tinetti Mobility Scale (POMA) is used for assessing both Static and Dynamic Balance as well as Gait parameters and it is less time consuming so, POMA is used for Elderly population.<sup>7</sup> Dynamic Balance and Anticipatory Balance can be assessed by Multi-Directional Reach Test.<sup>5</sup>

One aspect of walking that changes with age is Gait Speed.<sup>8</sup> After the seventh decade of life, Habitual Gait Speed declines at the rate of 12% to 16%.<sup>8</sup> 10-Meter Walk Test is valid tool than 4-Meter Walk Test to assess the Gait Speed among Elderly population.<sup>9</sup>

The term muscle strength be employed to refer to the maximum force a muscle or muscle group can generate at a specified velocity.<sup>10</sup> Insufficient muscular strength can contribute to major functional losses of even the most basic activities of daily living.<sup>11</sup> 30 Secs Sit to Stand Test is valid test to assess the Lower Body Functional Strength among Elderly population.<sup>12</sup>

Most of the previous research on walking has focussed on Forward propulsion or walking.<sup>13</sup> In Forward walking stance begins with heel strike and end at toe-off.<sup>13,14</sup> In Forward walking 60% is of stance phase and 40% is of swing phase.<sup>13,14</sup> Retro walking is nearly a mirror image or time reversed copy of walking Forward.<sup>13,14</sup> In Retro walking toe contact the ground first and the heel is lifted off the ground at the end of the stance phase.<sup>13,14</sup> The muscles responsible for

acceleration during walking Forward function as decelerator during Retro walking.<sup>13,14</sup>

There is scarcity of data on Retro walking in Elderly population. Even there is limited data comparing the effect of Forward walking and Retro walking among Elderly population. So, the aim of this study is to find out and to compare the effect of Forward walking and Retro walking on Balance, Gait Speed and Lower Body Functional Strength among the Elderly Population.

## **MATERIALS AND METHODOLOGY**

### **• INCLUSION CRITERIA**

- 65-75 year of age
- BMI between 18.5-24.9 kg/m<sup>2</sup>
- Both male and female
- Able to walk without assistive device
- Able to walk indoor and outdoor
- No fall experienced within 1 year before testing

### **• EXCLUSION CRITERIA**

- Subjects having any health-related conditions which can interfere independent walking.
- Subjects who are unable to walk for 20 minutes.
- Subjects engaged actively in outdoor sports related activities.
- Not willing to participate

### **• STUDY DESIGN:** Experimental study

### **• SAMPLING METHOD:** Convenient sampling method

### **• STUDY POPULATION:** Elderly individuals (65-75 yr.)

### **• SAMPLE SIZE:** 48 24 participants in each group Sample size was calculated using G \* power-software version 3.1.9.4.

