A Study on Footprint Dimensions Between Sports and Non-Sports Category in Mangaluru Students Population

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Abstract

Foot Print evidence is a type of circumstantial evidence mainly found at outdoor crime scene that can link a perpetrator to a crime. The valid foot print impression is based on the fact that it differs from person to person. A foot print taken in a controlled environment and a foot print at the scene of crime cannot be easily compared. Since crime scene prints are hardly ever complete, experts are then given the task of matching a partial footprint to one that is taken in a control environment. Most of the matching is done in order to compare and existing foot print to a partial print found at the crime scene is based on guess work. In case of sports persons, as they play, the footprint dimensions may change compared to non-sports. To check that difference on dimensions we have conducted this study. The study can help investigating officer to shortlist the suspects by comparing the footprint dimensions.

Keywords: Footprint dimensions; Crime scene; Suspects

Introduction

Footprints are the images or the impressions left behind by a person walking or running. Hoof prints and paw prints are those left by animals with hooves or paws rather than feet, while shoeprints are the specific term for prints made by shoes. They may be indentations in the ground or something placed on to the surface that was stuck to the bottom of the foot. A track way is a set of footprints in soft earth left by human or animals. Footprints can be followed while tracking during a hunt or can provide evidence of other activities. Some footprints remain unexplained, for other several factors [1].

The print left behind at a crime scene gives important evidence to the perpetrator of the crime. Shoes may have different prints based on the sole design and the wear that it has received this helps to identify the suspects. Photographs or castings of footprints can be taken to preserve the finding. Analysis of footprints and shoeprints is important in forensic science [2].

The methods used to collect foot prints include photography, tracing, lifting and casting. All prints and impressions should be photographed before attempting any other method. While taking the photographs keep the lens of the camera parallel to the surface on which the print is found. Set the shutter at the smallest permissible f-stop in order to obtain the greatest depth of the field. A lash should be used even in sun light so the details are clearly defined. Place a ruler along the length of the print. Identification details such as date, case number signature of the investigator, the witnesses may be written on a piece of paper and placed near by the print. [2]

Materials Required

- Color powder(red)
- Water
- Plastic plate
- A3 White paper sheets
- Measuring scale and protractor
- Writing materials

Methodology

The study population consisted of 50 Non sports persons and 50 sports persons belonging to a random student population in Mangaluru City, Dakshina Kannada district from the age group of 18-25 years. Footprints were collected from them using red powder, and the total number of prints obtained and their varied dimensions were statistically represented. All Samples were collected on voluntary Basis. Consent form was issued.

The following parameters were considered:

- Foot Length
- Foot Breadth
- Foot Angle

Foot length

The distance between the second toe to the heel of the foot.

Foot breadth

The maximum horizontal breadth, wherever found, across the foot perpendicular to the long axis.

Foot angle

The angle between second toe and the ball of the foot.

Objectives and Procedure

To determine whether there is a difference between the footprint dimensions among Sports and Non-Sports persons. After issuing a consent form the Researchers requested the subjects to clean their legs and later started to record the Footprints. The footprint was obtained

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by making the subjects to place their feet on the red paste obtained by mixing red powder in water and immediately made them to place their feet on A3 sheet and was eventually pressed. Then the subjects were asked to clean their legs. After drying the prints, the prints were measured by using the scale and protractor foot length, breadth and foot angle (Figure 1).

Profiling

Height and foot length

From Table 1 it can be observed that out of 50, the maximum number of impressions (28) whose height falls between 169-178 cm out of which 10 prints are of length 23.2-24.2 cm and minimum 6 impressions whose height falls between 149-158 cm and their foot length is between 24.2-26.2 cm.

Out of 50 impressions maximum number of foot length impression is 18 whose Foot length is between 23.2-24.2 cm and minimum is between 20.2-22.2 cm.

