



## Original Research Article

## Influence of profession on Gait Pattern and it's analysis

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## ABSTRACT

Gait is, quite simply, the pattern of how a person walks. These gait parameters vary due to age, weight, height and the duration of a mode of work stress on the individual. Gait pattern is used to identify the individuals with the help of anthropological adoptions of the individual. The present study, it is a standardized pattern of collection and with the purpose of compression of gait patterns among two different occupations. In this present study different occupations like officials and labours are taken as subjects of sampling. And samples are in number of 30 each, and were observed under 7 parameters.

From these parameters we get to know that the subject with different occupation will change the gait parameters such as stride length and step length shorten while the stride width widens to achieve postural stability and kinematic adaption. There is a significant difference in mean value and value of gait parameters across the different occupation for the angle of left shoe print, the distance between left to right and right to left shoe step and gait base in both the occupations. It appeared that the occupational stress of different mode of occupations would change the orientation of the lower extremity segments with particular changes occurring at the ankle and knee due to which to maintain balance smaller steps taken by the subject.

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## 1. Introduction

Gait recognition is the manner of figuring out a character by means of the manner in which they stroll. Gait created throughout the years as a people grow up and it fluctuates essentially. Due to the associated impacts of heredity, way of life, and climatic variable.<sup>1</sup> There are different components which influence the gait design in human, for example, outward: footwear garments; There are different components which influence the gait design in human, for example, outward: footwear garments; At the point when the individual walk on a surface the impressions of the foot abandoned whether unmistakable (patent) or unnoticeable (inert) formed while entering or getting away. A more critical check out our condition demonstrates that its use among females is winding up progressively normal, the obeyed shoes are getting higher and rest in the foot, footwear and associated stamps as the lucidity of individual

imprints isn't so significant in stride example examines, it is the utilization of high obeyed footwear. To assess the walking example realized that at any rate 3 to 4 sequential foot or footwear imprints are required. Human gait refers to locomotion achieved through the movement of human limbs. Human gait is defined as bipedal, biphasic forward propulsion of centre of gravity of the human body, in which there are alternate sinuous movements of different segments of the body with least expenditure of energy.

There are many current techniques to understand someone who incorporates an inertial sensor primarily based on gait together with identification by way of gait patterns<sup>1,2</sup> or verification by means of gait patterns,<sup>3-8</sup> which showed the promising applications of the inertial sensor for gait-based recognition. Because the human gait is a periodic motion, a large wide variety of gait reputation strategies hit upon periods<sup>1,2,5-7,9</sup> for constructing gait patterns. Some researchers employ version-based methods,<sup>10,11</sup> in which gait signal has modelled the use of a finite state machine. Different gait patterns are characterized by

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differences in limb movement patterns, overall velocity, forces, kinetic and potential energy cycles, and changes in the contact with the surface (ground, floor, etc.). Human gaits are the various ways in which a human can move, either naturally or as a result of specialized training.<sup>12</sup>

### 1.1. Footprints are produced under the following circumstances

1. The impressions of the foot may be because in mud, dust, sand, and snow or like substances. Such impressions will be depressed or three-dimensional type and referred to as sunken foot impressions. There are gender differences in human gait patterns: females tend to walk with smaller step width and more pelvic movement. Gait analysis generally considers gender. Gender differences in human gait can be explored using a demonstration created by the Biomotion Laboratory at Queen's University, Kingston, Canada.<sup>1,12</sup>

## 2. Natural gait pattern

The so-called natural gaits, in increasing order of speed, are the walk, jog, skip, run, and sprint. While other intermediate speed gaits may occur naturally to some people, these five basic gaits occur naturally across almost all cultures. All-natural gaits designed to propel a person forward, but can also be adapted for lateral movement. As natural gaits all have the same purpose, they mostly distinguished by when the leg muscles used during the gait cycle.<sup>13</sup>

## 3. Children Gait Pattern

By the age of three, most children have mastered the basic principles of walking, consistent with that of adults. Age is not the only deciding factor in gait development. Girls tend to have a more stable gait than boys between the ages of 3–6 years old. Girls showed a smaller contact area in plantar loading patterns than boys in children with healthy feet.<sup>14</sup>

## 4. Abnormal Gait Pattern

Abnormal gait is a result of one or more of these tracts being disturbed. The most prominent example of gait irregularities due to developmental problems comes from studies of children on the autism spectrum. They have decreased muscle coordination, thus resulting in abnormalities in gait. The most prominent example of abnormal gait as a result of neurodegeneration is Parkinson's.<sup>15</sup>

