

## ORIGINAL ARTICLE

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## READING AND TEXTING WHILE WALKING: EFFECT ON GAIT INDICES IN HEALTHY YOUNG FEMALES

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## ABSTRACT

**Background:** Mobile phones are becoming one of the necessities now a day. Divided attention leads to affected performance in one or both tasks. Effects of such dual tasking using mobile while walking needs to be explored as the use of mobile phones during walking/stair climbing etc. are very common.

**Methods:** 132 female students of age 18 yrs to 21 yrs were made for walking under three conditions (walking, walking and reading on mobile, walking and texting). Gait indices (step and stride length, toe outangle) were compared in all conditions using the paired t-test.

**Results:** Step length, stride length reduced and angle of toe out increased significantly in reading during walking and texting during walking as compared to only walking ( $p < 0.0001$ ). Parameters during texting while walking showed maximum affection.

**Conclusion:** Reading or texting during walking can affect walking performance adversely. You are texting while walking is most deleterious in the above three conditions.

**Keywords:** Gait Indices, attention demand, dual tasking, mobile phones.

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## INTRODUCTION

Mobile phones have become an important part of everyone's life. 77% of the total world's population uses mobile phones. Text messaging is popular and frequently used as it is cost effective and easy [1,2]. Writing or reading messages while walking is a customary task for youngsters. This is one of the complex dual tasks that is mastered by youngsters to perform efficiently in their highly demanding life.

Walking is a complex task that requires a co-ordinated functioning between all body parts and brain. It is an automated rhythmic motor behavior [3]. It requires the capacity to altering locomotor patterns to respond effectively to the continuously changing environment. As per Vasudevan E, Glass R, Packet A (2014), it is an important precursor for community walking [4]. Such adaptations require intact attention and executive function. Attention can get diverted during using mobile phones and doing motor task simultaneously thus, affecting either one or both task adaptations. This change in the gait pattern of gait while doing some simultaneous task is referred to as interference. It is due to competition amongst resources resulting in attention diversion and increase risk of falls [5-7].

There is a vast literature indicating a crucial role of attention in safe walking [8] the important role of cognitive factors in balance capacity is well proved. Task difficulty influences attentional demands required to complete a dual task efficiently. Motor adaptation rates are slowed even in neurologically intact adults in complex dual task scenarios [9]. Thus, as the complexity of task increases the dual tasking performance may deteriorate.

Use of cell phones is expanding every day; hence safety experts have started exploring the effect of such distractions while walking for commuter safety. Studies indicate a growing number of accidents and injuries while walking and using mobile phones simultaneously [10-16]. Understanding the effects of such simultaneous cognitive task on walking may help in setting pedestrian safety guidelines.

Impaired walking performance while doing dual tasking on the phone has been proved in some studies in the past [6, 14, 16-24]. Although, some researchers have studied the use of anticipatory control (e.g., visuo-motor) to overcome obstacles, the effect of mobile phone use, e.g., texting, talking or a combination of it, on walking capacity is yet to be discovered completely. Previous researches have not examined the effects of simultaneous reading/texting on walking. Therefore, task prioritization and its effect on gait while texting and walking are recurrently unknown. Plummer et al suggested that although ill effects of messaging while driving have been proved to be fatal in many studies, safety risks associated with it on simple walking is yet to be explored [25].

Considering the above-stated studies and findings, this study was planned to find out the effects of texting or reading while walking on gait parameters in healthy young females.

## METHODOLOGY

This was a cross-sectional study done on 132 participants (sample size decided by the pilot study). The participants

were recruited through convenience sampling. The assessment was done in physiotherapy OPD of DES Brijal Jindal College of Physiotherapy, Pune. Healthy females of 18-21 years who used touch screen cell phones daily for at least 4 hrs since last six months were selected. These females were included in the study if they were able to read, type messages in their phones. Anyone with known neurological, musculoskeletal or cognitive deficits that may affect walking abilities were excluded. Females with an allergy to ink or uncorrected refractive errors were excluded from the study.

After taking Ethics clearance college authorities and after explaining the study procedure and taking consent of participants they were screened. 8-meter walkway area was prepared (in the OPD/college corridors) which was free from visual or auditory distraction. The condition of walking was decided by chit method.