From Table 2 it can be observed that out of 50, the maximum number of impressions (22) whose height falls between 169-178 cm in which 9 prints are of length 24.2-25.2 cm and minimum is 8 impressions whose height falls between 159-168 cm and their foot length is between 22.2-26.2 cm.
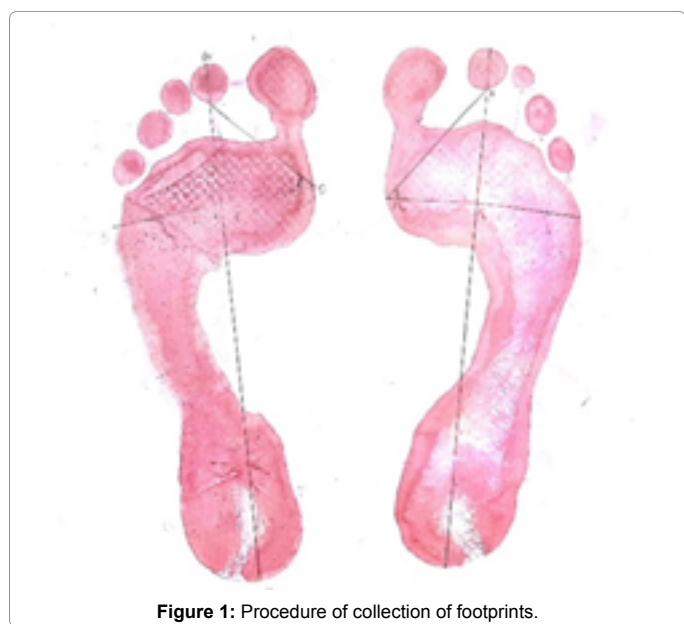

Figure 1: Procedure of collection of footprints.

HEIGHT (CM)	149-158	159-168	169-178	179-188	GRAND TOTAL
FOOT LENGTH (CM)					
20.2-21.2	-	-	1	-	1
21.2-22.2	-	-	1	-	1
22.2-23.2	-	3	-	-	3
23.2-24.2	4	2	10	2	18
24.2-25.2	1	2	6	1	10
25.2-26.2	1	1	6	5	13
26.2-27.2	-	-	2	-	2
27.2-28.2	-	-	2	-	2
GRAND TOTAL	6	8	28	8	50

Table 1: Non-sports-male.

HEIGHT (CM)	159-168	169-178	179-188	GRAND TOTAL
FOOT LENGTH (CM)				
22.2-23.2	2	-	-	2
23.2-24.2	2	4	-	6
24.2-25.2	2	9	3	14
25.2-26.2	2	6	9	17
26.2-27.2	-	3	5	8
27.2-28.2	-	-	3	3
GRAND TOTAL	8	22	20	50

Table 2: Sports-male.

Out of 50 impressions maximum number of foot length impression is 17 whose Foot length is between 25.2-26.2 cm and minimum is between 22.2-23.2 cm.

From Table 3 it can be observed that out of 50, the maximum number of impressions (30) whose height falls between 149-158 cm in which 15 prints are of length 22.2-23.2 cm and minimum is 10 impressions whose height falls between 159-178 cm and their foot length is between 22.2-24.2 cm.

Out of 50 impressions maximum number of foot length impression is 23 whose Foot length is between 22.2-23.2 cm and minimum is between 24.2-26.2 cm.

From Table 4 it can be observed that out of 50, the maximum number of impressions (22) whose height falls between 149-158 cm in which 8 prints are of length 21.2-22.2 cm and minimum is 10 impressions whose height falls between 169-178 cm and their foot length is between 23.2-24.2 cm.

Out of 50 impressions maximum number of foot length impression is 12 whose Foot length is between 22.2-23.2 cm and 24.2-25.2 cm respectively and minimum is between 25.2-26.2 cm.

Height and foot breadth

From Table 5 it can be observed that out of 50, the maximum number of impressions (28) whose height falls between 169-178 cm in which 17 prints are of breadth 9.2-10.2 cm and minimum is 6 impressions whose height falls between 149-158 cm and their foot breadth is between 9.2-10.2 cm.

Out of 50 impressions maximum number of foot breadth impression is 28 whose Foot breadth is between 9.2-10.2 cm and minimum is between 8.2-9.2 cm.

From Table 6 it can be observed that out of 50, the maximum number of impressions (22) whose height falls between 169-178 cm in which 11 prints are of breadth 9.2-10.2 cm and minimum is 8 impressions whose height falls between 159-168 cm and their foot breadth is between 8.2-10.2 cm.

Out of 50 impressions maximum number of foot breadth impression is 23 whose Foot breadth is between 9.2-10.2 cm and minimum is between 8.2-9.2 cm.

From Table 7 it can be observed that out of 50, the maximum number of impressions (30) whose height falls between 149-158 cm in which 21 prints are of breadth 8.2-9.2 cm and minimum is 20 impressions whose height falls between 159-178 cm and their foot breadth is between 8.2-9.2 cm.

