

To Study the Effect of Smartphone Multitasking on Dynamic Balance in Young Adults

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Abstract

The objectives of this research was to see how using smartphone functions during gait affected dynamic balance. From a university, a sample of 100 subjects was taken. Four types of gait tasks were given: General Gait (to walk without any task); Task Gait 1 (to walk while chatting through text); Task Gait 2 (to walk while web surfing and hearing music) and Task Gait 3 (to walk while playing an online multiplayer videogame). The conditions were the same for all the experiments. The subjects used earphones for listening to music and having conversation during games. The sequence of tasks was not done in systematic manner. The Timed Up and Go (TUG) test was used to assess dynamic balance. After three repetitions of the tasks, the mean of the measured values was analysed. In the TUG tests, there were statistically significant unfavourable differences. Use of smartphone features during walking affects dynamic balance of a person. As a result, when ambulating, using various features of a cell phone may result in falls and injuries.

Keywords: Smartphone, Multitasking, Dynamic balance, Timed Up and Go (TUG) Test

Introduction

In India, smartphone users are anticipated to rise from 468 million users in 2017 to 859 million by 2022.

^[1]The easy availability of smartphones and its ability to provide variety of information has led common man to increase his dependency on smartphone as well as its excessive use caused many complications.^[2]

One research on smart phone uses among the young people shows that during weekdays, a person uses smartphone for 5.1 hours and during weekend,

uses for 5.9 hours. This implies that in average, youngsters use smart phones noticeably a lot and most of the feature used was chatting as well as playing games.^[3] According to a study on university students of degree and addiction of smartphone usage, 31% of subjects showed ocular fatigue, 15% showed myalgia, and 5% showed neural dysfunction. Moreover, psychiatric conditions such as interpersonal disorder, social anxiety, and smartphone dependence were also seen among the most subjects.^[4] (Park, J.S., et al. 2014) Further, all day long use of smartphone may result in an incorrect posture such as upper cross syndrome^[5] as well as damages ligaments and other nearby soft tissues. While using a smartphone during gait, visual and auditory distractions occur certainly.^[6]

It has been also seen that visual distraction may affect static balance during simple, dual or multi tasks resulting in postural sway.^[7-8] As smartphones

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are potable, its various features are easy to use while ambulating. Particularly, during gait, listening to music, chatting, web surfing and playing games are some of the smartphone's functions used commonly. Using different smartphone functions during walking are called dual- or multitasking.^[9] However, probability of injuries as well as falls increase due to such multitask mainly in an accidental or unexpected situation as cognitive function decreases.

There is need to maintain the balance for functional activities in a static or dynamic situation.^[10] For balance control, there is need of synergy between the neural pathways and muscular skeletal systems as well as surrounding related effects. Furthermore, for adequate control of balance the interplay between vestibular function, visual feedback, proprioception, musculoskeletal and cognitive functions is crucial.^[11-12] Thus, any fact or information is inaccurate, this results in an evident impact on balance.^[13] A research indicated that use of smartphone can restrain visual data and, thus, postural balance is impaired.^[14] Also it is necessary to remember that if there is decrease in sensory or motor control, it is stated by an increase in sway.^[15]

People use smartphones even while walking and this behaviour interferes with the perception of speeding vehicles and nearby things thus gait velocity is decreased, and the risk of road accidents is increased as it also causes distraction.^[2] It is seen that a person generally while waiting on something, or when they are in moving transport uses smart phones the most. Multitasking conditions, such as utilising mobile phone features while in a moving vehicle, might contribute to posture impairment. Despite that, there are only few research done which explore this prospect of usage of smartphone.

Particularly, dual tasking using smartphone functions during gait, like listening to music, chatting, browsing internet, or playing a videogame, has been

seen to affect the dynamic balance.^[16] The cognitive distraction due to use of a smartphone decreases awareness in society thereby increasing risky behaviour, like not looking sideways and neglecting traffic lights while going across the street. A study discovered that talking on the phone is less distracting than hearing music and chatting via messages, because messaging includes both reading and typing: an activity where there is need of more cognitive demand than talking, whereas hearing music is relatively continuous vestibular distraction.^[17] These studies only examined the behavioural effect of using smartphones which may result in accidents due to distractions.

