



# Effects of Walking with Aids on Walking Speed and Selected Cardiovascular Parameters in Apparently Healthy Elderly Individuals

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## Abstract

**Background:** Elderly individuals make up a large part of the population, many of whom use walking aids and also tend to have a higher percentage of cardiovascular complications. There is a need to document the effects of walking with different aids on walking speed and selected cardiovascular parameters.

**Objectives:** This study aimed at determining and comparing the effects of walking with cane, tripod, and walking frame on walking speed and selected cardiovascular parameters in apparently healthy elderly individuals.

**Methods:** Thirty-five (35) elderly individuals participated in this study. Participants' systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) were measured after ambulation with and without walking aids. Walking speed (WS) was measured as each participant walked at their normal comfortable pace without aid and with 3 walking aids on separate days. Analysis of variance (ANOVA) was used to find a significant difference between variables.

**Results:** Participants' mean age was  $74.89 \pm 7.15$  years. Systolic blood pressure (SBP) ( $138.57 \pm 16.62$  mmHg), diastolic blood pressure (DBP), ( $80.37 \pm 9.57$  mmHg), and heart rate (HR) ( $75.51 \pm 9.54$  beats/min) after walking frame ambulation were higher than with cane ( $132.91 \pm 18.97$  mmHg;  $78.74 \pm 8.59$  mmHg;  $75.37 \pm 10.28$  beats/min) and tripod ( $130.40 \pm 16.59$  mmHg;  $77.31 \pm 9.13$  mmHg;  $74.63 \pm 9.92$  beats/min) ambulation, respectively. Walking speed ( $0.58 \pm 0.21$  m/s) with a cane was significantly faster ( $P = 0.001$ ) than with frame ( $0.31 \pm 0.12$  m/s), and tripod ( $0.50 \pm 0.19$  m/s).

**Conclusions:** Walking frame ambulation elicited a higher blood pressure, a higher HR and a slower WS than cane and tripod ambulation, respectively. The participants walked significantly faster with a cane than tripod and walking frame.

**Keywords:** Elderly, Walking Aids, Cardiovascular Parameters, Mobility Limitation

## 1. Background

Aging leads to a slowed capacity to develop high velocity movements and perform physical tasks to maintain independent functioning (1, 2). The elderly people represent the fastest growing age group and approximately two-thirds are living with high blood pressure (3), accepting the chronological age of 65 years and above as the definition for elderly (4). Studies have shown that high blood pressure is a risk factor for cardiovascular diseases and death in elderly people (5, 6), while a lower muscle mass has been associated with increased risk of mobility loss in older males and females (7).

Physical activity maintained throughout life is associated with lower incidence and prevalence of chronic diseases, such as cancer, diabetes, and cardiovascular diseases (8, 9). Therefore, the maintenance of mobility is thought to be fundamental to active aging, allowing older adults to continue to lead dynamic and independent lives (10).

Walking speed has been shown to be an important measure in comprehensive geriatric assessment in all clinical settings for the purposes of developing risk profiles and care plans for geriatric patients (11). Walking aids are usually prescribed routinely during geriatric rehabilitation to compensate for balance and mobility deficits (12), protect against falls (13), and increase activity and participation in patients with mobility limitations (14).

During rehabilitation of the elderly, physiotherapists usually prescribe walking aids with the aim of increasing the patient's base of support, increasing gait safety, preventing falls, improving balance, functional independence, and improving ambulation. Because elderly individuals comprise a large part of the population using walking aids, the effect of using these aids on their walking speed and cardiovascular parameters, which are important indicators of overall health and function in aging and disease, is of major concern.

This study was therefore designed to determine the effects of walking without walking aids and walking with walking aids on walking speed and selected cardiovascular parameters (systolic blood pressure, diastolic blood pressure, and heart rate).

## 2. Methods

A total of 36 apparently healthy elderly individuals (17 males and 19 females), who could walk without aids were recruited in the study. They were recruited from 2 retirement homes for the elderly in Lagos state, Nigeria. This study was an observational study, in which elderly participants were assessed by observation of gait and by questioning to ensure they fulfilled the inclusion criteria for this study. Included in this study were elderly people, who were 65 years of age and above, male or female, could tolerate walking without any complaints, could walk without aids, had no visual defects (impairment of vision, such as blindness), and had no cognitive impairment. Excluded from the study were elderly people, who required the assistance of another person or supportive device for walking, had any neurological disorder, uncontrolled metabolic disorder, and had uncontrolled cardiopulmonary disorders. Information relating to age, walking ability, past medical and surgical history were also obtained to determine eligibility for the study. After satisfying the inclusion criteria, the participants were fully admitted to the study after written informed consent form was dually signed by them.

Of the 36 elderly participants, 1 of the participants dropped out of the study as a result of ill health, therefore, 35 participants completed the study.