Out of 50 impressions maximum number of foot breadth impression is 31 whose Foot breadth is between 8.2-9.2 cm and minimum is

HEIGHT (CM)	149-158	159-168	169-178	GRAND TOTAL
FOOT LENGTH (CM)				
20.2-21.2	1	-	-	1
21.2-22.2	12	-	-	12
22.2-23.2	15	5	3	23
23.2-24.2	2	5	3	10
24.2-25.2	-	-	2	2
25.2-26.2	-	-	2	2
GRAND TOTAL	30	10	10	50

Table 3: Non-sports-female.

HEIGHT (CM)	149-158	159-168	169-178	GRAND TOTAL
FOOT LENGTH (CM)				
20.2-21.2	4	-	-	4
21.2-22.2	8	1	-	9
22.2-23.2	6	5	1	12
23.2-24.2	2	3	5	10
24.2-25.2	1	7	4	12
25.2-26.2	1	2	-	3
GRAND TOTAL	22	18	10	50

Table 4: Sports-female.

HEIGHT (CM)	149-158	159-168	169-178	179-188	Grand Total
FOOT BREADTH (CM)					
8.2-9.2	1	2	4	-	7
9.2-10.2	3	3	17	5	28
10.2-11.2	2	3	7	3	15
Grand Total	6	8	28	8	50

Table 5: Non-sports-male.

HEIGHT (CM)	159-168	169-178	179-188	Grand Total
FOOT BREADTH (CM)				
8.2-9.2	3	2	-	5
9.2-10.2	3	11	9	23
10.2-11.2	2	9	11	22
Grand Total	8	22	20	50

Table 6: Sports-male.

HEIGHT (CM)	149-158	159-168	169-178	Grand Total
FOOT BREADTH (CM)				
7.2-8.2	4	-	3	7
8.2-9.2	21	7	3	31
9.2-10.2	5	3	4	12
Grand Total	30	10	10	50

Table 7: Non-sports-female.

between 7.2-8.2 cm.

From Table 8 it can be observed that out of 50, the maximum number of impressions (22) whose height falls between 149-158 cm in which 18 prints are of breadth 8.2-9.2 cm and minimum is 10 impressions whose height falls between 169-178 cm and their foot breadth is between 9.2-10.2 cm.

HEIGHT (CM)	149-158	159-168	169-178	Grand Total
FOOT BREADTH (CM)				
7.2-8.2	-	1	-	1
8.2-9.2	18	2	2	22
9.2-10.2	4	13	6	23
10.2-11.2	-	2	2	4
Grand Total	22	18	10	50

Table 8: Sports-female.

HEIGHT (CM)	149-158	159-168	169-178	179-188	Grand Total
FOOT ANGLE (°)					
51-53	-	-	3	-	3
54-56	-	1	4	-	5
57-59	-	1	-	1	2
60-62	4	4	8	-	16
63-65	-	1	4	3	8
66-68	-	1	4	3	8
69-71	2	-	3	1	6
72-74	-	-	2	-	2
Grand Total	6	8	28	8	50

Table 9: Non-sports-male.

Out of 50 impressions maximum number of foot breadth impression is 23 whose Foot breadth is between 9.2-10.2 cm and minimum is between 7.2-8.2 cm.

Height and foot angle

From Table 9 it can be observed that out of 50, the maximum number of impressions (28) whose height falls between 169-178 cm in which 8 prints are of foot angle 60°-62° and minimum is 6 impressions whose height falls between 149-158 cm and their foot angle is between 60°-62°.

Out of 50 impressions maximum number of foot angle impressions are 16 who's Foot angle is between 60°-62° and minimum is between 57°-59° and 72°-74° respectively.

From Table 10 it can be observed that out of 50, the maximum number of impressions (22) whose height falls between 169-178 cm in which 8 prints are of foot angle 63°-65° and minimum is 8 impressions whose height falls between 159-168 cm and their foot angle is between 54°-56°.

Out of 50 impressions maximum number of foot angle impressions is 13 who's Foot angle is between 66°-68° and minimum is between 72°-74°.

From Table 11 it can be observed that out of 50, the maximum number of impressions (30) whose height falls between 149-158 cm in which 8 prints are of foot angle 63°-65° and minimum is 20 impressions whose height falls between 159-178 cm and their foot angle is between 60°-62°.

Out of 50 impressions maximum number of foot angle impressions is 13 who's Foot angle is between 60°-62° and minimum is between 72°-74°.

