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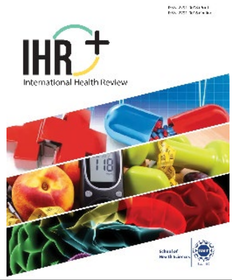

Title: **Gender Differences in Step and Stride Length Among Physiotherapy Students at Holy Family Hospital, Rawalpindi**

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Gender Differences in Step and Stride Length among Physiotherapy Students at Holy Family Hospital, Rawalpindi

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ABSTRACT

Notable gender dimorphism in anatomy shows effects that extend beyond morphology to functional dynamics. Gait, as a major locomotor activity, can demonstrate these differences, especially in such parameters as step length and stride length. To determine whether perceived differences are statistically significant, the current study aims to quantitatively investigate and compare these gait parameters in both male and female participants in order to determine their mutual variability. A group of 50 healthy undergraduate students (13 males and 37 females) was selected based on a pre-determined inclusion criteria. This study was conducted in the Physiotherapy Department of the Holy Family Hospital, Rawalpindi, Pakistan. A small setup was created within the department. The complete procedure and one familiarity trial were performed before the actual data collection. All the participants were told to walk a 10-meter marked distance at a self-paced, comfortable walk. The total number of steps taken from the start to the end point of the 10-meter track were carefully noted down, enabling the computation of the mean step length and stride length. The data was analysed with the help of IBM SPSS (version 17.0). The analysis showed a significant difference between the two groups. The mean step length taken by men was 27.39 ± 1.74 inches, which is larger as compared to the mean step length of women, that is, 25.80 ± 2.31 inches. Stride length also varied, with the mean length for men being 54.79 ± 3.49, as compared to women with the mean length of 51.61 ± 4.62. Further, independent samples t-test established statistically significant differences in both step and stride length ($p > 0.05$). These findings empirically support the notion that gender is an important predictor of gait dynamics. The male subjects were found to have a longer step and stride length when walking, as compared to their female counterparts, in this cohort. The results underline

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the need to include biological differences, causing gender differences in ergonomics, rehabilitation, and sports science.

Keywords: gait analysis, gender difference, step length, stride length, walking

1. INTRODUCTION

Human gait is a sophisticated, concurrently coordinated action. It is a form of bipedal movement that moves the center of mass forward in a rhythmic and alternating motion using limbs while consuming minimum energy [1]. The locomotor cycle, also known as the gait cycle, divides the movement into the stance phase (the period when the foot remains in contact with the ground) and the swing phase (the period when the limb moves forward). The smooth continuation of these phases creates one stride, which is the distance between successive heel strikes of the same foot. A step is the distance between heel strikes on opposite feet [2].

The dynamic alignment, cadence, base of support, and velocity of the gait pattern are several biomechanical parameters whose interrelationship allows to maintain a stable and efficient gait pattern. The stance time during the normal ambulation of the body represents about 60% of the total cycle, while swing time comprises 40% of the total cycle. The phases of double limb support in this cycle are essential to ensure stability. There is minimal vertical and horizontal movement of the body's centre of mass during this process. The balance is maintained as long as it does not fall out of the base of support of the individual [3]. Gait analysis has developed significantly from the basic forms of observation to employing complex devices, including force plates, electromyography, and motion capture devices that, in turn, generate more complex data of dynamics, kinetics, and muscular action [4].

In clinical practice, gait analysis cannot be ignored. Gait can be affected by a large number of factors, such as the physiological characteristics of a person, including their sex, age, and height, as well as pathological issues, such as musculoskeletal trauma and nervous disorders [5]. Differences in walking are observed because of the anatomical differences between men and women, for instance, they have varied ways of walking. These differences are caused by the differences in the width of the pelvis, the length of the limbs, and the distribution of muscle mass. As a rule, studies find men to have longer strides, while women are characterized by higher pelvic motion and a comparatively small step width [6].

Step and stride length are among the key measures of gait. According to the American College of Sports Medicine, the average length of the stride made by an average adult is around 62 inches, but this length depends on the anthropometry and the level of activity of a given person [7]. One of the most frequently used clinical techniques in determining stride length is to count the number of steps that one takes over a given distance and divide the total by two, thus giving a rough estimate of gait efficiency, as well as lower limb functioning.

Abnormalities are seen when the complex gait processes are impaired. Specific characteristics altering gait patterns, such as antalgic, ataxic, or festinating gaits, may be caused by various pathologies including arthritis, stroke, Parkinson's disease, or structural deformities [8]. Rehabilitation methods usually focus on these parameters. Visual or externally aided gait training, such as that of an individual with a neurological deficit, has been found to enhance the distance of the stride, speed, and motor control, giving support to the importance of gait analysis in diagnosing and informing therapeutic measures and assessing functional recovery [9].