### **• STUDY SETTING:** Vadodara

### **• STUDY PERIOD:** 1 year

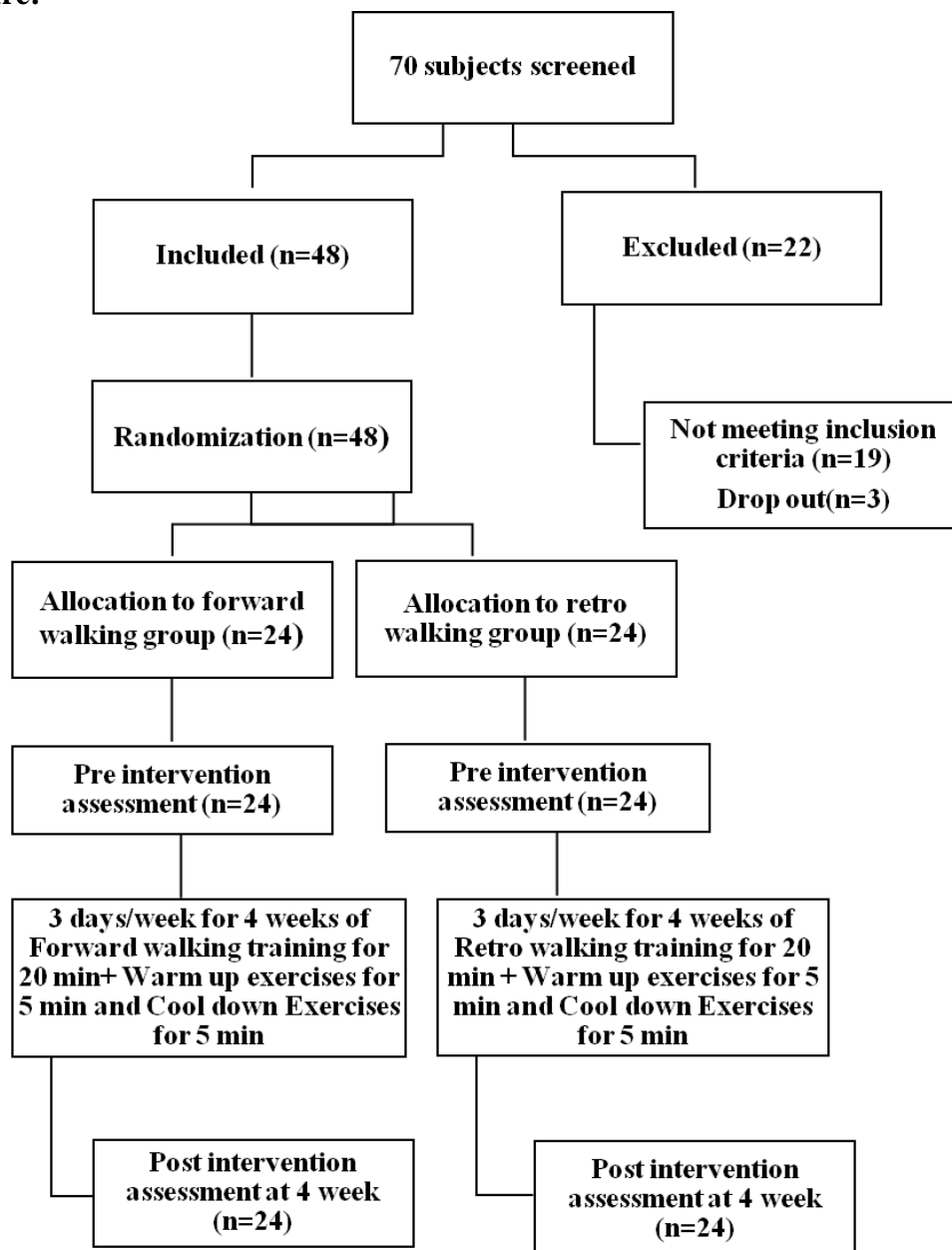
### **• MATERIALS:**

- A straight back chair with a solid seat with 17-inch height (armless)
- Stop watch

- Pens
- Chalk
- Yard stick for Multi-Directional reach test
- Measure tap
- Mat

- **OUTCOME MEASURES:**
  - Tinetti performance-oriented mobility assessment (POMA)
  - Multi-directional reach test (MDRT)
  - 10-Meter walk test
  - 30-sec sit to stand test

**Procedure:**



**FLOW CHART**

Ethical clearance was obtained from institutional review board. 48 participants out of 70 meeting inclusion criteria were selected and then randomly divided into two Groups by chit method. They signed a

consent form and then brief assessment was taken for each subject. COVID-19 Guidelines like wearing a face mask, using hand sanitizer and maintaining social

distancing were followed during data collection.