Following were the walking conditions -1] Walking 2] Walking while reading 3] Walking while texting. A rest period of 2 min was given in between each condition to avoid fatigue. The participants were asked to step in the chalk powder tray without wearing footwear and then walk on the floor. While reading, all subjects were given a common content. While texting common audio was played for all subjects. (mentioned in Annexure). The subjects having spectacles were allowed to wear the specs during the study procedure. They were advised to maintain their comfortable position, speed, and base of support. Initial ten steps were discarded from data analysis to avoid errors due to participants being conscious or adjusting to the walking condition.

Step length, stride length, and angle of toe out were measured. Following procedure was used for measurement. a) Stride length- the line was drawn perpendicular from the heel of one foot, and another perpendicular from the consecutive heel of same foot and distance will be measured in centimeters. b) Step length- the perpendicular was drawn from the heel of one foot, and another perpendicular from the heel of consecutive opposite extremity foot and the line was drawn and the distance measured in centimeters. c) The degree of toe out- a line was drawn from the center of the heel of one foot and second toe, and the angle is measured.

Data analysis was done using Paired t-test on SPSS 20.00. Comparison of each parameter between only walking, walking and texting, walking and reading was done

## RESULTS

**Table 1:** Demographic data

Age group(in yrs)	No.of participants	Percentage
19-19 yrs 11 months	29	22
20-20 yrs 11 months	24	19
21-21 yrs 11 months	21	16
22-22 yrs 11 months	39	30
23-23 yrs 11 months	14	11
24-24 yrs 11 months	2	2

(Maximum participants were between 22 to 22.11 yrs)

**Table 2:** Screen dimensions (in inches)

Screen in inches	No. of participants	Percentage
3 -3.9	4	3
4-4.9	26	20
5-6	100	77

(77 % of participants used 5-6 inches screen phone)

**Table 3:** Comparison of Step length changes in all conditions(in inches)

	Step length	Walking	Walking and Reading	Walking and Texting
	Mean(Standard Deviation)	59.17(7.56)	57.79(41.8)	48.84(8.43)
(using a paired t-test)	P value (walking Vs. walking and reading)	<0.05-sig diff		
	P value(Walking and reading Vs. Walking and texting)	<0.05-sig diff		
	P value(walking Vs. walking and texting)	<0.05-ext sig diff		

(There was a significant difference in step lengths of all conditions. Walking and texting is the most difficult)

**Table 4:** Comparison of Stride length changes in all conditions(in inches)

	Stride length	Walking	Walking and Reading	Walking and Texting
	Mean(Standard Deviation)	121.6(13.1)	111.5(17.4)	104.6(14.7)
(using a paired t-test)	P value (walking Vs. walking and reading)	<0.0001-ext sig diff		
	P value(Walking and reading Vs. Walking and texting)	<0.0001-ext sig diff		
	P value(walking Vs. walking and texting)	<0.0001-ext sig diff		

(There was a significant difference in stride lengths of all conditions. Walking and texting is the most difficult)

**Table 5:** Comparison of the angle of toe out in all conditions (in degrees)

	Stride length	Walking	Walking and Reading	Walking and Texting
	Mean(Standard Deviation)	8.56(1.73)	8.59(1.54)	8.95(1.65)
(using a paired t-test)	P value (walking Vs. walking and reading)	<0.0001-ext sig diff		
	P value(Walking and reading Vs. Walking and texting)	<0.0001-ext sig diff		
	P value(walking Vs. walking and texting)	<0.0001-ext sig diff		

(There was a significant difference in angle of toe out in all conditions. Walking and texting is the most difficult)

Thus it can be seen that Step length, Stride length and angle of toe out were significantly different in all walking conditions ( $p < 0.0001$ ). Step length and Stride length performance reduced significantly while walking and texting, the angle of toe out increased maximally during the same.

## DISCUSSION

Human locomotion requires a harmonious interaction between nervous system, musculoskeletal system and environment. Doing two tasks simultaneously causes competition for resources leading to the affected performance of one or both the tasks. Use of mobile phones while walking, crossing the road or stair climbing is a common activity nowadays; hence, the safety of such practice needs to be studied. Keeping in mind theory of capacity sharing, it was hypothesized that, either gait or response on a mobile phone would get compromised when both tasks are done simultaneously. This study was planned to test the above-stated hypothesis.