Aims and Objective: The goal of this study was to see how using different smartphone functionalities while walking affected dynamic equilibrium. This will help to imply the risk of using a smartphone during ambulation.

Experimental Hypothesis: There is significant effect of multitasking using smartphone during gait on dynamic balance in college students.

Null Hypothesis: There is no significant effect of multitasking using smartphone during gait on dynamic balance in college students.

Methodology

Research Design- Cross sectional observational study

Inclusion Criteria:

1. Both males and females
2. Age group: 20-25 years.^[17]
3. Participants are using smartphone for at least 4 hours per week for the past 1 year.
4. Should understand verbal command/ English.
5. Normal vision or corrected with use of spectacles.

EXCLUSION Criteria: 1. History of vestibular problems. 2. History of reported dizziness. 3. Could not stand properly due to lower limb injury.

4. Any history or diagnosed case of neurological or psychiatric disorder which could affect outcome of study.

OUTCOME MEASURE: Score of TIMED UP and GO Test (TUG Score)

PROCEDURE: For this study, 75 female and 25 male participants without any symptoms were recruited from a local institute. The subjects were given a verbal description of the study's goal, as well as a demonstration of the test. Consent was also taken from all the subjects prior to study. The following test was performed:

TIMED UP and GO (TUG) test

1. Participants wear their usual footwear and if needed, may use mobility aid.
2. The participant first seat on a chair then stands up on researcher's command, walks for three meters, turn around, walk back and then sit on chair.
3. When the subject is seated once again, time is stopped.

Documentation of time taken was done in seconds with the help of a stopwatch. And the time recorded is the score given for this test.

Following four tasks were executed in total:

General Gait: to walk without any task; Task Gait 1: to walk while chatting through text; Task Gait 2: to walk while web surfing and hearing music and, Task Gait 3: to walk while playing an online multiplayer videogame. The participants used earphones for listening to music as well as while having conversation during games. After three repetitions of the tasks, the mean of the measured data

was analysed. The sequence of tasks was not done in systematic manner so that the learning effect can be avoided. Demonstration of the test was given. Before the competition of timed trial, a practice trial was also done.

Result

Data was analysed using t-test for paired variables as well as Karl Pearson's correlation constant which are used to discern the relationship among different variables of the study, followed by regression analysis to appraise the effects of multitasking using smartphone features on dynamic balance of the students with 20.0 version of SPSS. The significance level was chosen at $p < 0.05$.

The general characteristics of the participants were an age of 22.26 ± 0.27 years, a height of 169.28 ± 1.21 cm tall, and a weight of 63.31 ± 1.81 kg.

As shown in table 1, p-value was found to 0.001 which is significant i.e., there is significant effect of dual tasking using smartphone (texting messages) on dynamic balance. As shown in Table 2, p-value was found to 0.001 which is significant i.e., there is significant effect of dual tasking using smartphone (web surfing while listening music) on dynamic balance.

As shown in Table 3, p-value was found to 0.001 which is significant i.e., there is significant effect of dual tasking using smartphone (playing multiplayer videogames) on dynamic balance.

As shown in Table 4, level of significance was found to 0.01 as well as there is significant effect of dual tasking using smartphone (playing multiplayer videogames) on dynamic balance. Highly correlation relationship is seen between General Gait and Task 1; moderate correlation relationship is seen between General Gait and Task 2 whereas mild correlation relationship is seen between General Gait and Task 3.

Table 1: Paired T-test to show the comparison between General Gait and Task.

	Mean	Standard deviation	T-value	P-value
General Gait	7.8651	1.03969	13.399	.001
Task 1	9.2519	1.49303		

Table 2: Paired T-test to show the comparison between General Gait and Task 2.

	Mean	Standard deviation	T-value	P-value
General Gait	7.87	1.04	12.65	.001
Task 2	9.32	1.52		

Table 3: Paired T-test to show the comparison between General Gait and Task 3.