The available literature depicts the impact of gender, age, and physique on gait parameters. Some studies indicate that women walk slower than men do at the same pace; however, it has been observed that women generally have a higher cadence and a shorter stride length as compared to men [10, 11]. According to one study, men tend to have a higher cadence, higher stride length, and a faster walking speed, whereas women have a shorter stride length [12]. These observations are indicative of inherent gender-based anatomical variations that could have an effect on lower-extremity biomechanics. Interestingly, a study says that the disparity in leg length in both gender might not be the major determinant of step length at normal walking speed, thus showing that other biomechanical factors could also be involved [13].

All these facts prove beyond a doubt that anatomical and biomechanical gender-specific factors have a great deal of influence on gait, such as determining step and stride length. Clinicians, researchers, and therapists engaged in assessment and rehabilitation have thus identified an understanding of these differences as being very important. In view of the above, the current research aims to identify and compare the average step and stride lengths among male and female subjects. Consequently, normative data is produced that could be directly used to inform and improve gait rehabilitation procedures.

2. METHODS

This descriptive and cross-sectional study was conducted in the Physiotherapy Department of the Holy Family Hospital, Rawalpindi, Pakistan. The duration of the study was 06 months (from March 2012 to August 20212). The ethical approval of the study was obtained from the Institute of Allied Health Sciences, Rawalpindi Medical College (Ref: AHS-RMC-9116). The sample participants were identified through purposive sampling approach. Using this approach, 50 undergraduate students of physiotherapy were recruited and their written informed consent was obtained. The sample size was not calculated because of various constraints.

The participants were required to be healthy, aged between 18 and 25 years, and with a height of 4 feet 7 inches to 5 feet 5 inches. The exclusion criteria comprised any leg-length inequality, a history of fracture of the lower extremity or pelvis, and any current neurological or musculoskeletal disorder. After describing the whole procedure, all the participants were asked to carry out a single familiarisation trial. During the actual measurement, the subjects were required to walk at their own natural pace over a 10-metre marked track. The total number of steps was carefully recorded to measure the average step and stride length of the participants.

IBM SPSS (version 17.0) was used to perform all the statistical analyses. The data were summarised using descriptive statistics, such as measures of central tendency and measures of dispersion. Normality was checked and independent sample t-test was applied, comparing the mean step and stride between gender. Then, statistical significance was evaluated at 95% confidence interval ($p < 0.05$).

3. RESULTS

The average age of the participants was 19.32 ± 1.72 years, with male subjects being (20.38 2.32 years) slightly older than female subjects (18.95 ± 1.29 years). The gender-wise distribution of the sample (50) is as follows: females (74% n=37) and males (26% n=13), as shown in Figure 1.

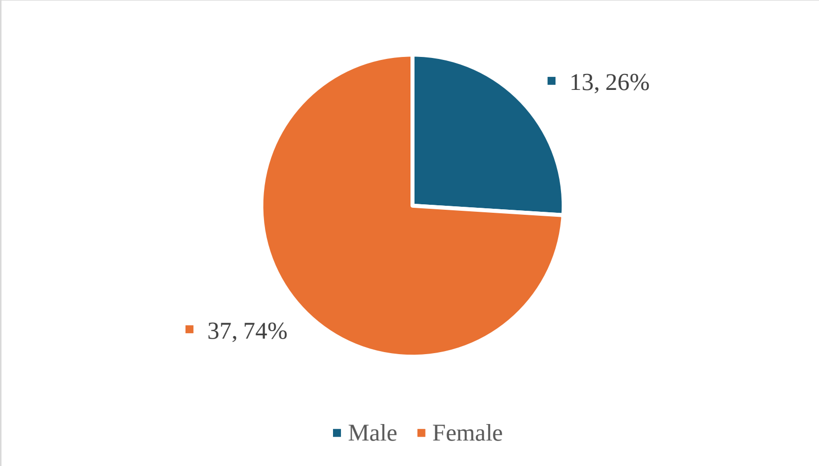

Figure 1. Pie Chart of Participants' Gender

The gait parameters of step and stride length were measured and compared between both gender. The average step length of male participants was 27.39 ± 1.74 inches and stride length was 54.79 ± 3.49. Whereas, the average step length of female participants was 25.81 ± 2.31 inches and stride length was 51.61 ± 4.62 inches, as shown in Table 1. This indicates that the gait cycles of males tend to be longer. Indeed, the step length of male participants was 1.58 inches longer and their stride length was 3.18 inches longer than female participants. This difference was tested for significance using independent samples t-test. The results revealed that both step and stride lengths of male participants were statistically significantly larger than female participants ($p < 0.05$). The t-test details are shown below in Table 2.