From Table 12 it can be observed that out of 50, the maximum number of impressions (22) whose height falls between 149-158 cm in which 5 prints are of foot angle 51°-53° and minimum is 10 impressions whose height falls between 169-178 cm and their foot angle is between 63°-65°.

HEIGHT (CM)	159-168	169-178	179-188	Grand Total
FOOT ANGLE (°)				
51-53	1	1	-	2
54-56	3	-	1	4
57-59	2	2	4	8
60-62	1	3	3	7
63-65	-	8	4	12
66-68	1	6	6	13
69-71	-	2	1	3
72-74	-	-	1	1
Grand Total	8	22	20	50

Table 10: Sports-male.

HEIGHT (CM)	149-158	159-168	169-178	Grand Total
FOOT ANGLE (°)				
51-53	3	1	-	4
54-56	5	1	1	7
57-59	4	2	1	7
60-62	7	4	2	13
63-65	8	2	1	11
66-68	1	-	2	3
69-71	2	-	2	4
72-74	-	-	1	1
Grand Total	30	10	10	50

Table 11: Non-sports-female.

HEIGHT (CM)	149-158	159-168	169-178	Grand Total
FOOT ANGLE (°)				
51-53	5	1	-	6
54-56	4	5	1	10
57-59	4	4	2	10
60-62	3	2	-	5
63-65	3	2	4	9
66-68	2	3	1	6
69-71	-	1	1	2
72-74	-	-	1	1
75-77	1	-	-	1
Grand Total	22	18	10	50

Table 12: Sports-female.

Out of 50 impressions maximum number of foot angle impressions is 20 who's Foot angle is between 54º-59º and minimum is between 72º-77º.

Analysis and Results

Comparison between non-sports and sports persons

Left foot-males: Figure 2 represents the comparison of footprint length, breadth, θ between non-sports and sports person in left leg of males. From the above graph it can be observed that there is a significant difference of 1 cm in Length and also a minute difference in angle between Non-Sports and Sports person.

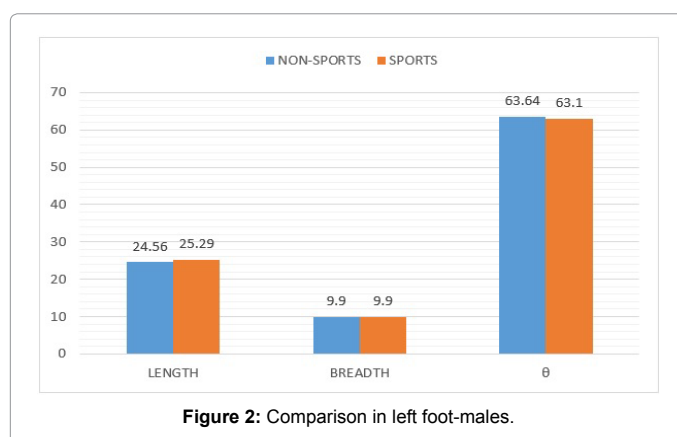**Right foot-males:** Figure 3 represents the comparison of foot print
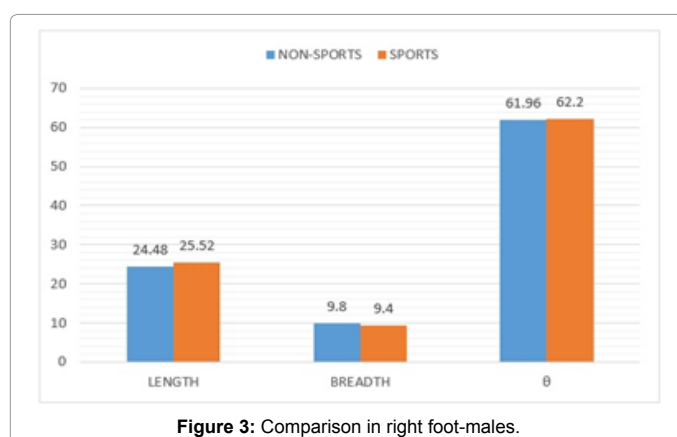

Figure 2: Comparison in left foot-males.

Figure 3: Comparison in right foot-males.

length, breadth, θ between non-sports and sports person in right leg of males. From the graph it can be observed that there is a significant difference of 1 cm length and also 1° difference in angle between non-sports and sports person.