	Mean	Standard deviation	T-value	P-value
General Gait	7.8651	1.03969	20.966	.000
Task 3	10.5068	1.52217		

Table 4: Karl Pearson’s correlation to show correlation between different tasks.

	General Gait	Task 1	Task 2
Task 1	.721**		
Task 2	.654**	.935**	
Task 3	.572**	.859**	.882**

Sampling Size and Distribution

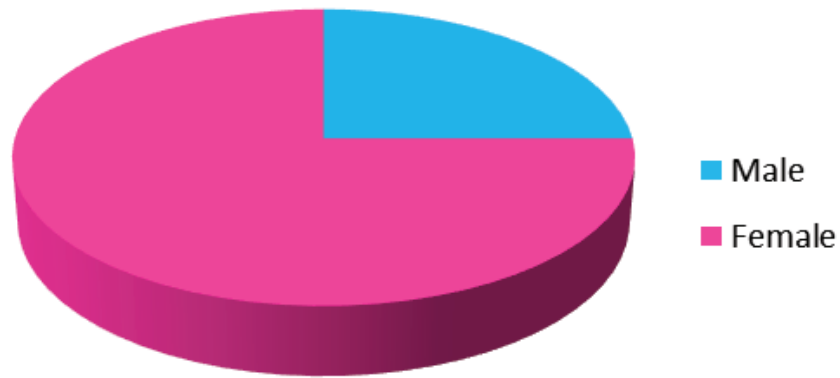


Figure 1: Sample size and distribution

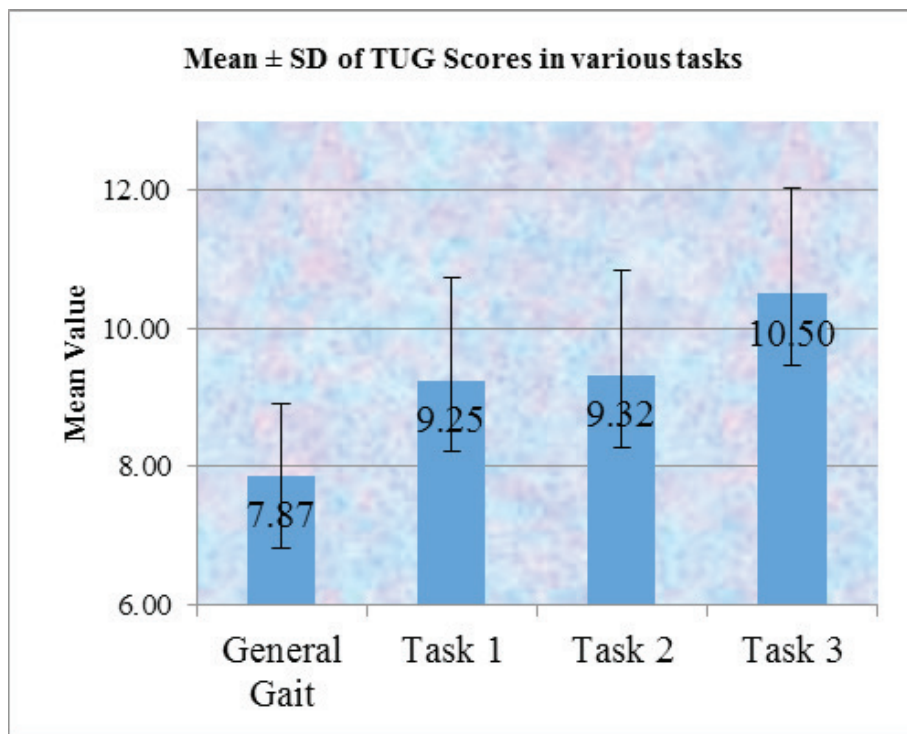


Figure 2: Comparison of Mean \pm SD of Timed Up and Go Score in various tasks performed in the study.

Discussion

The smartphone users are the highest among twenties, which is also the most significant for the research on balance. [17] Multitasking with different functions of the smartphone is quite common. Such multi-tasking activities reduce cognitive ability, affecting control of balance as well as posture. For control of posture and balance, visual and vestibular sensation, cognitive function, and the muscular system should work in an integrated manner. Therefore, in this study, we intended to look at the effects of multitasking using various smartphone features while walking on dynamic balance.