All participants were asked to perform 5 minutes Warm up exercises and cool down exercises in both groups.<sup>15,16,17</sup> They were given Calf and Hamstring muscle self-stretching, Double heel raised, Double toe raised exercises and Marching in place during Warm up and Cool down period.<sup>15,16,17</sup>

Participants were instructed to walk on 20-meter pathway between 2 markings at their comfortable pace for 20 minutes.<sup>18,19,20</sup> participants in Group A performed 20

minutes Forward walking exercise and participants in Group B performed 20 minutes Retro walking exercise.<sup>18,19,20</sup> One day Retro walking practice was given to the participants in Group B before the intervention was started.<sup>19</sup>

The participants were asked to wear comfortable shoes with flexible soles, good arch support and roomy toe boxes.<sup>21</sup> A comfortable time of the day was chosen, that was not too soon after eating and the weather was not too cold or hot.<sup>21</sup>

Total intervention duration was 30 min/day for 3 days/week for 4 weeks.<sup>19</sup>



A (FORWARD WALKING)



B (RETRO WALKING)

FIGURE 2: FORWARD WALKING AND RETRO WALKING

### Statistical Analysis:

Data was analysed by using SPSS version 20.0 and Microsoft Excel 2010. Within group analysis was done by Wilcoxon Signed Ranks test and Between

groups analysis was done by Mann-Whitney U test. Data was analysed at 5 % level of significance with confidence interval (CI) at 95 %.

## RESULT

TABLE 1: BASELINE CHARACTERISTICS OF SUBJECTS IN BOTH GROUPS

CHARACTERISTIC	GROUP A MEAN ± SD	GROUP B MEAN ± SD	p VALUE
AGE (years)	69.41 ± 2.84	68.20 ± 2.46	0.150
BMI (kg/m <sup>2</sup> )	24.14 ± 0.579	23.84 ± 1.303	0.861

TABLE 2: WITHIN GROUP PRE-POST INTERVENTION MEAN FOR POMA (POMA B, POMA G AND POMA T) SCORE

GROUP	POMA SCALE	PRE-INTERVENTION MEAN ± SD	POST-INTERVENTION MEAN ± SD	W VALUE	P VALUE
GROUP A	POMA-B	13.08 ± 3.72	13.12 ± 3.69	-1.000	0.317
	POMA-G	11.83 ± 0.56	11.91 ± 0.28	-1.414	0.157
	POMA-T	24.91 ± 3.99	25.04 ± 3.82	-1.732	0.083
GROUP B	POMA-B	13.83 ± 3.08	15.20 ± 2.02	-4.056*	< 0.001
	POMA-G	11.83 ± 0.38	12.00 ± 0.00	-2.000*	0.046
	POMA-T	25.70 ± 3.07	27.25 ± 2.02	-3.992*	< 0.001

\* = Statistically significant

Result shows statistically significant difference in POMA B, POMA G and POMA T in Group B and no statistically significant difference is observed for all POMA scores in Group A.

**TABLE 3: WITHIN GROUP PRE-POST INTERVENTION MEAN FOR ALL COMPONENTS OF MULTI-DIRECTIONAL REACH TEST**

GROUP	MDRT	PRE-INTERVENTION MEAN ± SD (INCH)	POST INTERVENTION MEAN ± SD (INCH)	W VALUE	p VALUE
GROUP A	FR	8.68 ± 1.66	8.71 ± 1.65	-1.94*	0.052
	BR	5.12 ± 1.45	5.19 ± 1.45	-2.87*	0.004
	RR	7.07 ± 1.57	7.13 ± 1.56	-2.46*	0.014
	LR	7.20 ± 1.47	7.25 ± 1.48	-1.96*	0.050
GROUP B	FR	7.85 ± 1.54	10.37 ± 1.82	-4.289*	< 0.001
	BR	5.29 ± 1.76	7.11 ± 1.81	-4.163*	< 0.001
	RR	6.73 ± 1.65	8.87 ± 1.42	-4.291*	< 0.001
	LR	6.91 ± 1.54	9.00 ± 1.40	-4.291*	< 0.001

\* = Statistically significant

Result shows statistically significant difference in all components of Multi-directional reach test in both Group.