Left foot-females: Figure 4 represents the comparison of footprint length, breadth, θ between non-sports and sports person in left leg of females. From the graph it can be observed that there is a significant difference of 1 cm length and breadth and also a 1° difference in angle between non-sports and sports persons.

Right foot-females: Figure 5 represents the comparison of footprints length, breadth, θ between non-sports and sports person in right leg of females. From the bar graph it is observed that there is a significant difference of 1 cm length and 4 cm difference in breadth and also a 2° difference angle between non-sports and sports persons.

Comparison graph between non-sports and sports

The length and angle difference exist between non-sports and sports person in males while all length, breadth, angle difference exist in females (Figure 6).

Results

On Comparison between non-sports and sports

In male-left, there is a length difference of 0.7 cm and 0.5° difference in angle.

In male-right, there is a length difference of 1.1 cm, 0.4 cm difference in breadth, 0.3° difference in angle.
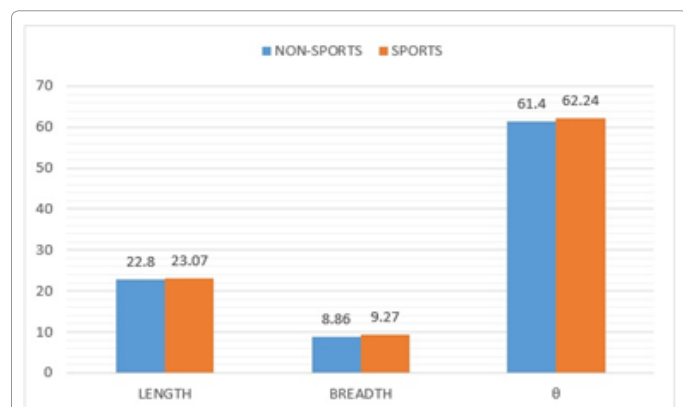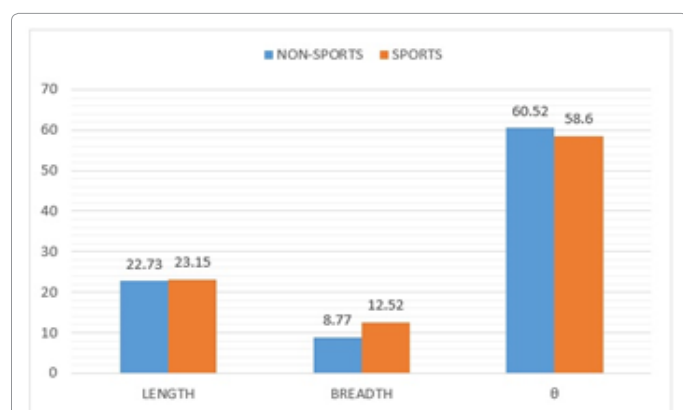
Figure 4: Comparison in left foot–females.

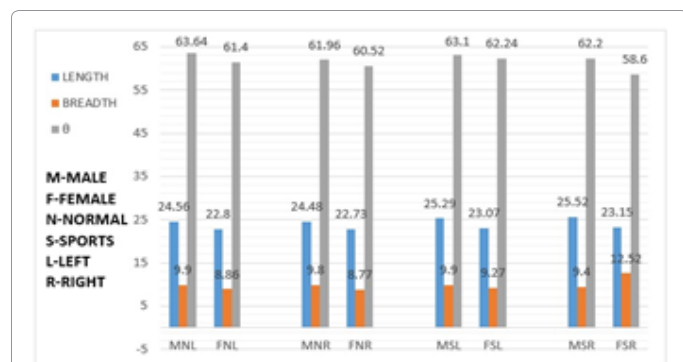**Figure 5:** Comparison in right foot-females.

Figure 6: Comparison of length, breadth and angle.

In female-left, there is a length difference of 0.2 cm and 0.4 cm difference in breadth, 0.8° difference in angle.

In female-right, there is a difference of 0.4 cm length and 3.8 cm difference in breadth and also a 2° difference in angle.

Discussion

The study reveals that there exists only a minute difference between non-sports and sports person in footprint dimensions. The study was limited to Mangaluru city. Since the researchers are students both time and finance constrains existed. Specific sports categories could be included and can increase the sample size on the availability of the sports persons. More Parameters could be included for further study. Gait pattern analysis could be also be done for further studies other than measurements.

Conclusion

The study is on footprint dimensions between sports and non-sports persons [3-7]. The study shows there is no much difference in Footprint dimensions among sports and non-sports persons.

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