Table 1. Mean, Median, and Mode of Step and Stride Length (in inches)

Gender of the Participants		Stride Length in Inches	Step Length in Inches
Male	Mean	54.78	27.39
	Median	53.38	26.69
	Mode	26.69	53.39
	S.D.	3.49	1.74
Female	Mean	51.61	25.80
	Median	49.82	24.91
	Mode	24.91	49.83
	S.D.	4.62	2.31

Table 1. Independent Samples t-test for Step and Stride Length

Independent Samples Test	Gender	Mean	Sig. (2-tailed)	Mean Difference
Stride Length	Male	54.78	0.02	3.18
	Female	51.61		
Step Length	Male	27.39	0.02	1.58
	Female	25.80		

4. DISCUSSION

The current research proves that the step and stride length of male participants are statistically longer in comparison with the step and stride length of female participants. The specified tendency is supported by the existing body of literature regarding gender-specific differences in gait. It is best to attribute the noted differences to underlying anthropometric and biomechanical variations, such as greater stature, longer lower-limb length, and various kinematics about the joints that characterize males.

Earlier studies support this conclusion. A study that used BTS G Walk inertial sensors concluded that the absolute stride length that healthy adult males took was higher than that of females. Thus, it is understandable that their result aligns with our results [14]. This consistency in variations takes inherent anatomical determinants as one of the primary causes of gait variability. Another research found a direct relationship between an increase in limb length in men and significantly higher stride length [15], hence strengthening the physiological basis of the results available at present.

These observations are given context in available literature. It has been recorded that females often take the compensatory approach of taking more steps as compared to males in an attempt to maintain the same walking speed, which is due to their shorter step length [10]. Furthermore, it has been reported that both gender have different kinematic profiles. Males always exhibit gait traits characterized by a higher speed, increased stride length, and a lower step count pattern, strongly unlike those of females [16]. Gait also changes as circumstances change. If an external load is carried, it results in a reduced stride and swing time in females, which is also accompanied by an increase in stride rate and periods of double limb support. This pattern can be attributed to decreased muscle strength in females [17].

Elina et al in 2025 conducted a study on inertial sensor gait analysis employing the BTS G-Walk system on healthy participants. They found that males had longer absolutes strides than females. This conclusion further supported the idea that sex difference can be identified even in wearable-based evaluation and typical walking circumstances [18].

Furthermore, a study was conducted by KWON et al in 2025 on walking speed difference between male and female participants. The results of the study are aligned with our results, indicating that leg length and stature are major determinants of stride length. In this study, when walking performance was interpreted relative to the anthropometric characteristics, females demonstrated gait strategies that resulted in comparable longer normalized stride length, suggesting absolute differences as also observed in the current study [19].

In addition, several studies reported that females often show higher cadence as a compensatory mechanism to maintain their walking speed despite shorter step length, which contextualizes why similar speeds can be achieved with different spatial parameters. A gait parameter comparison in healthy adults found that males commonly show greater stride length and longer swing/single-support phases, whereas females tend to display higher cadence and relatively greater stance/double-support components, supporting the broader pattern described in the current findings. This cadence-stride trade-off is consistent with the general principle that walking speed can be achieved through different combinations of step length and step frequency [20].

4.1. Conclusion

The current study provides irrefutable evidence that the variables of gait parameters, that is, step and stride length, are significantly different in healthy young adult males and females in elementary stages, which appears to be in accordance with their basic anatomical differences. The descriptive metrics obtained in this study provide practitioners and researchers with reference values to be used in clinical gait measurement in comparative studies. Moreover, even though the measurement plan was rather convenient in a clinical setting, its predisposition to insignificant errors requires follow up studies that apply more sophisticated techniques, such as motion-capture technology, to improve measurement accuracy and provide more detailed biomechanical information.

4.2. Recommendations

Even though the cohort included more female participants, statistically significant results support the existence of gender-based differences. Hence, future work should be better generalized with a more equal representation of the sample in terms of gender. Gait speed should also be measured in order to have a more comprehensive notion about gender-based changes. The study, therefore, highly recommends the need to integrate these gender-specific differences in clinical rehabilitation models and research design in order to ensure that therapeutic interventions are aimed at restoring a physiologically normative gait pattern.

4.3. Limitations

- Sample size was not calculated as per the criteria set by STROBE guidelines.
- Step length was calculated using a very basic approach (Total Distance / Number of Steps taken), which lead to inaccurate measurement for right and left steps and strides.
- No other gait parameters were measured, such as speed and velocity.
- Due to the participants' awareness about them being observed, the possibility of cosmetic gait cannot be excluded, as they might have walked at a different pace and not at their actual pace.

Author Contribution

Syed Ali Hussain: conceptualization, writing - original draft, project administration. **Rabia Afzal:** formal analysis, writing - review & editing. **Samina Batool:** methodology, validation, investigation. **Nouman Khan:** formal analysis. **Esha Khan:** data curation. **Amer Dawood Salman:** visualization, writing - review & editing.

Conflict of Interest

The authors of the manuscript have no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

Data Availability Statement

Data supporting the findings of this study will be made available by the corresponding author upon request.

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The authors did not used any type of generative artificial intelligence software for this research.

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