**TABLE 4: WITHIN GROUP PRE-POST INTERVENTION MEAN FOR GAIT SPEED SCORE**

GROUP	PRE INTERVENTION MEAN ± SD (m/sec)	POST INTERVENTION MEAN ± SD (m/sec)	W VALUE	p VALUE
GROUP A	0.86 ± 0.16	0.89 ± 0.15	-4.22*	< 0.001
GROUP B	0.74 ± 0.12	0.91 ± 0.14	-4.293*	< 0.001

\* = Statistically significant

Result shows statistically significant difference in Gait speed in both Groups.

**TABLE 5: WITHIN GROUP PRE-POST INTERVENTION MEAN FOR 30 SEC SIT TO STAND TEST SCORE**

GROUP	PRE INTERVENTION MEAN ± SD	POST INTERVENTION MEAN ± SD	W VALUE	p VALUE
GROUP A	9.20 ± 1.91	13.50 ± 2.37	-4.31*	< 0.001
GROUP B	8.87 ± 2.32	14.25 ± 2.50	-4.31*	< 0.001

\* = Statistically significant

Result shows statistically significant difference in 30 Sec Sit to Stand test in Group A and Group B, with W value -4.31.

**TABLE 6: BETWEEN GROUP MEAN DIFFERENCE IN POMA (POMA B, POMA G AND POMA T) SCORE**

VARIABLES	DIFFERENCE PRE AND POST INTERVENTION		U VALUE	p VALUE
	GROUP A MEAN ± SD	GROUP B MEAN ± SD		
POMA-B	0.041 ± 0.20	1.375 ± 1.172	56.500*	<0.001
POMA-G	0.041 ± 0.20	0.166 ± 0.380	264.00	0.388
POMA-T	0.125 ± 0.33	1.541 ± 1.215	69.00*	<0.001

\* = Statistically significant

Between group result shows statistically significant difference in POMA B and POMA T. No statistically significant difference is found in POMA G.

**TABLE 7: BETWEEN GROUP MEAN DIFFERENCE IN ALL COMPONENTS OF MULTI-DIRECTIONAL REACH TEST**

VARIABLES	DIFFERENCE PRE AND POST INTERVENTION (INCH)		U VALUE	p VALUE
	GROUP A MEAN ± SD	GROUP B MEAN ± SD		
MDRT				
FR	0.041 ± 0.077	0.522 ± 0.724	0.00*	<0.001
BR	0.062 ± 0.087	1.923 ± 0.986	0.00*	< 0.001
RR	0.091 ± 0.105	2.138 ± 0.768	0.00*	< 0.001
LR	0.070 ± 0.090	2.088 ± 0.731	0.00*	< 0.001

\* = Statistically significant

Between Group result shows statistically significant difference in all components of Multi-directional reach test.

**TABLE 8: BETWEEN GROUP MEAN DIFFERENCE IN GAIT SPEED SCORE**

GROUP	DIFFERENCE PRE AND POST INTERVENTION MEAN ± SD (m/sec)	U VALUE	P VALUE
GROUP A	0.034 ± 0.018	0.00*	<0.001
GROUP B	0.167 ± 0.079		

\* = Statistically significant

Between Group result shows statistically significant difference in Gait speed.

**TABLE 9: BETWEEN GROUP MEAN DIFFERENCE IN 30 SEC SIT TO STAND TEST SCORE**

GROUP	DIFFERENCE PRE AND POST INTERVENTION MEAN ± SD	U VALUE	P VALUE
GROUP A	4.29 ± 1.22	158.00*	0.006
GROUP B	5.375 1.312		

\* = Statistically significant

Between Group result shows statistically significant difference in 30 Sec Sit to Stand test score.

## DISCUSSION

In present study, within Group result for POMA score showed no statistically significant difference in POMA B, POMA G and POMA T in Group A while statistically significant difference was found in Multi-Directional Reach Test in Group A.