Gait involves complex mechanism, and at present, inexpensive, quantitative and reliable clinical methods of evaluating gait are limited. Temporal and spatial variables such as step length, step duration, stride length, cadence, and velocity provide essential quantitative information and are used ubiquitously in classic research of over 30 years [26,27-32]. The length of one stride includes all the phases of the gait cycle whereas step length is an indication of gait symmetry. The angle of toe out signifies base of support i.e. balance. Hence these parameters were included for assessment in this study. Hamacher and Torpelahave proved the reliability of these gait parameters in clinical trials planned to study the effects of different tasks on gait parameters in dual tasking conditions [33].

It was observed that stride and step length decreased and angle of toe out increased as per the complexity of task increased. This suggests asymmetrical gait pattern, narrow BOS, small and closer steps and a compensatory increase in the angle of out to maintain balance while performing dual task of reading and texting while walking which is due to increased attention demand. (As seen in table 2,3,4).

Several neuropsychological studies have proved that cognition (executive function and visuospatial abilities) is an important domain during walking [8]. As attention and thinking are important precursors for efficient dual-task performance, attention diversion may result in task interference causing decreased performance in one or both task [7,11]. It is also found in previous studies that, cognitive tasks cause a greater degree of interference between factors hence causes more deterioration in task quality as compared to any other task where external interference is more.<sup>[34]</sup> Previous studies have proved that, as the complexity of task increases, this increases attention demands, cause distraction and thus reduces performance [1,5,7,11,17]. Results of this study also showed a similar phenomenon. Many other researchers also had similar observations which they attributed to alteration in gait kinetics and kinematics, increased attention demands and decrease in reaction time[11,16,17,19,20,21,22,23,24]. Thus the hypothesis of affection of gait parameters while doing dual tasking of mobile phone (either reading while walking or texting



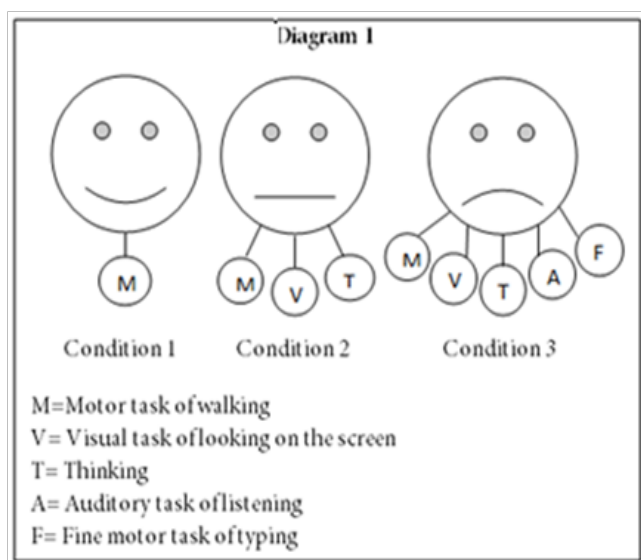
while walking) use was found to be true in this study. Parameters of gait, while texting+ walking, were found to be more affected as compared to reading while walking. This can be because, texting and walking was a more complex task which involved a combination of walking, thinking, reading and doing the fine motor task of typing (as shown in diagram 1). Many researchers explain this phenomenon, e.g., according to research by Shumway-Cook and Wollacott (2002), task complexity determines the need for attentional resources for a given task [5]. Motor adaptation rates are found to be affected even in healthy adults when they are distracted by with a more demanding additional task leading to the affection of either or both tasks [9]. More resources might have been required for performing texting while walking as compared to only reading while walking or walking and reading. Thus, as the complexity of task increased the performance in gait might have reduced.

This information can be used for awareness generation in youngsters regarding the hazards of cell phone usage on roads as distraction based injuries is increasing which is a matter of concern. Policymakers can make use of this information for making and implementation of steps to enhance safety during dual tasking conditions of walking.

This study was done in a physiotherapy institute where female participants were in the majority; hence the study included only female participants. Phone dimensions, duration of use per day, duration of experience of mobile phone use, visual acuity practice of reading and texting while walking was not taken into account hence their influence on gait parameters cannot be commented. To maintain uniformity, all assessments were done in a closed setting hence the effect of moving traffic; other distractions could not be simulated. Thus findings of this study may not be generalized for daily walking conditions. A similar study can be replicated in community or an open environment to see the actual effect of changing the environment on these parameters.

## CONCLUSION

Thus the study indicates that simultaneous texting or reading can affect an individuals gait performance adversely. It is maximally affected when attention demands are challenged, eg. Combination of walking reading and texting.



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