A non-probability consecutive sampling technique was used, which meant that the participants that met the inclusion criteria were recruited as they were available. The participants were assessed for eligibility for the study. The purpose, procedure, and objectives of the study were fully explained to the participants by the researcher.

### 2.1. Procedure

Prior to the commencement of the study, ethical approval was sought and obtained from the Health Research and Ethics Committee of Lagos University teaching hospital, Idi-Araba, Lagos with approval number of ADM/DCST/HREC/APP/062. Approval was also obtained from the selected retirement homes in Lagos, Nigeria, where the study was carried out. Informed consent was also obtained from the subjects before participation in the study. The research design was experimental.

Measurements of weight, height, systolic blood pressure, diastolic blood pressure, and heart rate were taken at

the beginning of the study. The researcher demonstrated the correct use of different walking aids to the participants before walking. For maximal strength, balance and to protect against falls, the walking aids were adjusted to match the measurement of each participant before walking. The participants were advised to wear their normal comfortable footwear throughout the study. The subjects served as their own controls with the use of no walking aid as the comparison or baseline.

The participants walked a measured distance of 20 m unaided at their normal comfortable pace as instructed. A digital stop watch was used to record the time for the intermediate 10 m (from the 5 m mark to the 15 m mark). This was repeated twice with a rest interval of 10 minutes between each trial (15). The blood pressure and heart rate measurements were taken immediately after each trial. The mean of the variables was then obtained from the 2 measurements (before and after the trial). This was repeated using 3 different walking aids (a standard cane, tripod, and walking frame) on separate days.

### 2.2. Data Analysis

Data were analyzed using SPSS version 21. Mean and standard deviations (SD) was calculated for each variable. Analysis of variance was used to compare changes in the WS and selected cardiovascular parameters for each walking aid. Level of significance was set at  $P \leq 0.05$ .

## 3. Results

A total of 35 (35) apparently healthy elderly individuals, who could walk without aid completed this study. Seventeen (48.6%) of the participants were males and 18 (51.4%) were females (Table 1). They were aged between 65 and 100 years with a mean age of  $74.89 \pm 7.15$  years. Ten (28.6%) of the participants were between the ages of 61 and 70 years while only 1 (2.9%) was between the age of 91 and 100 years (Table 1). The mean height, weight, and body mass index (BMI) of the participants were  $1.57 \pm 0.09$  m,  $65.11 \pm 14.38$  kg, and  $26.47 \pm 5.86$  kg/m<sup>2</sup>, respectively (Table 1).

### 3.1. Baseline Cardiovascular Parameters of Participants

Table 2 shows the baseline cardiovascular parameters of the participants as measured before participation in the study, including the systolic blood pressure, diastolic blood pressure, and heart rate.

At rest, the systolic blood pressure (SBP) and diastolic blood pressure (DBP) ranged between 96 and 180 mmHg, and 62 and 105 mmHg with a mean of  $134.29 \pm 20.69$  mmHg and  $78.26 \pm 11.62$  mmHg, respectively (Table 2). THE HEART RATE (HR) of the participants measured at rest

**Table 1.** Physical Characteristics of Participants

Variable	Frequency, No	Percentage	Mean $\pm$ SD
<b>Age range, y</b>			74.89 $\pm$ 7.15
61 - 70	10	28.60	
71 - 80	20	57.10	
81 - 90	4	11.40	
91 - 100	1	2.90	
<b>Gender</b>			
Males	17	48.60	
Females	18	51.40	
<b>Height, m</b>			1.57 $\pm$ 0.09
<b>Weight, kg</b>			65.11 $\pm$ 14.38

**Table 2.** Baseline Cardiovascular Parameters of Participants

Variable	Range	Mean $\pm$ SD
<b>SBP, mmHg</b>	96 - 180	134.29 $\pm$ 20.69
<b>DBP, mmHg</b>	62 - 105	78.26 $\pm$ 11.62
<b>HR, beats/min</b>	49 - 94	74.94 $\pm$ 10.24

Abbreviations: DBP, Diastolic Blood Pressure; HR, Heart Rate; SBP, Systolic Blood Pressure.

ranged between 49 and 94 beats/minute with a mean of  $74.94 \pm 10.24$  beats/minute (Table 2).

Comparison of the changes in walking speed and selected cardiovascular parameters using Analysis of Variance (ANOVA) after walking with and without aids showed that there was no statistically significant difference ( $P > 0.05$ ) in cardiovascular parameter yet there was a statistically significant difference ( $P = 0.001$ ,  $f = 21.418$ ) in walking speed when comparison was made between each of the trials with and without aids (Table 3).

#### 4. Discussion

The purpose of this study was to determine and compare the effects of walking with aids on walking speed and some selected cardiovascular parameters.

The results of this study showed that walking with the 3 different aids by the elderly promoted reduction in walking speed when compared with walking with no aid. It is believed that one of the reasons for this is that the participants did not use these walking aids habitually and it was their first experience walking with these aids. This could have been avoided by the introduction of a period of adaptation to the walking aids.