Walking pattern is highly individualistic. Step length of an adult woman is between 25–28 inches. The length of a footprint is not always suggestive of the person's height, but generally, a longer footprint says, 10–12 inches and a step length exceeding 30 inches may suggest it to be that of a tall person (near about 5'–10" to 6 feet in height). A short person will not only have a smaller foot (say, 6 to 8 inches in length) but would also register a shorter step length.<sup>15,16</sup>

## 5. Other deductions from Gait pattern

Age of the person: It may be possible to know whether the track marks left are of a young or old person. A young person may show twisting action of the toes and the ball of the foot. Marks of the stick may also be found by the side of the foot impressions.<sup>17</sup> The gender: Step length of an adult woman is between 25–28 inches. Some Indian women wear rings on the toes, and if they walk barefooted are likely to leave their marks.<sup>17</sup>

The Height of the person: The length of a footprint is not always suggestive of the person's height, but generally a longer footprint say, 10–12 inches and a step length exceeding 30 inches may suggest it to be that of a tall person (near about 5'–10" to 6 feet in height). A short person will not only have a smaller foot (say, 6 to 8 inches in length) but would also register a shorter step length. Thus, a step length of about 20 or 24 inches with a foot whose length is about 6 to 8 inches suggest a person who is not more than 5'–3" or 5'–4" in height. Analysis indicates a quick estimate of height may be made by presuming foot length to be 15.346% in men, 14.926% in women. The height of a man with a foot length of 28 cm would be estimated as 28 divided by .15346 = 182.5 cm. Likewise, a woman's foot length of 9 inches would be calculated in a similar manner, 9 divided by .14926 = 60.29 inch. A single sequence of functions of one limb is called a gait cycle. It is essentially the functional unit of gait. The gait cycle has two basic components, the swing phase and the stance phase:<sup>15,16</sup>

1. Stance: phase in which the limb is in contact with the ground
2. Swing: phase in which the foot is in the air for limb advancement.

### 5.1. Gait cycle also referred to as a stride

Stride (Stride length): Linear distance between corresponding successive points of contact of the same foot (e.g., the distance measured from heel strike to heel strike of the same foot)

Step (Step Length): Linear distance in the plane of progression between corresponding successive contact points of opposite feet (e.g., the distance measured from heel strike of one foot to heel strike of the other foot). Normally, the step length is approximately 15–20 inches.<sup>12,18</sup>

## 6. Materials and Methods

Total 30 number of officials and 30 number of labours foot patterns were collected at Chandigarh university.

### 6.1. Method of collection of data

The study was conducted in Chandigarh university. The period of study was from September 2018 to February 2019.

**Table 1:** Independent sample t-test comparison of GAIT pattern analysis between official and labor males of the study showed the various parameters, which are extremely significant except the angle of right shoe print, distance b/w left-to-left print and distance b/w right to right print.

Parameters	Subject	N	Mean	Std. Deviation	Std. error mean	t-stat	p-value	Significance
Angle of right shoe print in degree	Official Male	30	13.80	3.93	.7166	4.037	0.000	Not significant
	Laborer Male	30	25.01	14.70	2.6833			
Angle of left shoe print in degree	Official Male	30	14.27	3.97	.72545	2.676	0.010	Extremely Significant
	Laborer Male	30	19.15	9.17	1.67441			
Distance b/w left to left print in cms	Official Male	30	104.38	14.05	2.56538	4.324	0.000	Not significant
	Laborer Male	30	80.61	26.63	4.86157			
Distance b/w right to right print in cms	Official Male	30	103.33	14.55	2.6559	4.416	0.000	Not significant
	Laborer Male	30	79.10	26.31	4.8026			
Left to right in cms	Official Male	30	50.83	7.76	1.41672	2.763	0.008	Extremely significant
	Laborer Male	30	41.86	16.02	2.92404			
Right to left in cms	Official Male	30	51.13	8.28	1.51220	1.295	0.200	Extremely significant
	Laborer Male	30	44.54	26.63	4.86234			
Base in cms	Official Male	30	8.67	10.00	1.82658	1.352	0.182	Extremely significant
	Laborer Male	30	6.06	3.45	0.63041			

P-value <0.05 is considered a significant difference between official and labourer males.