Measuring dynamic balance using the Timed Up and Go (TUG) test, the result showed that dynamic balance decreased as the gait time taken is longer for multi-tasking using smartphone features in proportion to single task where no mobile phone is being used during walking.

The outcomes of this research show that playing games decreased cognitive ability the most significantly, thus decreasing the dynamic balance the most among all the tasks performed. This was followed by internet browsing while hearing music and then sending a message which has the least impact on dynamic balance.

During the multitasking using smartphone during gait, as the tasks became more complicated sways increased which results in a longer gait time. These findings support In Hyong's research, which found that when using a mobile phone in a dual task situation, balance decreases in the anterior, posteromedial, and posterolateral directions because attention is required during simple tasks like listening to music and browsing the internet, but balance decreases significantly during more difficult tasks like writing a report and playing video games. [16] Likewise, Kim et al. while investigating the effect of using a smartphone

on obstacle gait found that the participants exhibited significant sway. [2] Also, gait velocity as well as cadence was decreased. [18-21] These results agreed with the results found in this study also.

Lacour et al. while examining found that generally there was no difficulty in balance and postural control doing any single task, but during a dual task, there was decrease in postural and balance control and the advanced cognitive task was given, the postural and balance control ability became more decreased. [22]

Physiologically, for balance control, there is need that there should be integrated communication between vestibular system as well as visual function and kinaesthesia in the cerebrospinal nervous system. [23] Different sensations already needed while walking; and if it is done along with using various smartphone features, visual and vestibular functions lack generally, thus sensory data necessary for general gait now dependent on superficial sensory perceptions and proprioception. [24] Hereby also confirmed that smartphone multitasking during gait decreases dynamic balance as there is need for compensation so that walking may be more stable. Thus, it results in reducing the walker's capability to distinguish or cope with potential challenges and risks in surrounding hence the chances of accidents increases during walking in outdoor area.

According to a study conducted Chen P. et al. in 2018 while investigating pedestrians in Taipei, Taiwan hearing music was the most connected with pedestrian smartphone misuse and inattentive deafness, whereas Pokémon Go (an augmented reality mobile game) was the most related with inattentive blindness and poor contextual awareness. [25] Thus, a person should avoid using mobile phone while walking. Using smartphone features while ambulating which may look easy, but it may be cause of accidents and injuries. So, executing a single task rather than using various features of mobile phone during gait is

a good way to prevent falls or injuries.

Clinical relevance: As it has been observed that multitasking using smartphone during gait while walking has a negative effect on dynamic balance. Therefore, the use of various smartphone functions while walking as well as on moving transport should be decreased.

Limitations of this study were as follows:

- As this study was intended on younger generation, the old people who are not much skilled in using mobile phone were excluded.
- Sample size is small.
- For tasks, not various complex functions of smartphones were given.
- It is necessary to research the use of multiple functions of smartphone during walking in various environments in the future as here experiment is done in normal environment.

Scope for future research:

- Study can be further divided based on gender.
- Study can be taken from other age groups.
- Study can involve various complex smartphone functions as tasks.

Conclusion

This study concluded that there was significant effect of multitasking using smartphone during gait on dynamic balance. Hence, the experimental hypothesis is accepted. Using smartphone features while walking affects dynamic balance of a person. So, using various features of a cell phone while ambulating may cause falls and injuries.

Conflicts of Interest: There are no financial conflicts of interest to disclose.

Source of Funding: The source of funding was self.

Ethical Clearance: Banarasidas Chandiwala Institute of Physiotherapy, New Delhi ethical committee approved this study. Human participants gave their informed consents.

Acknowledgements: With extreme gratitude, I wish to express my regards and sincere thanks to Officiating In-Charge Dr. Nidhi Kalra (PT) and my other professors at BCIP for their valuable guidance, for taking keen interest in this dissertation and timely assistance and suggestions. I am also thankful to all the subjects who volunteered to participate in this study.

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