Similar result was present in study carried out by T. paillard, C, Lafont et al.<sup>22</sup> Ross andel et al, detected that walking exercise may also increase flexibility and muscle strength and these changes may account for the improvement in balance.<sup>23</sup>

In present study, Within Group result for POMA score showed statistically significant difference in POMA B, POMA G, POMA T and Multi-Directional Reach Test in Group B. Hyun-Gyu cha et al, found statistically significant improvement in the backward walking group values before and after training on slop for medial-lateral and anterior-posterior balance in normal adults.<sup>6</sup>

Duysens et al, argued that the modulation of cutaneous reflexes in leg muscles during backward walking could be explained by a reversal of a common motor program, such as central pattern generator for locomotion.<sup>24</sup> It is assumed that such adaptations with BW which lead to the improvement in strength and balance.<sup>24</sup>

In present study, Within Group result for Gait Speed showed statistically significant difference in both Groups. Few researchers found similar result on normal

adults.<sup>6,25</sup> study conducted by Check Hooi Wong et al showed that every one-minute increases in habitual walking correlates with an increase in Gait speed.<sup>26</sup>

In present study, Within Group result for Lower Body Functional Strength showed statistically significant difference in Group A and Group B. Similar finding was present in the study carried out by Ross Andel et al, showed that Lower body strength improved by Forward walking in advanced old age.<sup>23</sup> Another study on Backward walking training found effective in improving the Lower limb functional strength in normal healthy individuals.<sup>27</sup> Flynn TW, Soutas-Little RW et al, detected that increased quadriceps strength with Retro walking is due to the isometric and concentric activity of the quadriceps femoris and ankle planter flexor muscle Groups.<sup>28</sup>

In present study, Between Group result showed statistically significant improvement in POMA B and Multi-Directional Reach test in Group B while no statistically significant difference was found in POMA G in both Groups. During Backward walking, the absence of peripheral visual feedback and visual flow which is used to plan movement during Forward gait is absent.<sup>29</sup> It may be due to lack of visual information which may require a reweighting of sensory feedback to control the stepping pattern.<sup>29</sup>

In present study, Between Group result showed statistically significant improvement in Gait Speed in Group B. Similar result was found in study carried out by Hyun-Gyu CHA el al. They showed the statistically significant difference in post

training gain in Gait speed between Forward walking and Retro walking Group in normal adults.<sup>6</sup> Researchers found that Backward walking training facilitated activation of key muscles such as hip extensors, which are important contributor to forward walking speed.<sup>30</sup>

In present study, Between Group results showed statistically significant improvement in Lower Body Functional Strength in Group B. Some authors detected that Retro walking has been proved to be effective in improving Lower body functional strength compared to Forward walking.<sup>16,27,31</sup> Studies suggested that ankle planter flexors, quadriceps and hip extensors are activated by Retro walking.<sup>16,27,31</sup>

Within Group result showed statistically significant improvement in both Groups whereas, Between Group result showed statistically significant improvement in Retro walking Group compared to Forward walking Group for Balance, Gait Speed and Lower Body Functional Strength. Hence, null hypothesis (Ho) is rejected and alternative hypothesis (H1) is accepted.

## CONCLUSION

In present study, Forward walking and Retro walking were found effective in improving Balance, Gait Speed and Lower Body Functional Strength among the Elderly Population. Even Retro-walking was found superior to Forward walking.

Walking program is inexpensive and also does not require any equipment. Forward walking and Retro walking both can be utilized in Fitness and Rehabilitation programme for Elderly. Even Retro walking may be used instead of Forward walking in Healthy Elderly population after practice and also for Rehabilitation purpose.

## Limitations

- Study was not blinded.
- Daily living activities of participants were not taken into account.

## Future Recommendations

- Future study can be done with large sample size and long follow-up.
- Future study can be done in Middle Old and Old-Old population.
- Future Study can also monitor the intensity of walking.
- Different gait parameters can also be measured.

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