**Table 2:**

Source of variation	SS	Df	MS	F	p-value
Between groups	10180	4	2545	19.76	0.0029
Within groups	644.2	5	128.8		
Total	10,824.2	9	2673.8		

One-way analysis of variance P value is 0.0029



**Fig. 1:** Showing muddy prints. <https://www.capetownetc.com/wp-content/uploads/2019/03/bay.jpg>



**Fig. 2:** Bloody prints. <https://userscontent2.emaze.com/images/6a19b41d-d645-4dad-a0c3-5297768aa167/4ce80470eb9115a633a34a920f4a9bbc.jpg>

The objectives and the methods of the study was explained to the sample population. All the measurements were taken in a reasonably well place, at a fixed time between 9.00 a.m. to 5.30.p.m. to eliminate diurnal variation. It was measured and recorded only by me, to avoid inter observer error in methodology.

It is a modified method of foot patterns. Total 30 number of officials and 30 number of labours foot patterns were collected. The measurements from Right foot to the right foot and left foot to left foot measured through measuring tape. The Base of gait measured from the centre of right

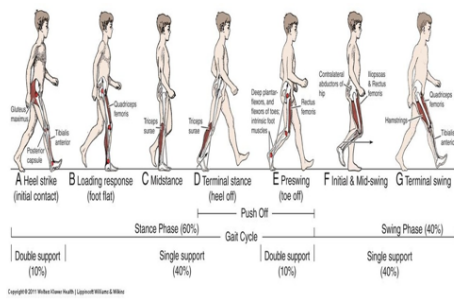
and left a footprint. The angle of the left foot and right foot measured through protractor.

#### 6.1.1. Anthropometric Measurements

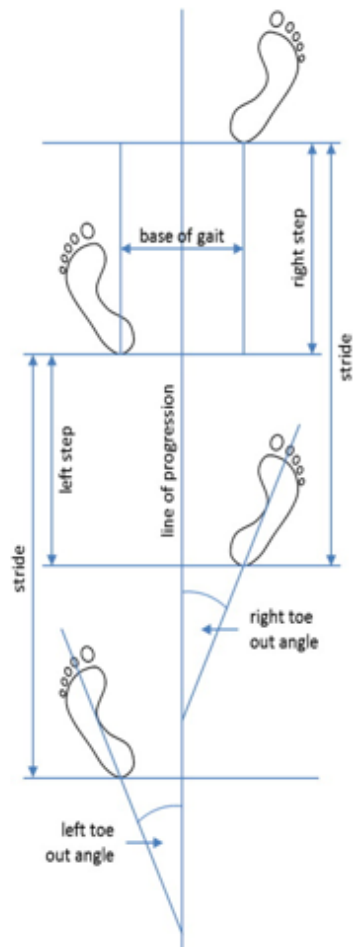
1. Angle of right shoe print in degree
2. Angle of left shoe print in degree
3. Distance between left to left prints in cms
4. Distance between right to right print in cms
5. Right to left in cms
6. Base in cms

Table 3:

	Levene's Test for Equality of Variances		t-Test for Equality of Means		Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
	F	Sig.	T	Df			Sig. (2-tailed)	Lower
Angle Of Right Shoe Print In Degree	21.638	.000	-4.037	58	-11.2133	2.7774	-16.7729	-5.6538
			4.037	33.116	-11.2133	2.7774	-16.8632	-5.5635
Angle Of Left Shoe Print In Degree	30.597	.000	2.676	58	-4.88333	1.82481	-8.53609	-1.23058
			2.676	39.517	-4.88333	1.82481	-8.57282	-1.19385
Distance B/W Left To Left Print In CMs	20.025	.000	4.324	58	23.77000	5.49692	12.76673	34.77327
			4.324	43.988	23.77000	5.49692	12.69161	34.84839
Distance B/W Right To Right Print In CMs	22.091	.000	4.416	58	24.2333	5.4881	13.2478	35.2189
			4.416	45.220	24.2333	5.4881	13.1813	35.2854
Left To Right In CMs	11.843	.001	2.763	58	8.97667	3.24917	2.47274	15.48059
			2.763	41.904	8.97667	3.24917	2.41913	15.53421
Right To Left In CMs	13.226	.001	1.295	58	6.59667	5.09206	-3.59620	16.789540
			1.295	34.558	6.59667	5.09206	-3.74550	16.93883
Base In CMs	.666	.418	1.352	58	2.61167	1.93231	-1.25627	6.47960
			1.352	35.812	2.61167	1.93231	-1.30795	6.53129



**Fig. 3:** Gait Cycle [http://chiropractornorthshore.com/wp-content/uploads/2015/01/chiropractornorthshore\\_giant-cycle.jpg](http://chiropractornorthshore.com/wp-content/uploads/2015/01/chiropractornorthshore_giant-cycle.jpg)