This finding is consistent with the results of a study by Foley et al. (16), involving 10 healthy adults where the comparison was made between walking with a cane and unassisted walking. There was an apparent decrease in walking speed when the cane was used. The current study also support the results of the study carried out by Cubo et al. (17), where the comparison was made using a standard walker, wheeled walker, and unassisted ambulation in elderly patients with Parkinson's disease, who had motor blocks or freezing while walking. Walking speed was significantly reduced for subjects using either assistive devices compared with the unassisted ambulation. Participants in this study, in contrast, did not have any neurologic conditions yet had reduced walking speed with all of the 3 different walking aids used.

From the results of this study, the greatest increase in cardiovascular parameters vis -a -vis systolic blood pressure, diastolic blood pressure, and heart rate was observed, when walking with a walking frame was compared with the 2 other walking aids and unassisted ambulation. This increase may be attributed to the fact that walking with a walking frame requires the user to use both upper extremities to completely lift up the frame with each step and move it forward, thereby placing greater demand on the cardiovascular and musculoskeletal systems and can easily result in fatigue when compared with the other 2 types of walking aids used. This is in support of the findings of Foley et al. (16), where systolic blood pressure, diastolic blood pressure, and heart rate were higher during ambulation with a standard walking frame as compared with unassisted ambulation and ambulation with a walking cane. This is also in agreement with the findings of Holder et al. (18), where it was reported that the use of assistive devices, which involved using axillary crutches, a standard walking frame, and a wheeled walking frame among 9 female physical therapists resulted in an increase in metabolic and cardiovascular responses compared with unassisted ambulation. They also stated that it is possible that the differences in metabolic and cardiovascular parameters may be more pronounced in an older population because of secondary changes in the cardiovascular system due to the aging process as well as cardiovascular disease in the older population.

From the findings of this study, the use of the tripod resulted in reduced systolic blood pressure, diastolic blood pressure, and heart rate while the use of the walking cane resulted in reduced systolic blood pressure and increased heart rate, while the diastolic blood pressure remained unchanged when compared with unassisted ambulation. This may be possibly due to the fact that the use of a tripod provided an additional base of support thereby increasing dependence on the tripod and thus reducing the

**Table 3.** Comparison of the Changes in Walking Speed and Selected Cardiovascular Parameters After Walking with and Without Aids<sup>a</sup>

Variable	No Aid	Walking Cane	Tripod	Walking Frame	f	P Value
WS, m/s	0.65 ± 0.21	0.58 ± 0.21	0.50 ± 0.19	0.31 ± 0.12	21.418	0.001 <sup>b</sup>
SBP, mmHg	134.89 ± 20.55	132.91 ± 18.97	130.40 ± 16.59	138.57 ± 16.62	0.753	0.585
DBP, mmHg	78.74 ± 10.34	78.74 ± 8.59	77.31 ± 9.13	80.37 ± 9.57	0.385	0.859
HR, beats/min	75.29 ± 9.57	75.37 ± 10.28	74.63 ± 9.92	75.51 ± 9.54	0.148	0.981

Abbreviations: DBP, Diastolic Blood Pressure; f, Analysis of variance; HR, Heart Rate; SBP; Systolic Blood Pressure; WS, Walking Speed.

<sup>a</sup>Values are expressed as Mean ± SD.

<sup>b</sup>Indicates significant difference at P < 0.05.

magnitude of the demands placed on the musculoskeletal and cardiovascular systems when compared with a walking cane.

Similar to the findings of Foley et al. (16), the results of this study showed that there was no significant difference in heart rate when walking with a walking cane was compared with walking unaided. This is contrary to the findings of Jones et al. (19) where the comparison was made between cane-assisted gait and unassisted walking in patients with knee osteoarthritis, where it was found that heart rate was higher when walking with a walking cane was compared with walking unaided.

#### 4.1. Limitations of This Study

The sample size was quite small. The participants of this study could walk without walking aids, therefore, they did not represent the typical population in need of such devices. Also, the participants had only a short time of training before using each walking aid.

#### 4.2. Conclusion

Walking with walking aids had a significant effect on walking speed (WS) in the elderly. Walking with walking aids did not have any effect on the cardiovascular parameters (systolic blood pressure, diastolic blood pressure, and heart rate) in the elderly. Walking frame ambulation elicited a higher blood pressure and HR and a slower WS than cane and tripod ambulation, respectively. The elderly individuals walked significantly faster with a cane than tripod and walking frame in this study.

#### 4.3. Recommendation

Based on the outcome of this study, the following recommendations were made:

It is recommended that when walking aids are being prescribed for elderly patients as a result of an underlying pathology, physiotherapists should periodically assess their walking speed, and their cardiovascular parameters, which is an indicator of health and function, to establish

the short and long-term effects of using aids on the overall health of the patient.

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