**Fig. 4:** Phase of gait pattern. <https://ars.els-cdn.com/content/image/1-s2.0-S1355030615000349-gr2.jpg>



**Fig. 5:** a. official male shoe print, b : official male shoe print, c : labour male shoe print, d : labour male shoe print

### 6.2. Land Marks and Technique involved in Taking Anthropometric Measurements

It was measured as after collecting axial line was drawn to the centre of the sample sheet. Distance from left to right, right to left measured by measuring tape. Angle of right and angle of left and base of the gait is collected by the central of end points of the heels. Angle of gait is measured by markings of shoe print starting and ending points which is centric print then a line is drawn from tip to end which is connecting to the axis point, which is then measured by protractor.

6.3. Sample taken at the time of sampling and were measured under above parameter are shown in the figure are as follows

### 7. Result and Discussion

The present study carried out to know whether there is any change in the gait pattern in correlation with the occupation. In the given study, statistical analysis carried out for the gait pattern collected from 60 subject(male) of two different occupations and observations are as follow:

The mean, standard deviation, variance, coefficient of variance, t-stat and difference of angle of left and right shoe print, left –left shoe print distance, right to right shoe print distance, right to left and left to right shoe print distance and distance of base of the gait pattern in total subjects are shown in the above table 3 showing the statistical comparative difference between angle of left shoe print ,distance of left to right, distance of right to left and distance of base. And the angle of right shoe print, distance b/w left to left print and distance b/w right to right prints while there is no statistically significant difference in the comparative study of gait patterns of officials and labours males.

Therefore, angle of right shoe print, distance b/w left to left print and distance b/w right to right prints cannot be considered as useful parameters for the comparison between different occupations as officials and labours male’s gait patterns.

Table analysed Data on five parameters excluding angle.

### 7.1. ANOVA

The above table showing compression of all the parameters between two methods Levine's Test for Equality of Variances and t-test for Equality of Means with independent analysis test.

Since there is no study available on gait pattern analysis in correlation with the occupation. The present study also compared with previous findings having different parameters. The similar kind of work done on gait pattern with the parameter of different footwear, gender and motion etc Kobayashi Y (2016) worked on age-independent and age-dependent sex differences in gait pattern determined by principal component analysis. They analysed sex and age interaction in gait pattern during normal waking, where they noticed that sex difference in pelvic sagittal and frontal motion vary with age and phase difference in pelvic frontal angle motion between sexes do not vary with age.<sup>19</sup>

Johnson and Tassinary (2005) worked on perceived sex, directly and indirectly, they employed on a novel technique to explore the body's motion and morphology affect judgments of sex and gender. They worked on the targeted scanning method to assess the sex difference with respect to motion.<sup>20</sup> Since there is no work done in this present study this study is significant and it can be used in the forensic investigation.

They compared both men and women samples (120) as per their speed and observed that women swing the arm more than men and women attentive acceleration from the pelvis to the head more than men.<sup>21</sup> Since there is no work done in this present study this study is significant and it can be used in the forensic investigation.

H.H. MERIFIELD et al. (2007) studied on compression of walking of women in different footwear like flat shoe and high heels and observed that the compression of flat shoe with respect to the high heels there is a significant decrease in the step length and stride length, where there was minimal change in the stride width and foot angle. Since there is no work done in this present study this study is significant and it can be used in the forensic investigation and also for personal identification.

Sumith, Ielas et al. (2002) they worked on the gender differences in pelvic motions and center of mass displacement during walking: stereotypes quantified and found the statistical difference in men and women.<sup>22</sup> Since there is no work done in this present study this study is significant and it can be used in the forensic investigation and also for the personal identification.

### 8. Conclusion

This study showed that the type of occupations does affect the gait pattern in the male. These gait parameters vary due to age, weight, height and the duration of the mode of work stress on the individual. From all the observations (tables, charts and figures) analysis and discussions, the conclusion

drawn that as the subject with different occupation will change the gait parameters such as stride length and step length shorten while the stride width widens to achieve postural stability and kinematic adaptation. There is a significant difference in mean value and value of gait parameters across the different occupation for the angle of left shoe print, the distance between left to right and right to left shoe step and gait base in both the occupations. It appeared that the occupational stress of different mode of occupations would change the orientation of the lower extremity segments with particular changes occurring at the ankle and knee due to which to maintain balance smaller steps taken by the subject.

### 9. Source of Funding

None.

### 10. Conflict of Interest

None.

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