

Descriptive Analysis of Foot Morphological Characteristics Among Inter-University Level Players of Different Sports

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Abstract

Descriptive Analysis of Foot Morphological Characteristics Among Inter-University Level Players of Different Sports in Uttar Pradesh, India. A total of 120 male players (20 from each sport) participating in different sports at university level were selected for the present study. The age category of students was between the range of 18 to 22 years. The shape of the foot has a significant impact on both injury prevention and athletic performance. The purpose of this study was to perform a descriptive examination of the morphological features of the feet in athletes competing at the intercollegiate level in a variety of sports, such as athletics, volleyball, badminton, football, cricket, and basketball. Through the measurement of factors like Length (Foot Length, Ball of Foot Length, Outside Ball of Foot, Toe Length, Heel to Medial/Lateral Malleolus), Width (Ball of Foot Width, Heel Width, Planter Arch Width), Circumference (Ball Girth, Heel Girth), Height (Medial/Lateral Malleolus Height) and Angles (Ball Angle, Hallux Angle). The goal of the study was to discover morphological adaptations unique to a given sport and offer suggestions for improving training and injury prevention techniques as well as help to sports shoe manufacturer companies to make customize shoes according to region.

Keywords: Foot morphology, characteristics, inter university, different sports

Introduction

The size, form, and structural alignment of the foot are all considered aspects of foot morphology, which is important for both injury prevention and sports performance. During a variety of physical activities, the foot serves as the base of motion, supporting weight, absorbing stress, and supplying propulsion. The demands placed on the foot by various sports vary, resulting in particular morphological modifications that improve performance and reduce the risk of injury. Comprehending these modifications is important for formulating efficient training regimens, creating footwear tailored to various sports, and executing tactics to avert injuries.

The intricate anatomical structure of the human foot is made up of bones, muscles, ligaments, and tendons, all of which cooperate to give stability and movement. Changes in the morphology of the foot can have a major impact on an athlete's ability to perform and their vulnerability to injuries. As an example, runners frequently have differences in the form of their foot arches, which can affect their gait and increase their risk of overuse injuries (Williams et al., 2001). In a similar vein, broader feet help to improve stability and support for basketball players, who constantly leap and move lateral (Nigg & Segesser, 1992).

Studies have indicated a strong correlation between foot shape and athletic performance. For instance, athletes who possess strong plantar muscles and well-developed arches are better able to create propulsion and absorb stress, which is important in sports involving sprinting and jumping (Menz et al., 2006). On the other hand, athletes who have flat feet may put more strain on their lower limbs, which increases their risk of shin splints and plantar fasciitis, among other problems (Bordin et al., 2001). Comprehending these anatomical distinctions is essential to customizing training and recovery regimens to the individual requirements of athletes.

Sports-specific morphological adaptations occur from the demands placed on the feet by various movements and forces. For example, strong and flexible feet are developed by soccer players to withstand high-impact pressures and quick direction changes while kicking and running (Dicharry, 2010). Conversely, to maximize propulsion in water, swimmers need flexible feet with a more prominent arch (Zaitseva et al., 2016). Depending on the event, track and field athletes may display different foot traits. For example, sprinters may have more stiff feet to generate explosive power, while distance runners may have more flexible feet to absorb stress and maintain endurance.

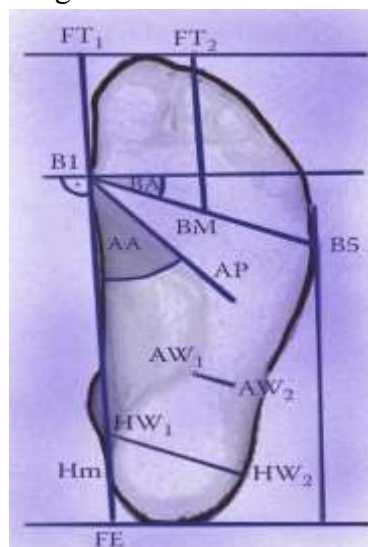
The unique demands of individual sports influence the morphological features of athletes' foot, resulting in modifications that can improve performance and lower the risk of injury. Through the examination of these sport-specific differences, scientists can pinpoint the essential morphological characteristics that lead to success in other sports. Using this information, customized training plans, orthotics, and footwear can be created to meet the particular requirements of athletes in various sports.

It is essential to comprehend how athletes from different sports differ in their foot morphology in order to maximize performance and minimize injuries. The purpose of this study is to determine the unique morphological adaptations linked to each activity in order to offer insightful information that can guide the creation of focused training plans, footwear, and orthotics.

Methodology

A total of 120 male players (20 from each sports) participating in different sports at university level were selected for the present study. The age category of students was between the range of 18 to 22 years.

For the purpose of the study, the scholar prepared an ink pad for foot imprint on A4 size paper. Subjects were asked to stand keeping both feet on ground and both leg imprint was taken by. Thus, both leg on ground left foot and both leg on ground right foot was taken for the purpose of the study.



These are described below-

1. **Foot length:** Distance between foot end (FE) (heel) and foot tip (FT1) (anterior point of the most protruding toe) along the medial tangent of the foot
2. **Ball of foot length:** Distance between FE (heel) and the first metatarsophalangeal protrusion (MTP)
3. **Outside ball of foot length:** Distance between FE (heel) and the fifth metatarsophalangeal protrusion (MTP) (B5) parallel to foot measuring line (FE – FT1)
4. **Toe length** Distance between the bisected ball line (B1 – B5) (BM) and foot tip (FT2) (anterior point of the most protruding toe)
5. **Heel to medial/lateral malleolus** Length from FE to the most medially/laterally protruding point on the medial/lateral malleolus measured along the foot axis (Kouchi 2003)
6. **Ball of foot width:** Connection line between first MTP joint (B1) and fifth MTP joint protrusion (B5) (ball line)
7. **Heel width:** Widest part of the heel (plantar print) (HW1– HW2) parallel to the ball line (B1 – B5)
8. **Planter arch width:** Narrowest section of the plantar medial longitudinal arch (AW1 – AW2)
9. **Baal girth** Maximum circumference over the first (B1) and fifth MTP joint protrusion (B5)
10. **Heel girth** Circumference passing through the point of distal heel curvature to the dorsal junction of the foot and leg (Kouchi 2003)
11. **Medial/lateral malleolus height:** height of the most medially/ laterally protruding point of the medial/lateral malleolus (H2) (Kouchi 2003)
12. **Ball angle:** angle between the horizontal (90° to foot measuring line) and orthogonal ball line (B1 – B5) in B1
13. **Hallux angle:** angle between the orthogonal ball line (B1 – B5) and the medial definition of the hallux in B1
14. **Chippoux smirek index:** Relation between arch width (AW1– AW2) and ball width (B1 – B5) A greater index indicates a high width in the arch area and thus a lowered medial arch of the foot. This is the ratio of the minimum width of the mid foot arch region to the maximum width of the fore foot region.
15. **Stehalli index:** Relation between the arch width (AW1 – AW2) and heel width (HW1 – HW2) High arch index is the result of a descending of the arch of the foot. This is the ratio of the minimum width of the mid foot arch region to the maximum width of the rear foot regions.

Results

Table No. 1 showed that the Overall descriptive analysis (mean, standard deviation, std. error, minimum and maximum)									
Descriptive statistics									
		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
foot length(R)	Athletics	20	24.905	1.0768	.2408	24.401	25.409	23.0	26.6
	Badminton	20	24.265	1.0932	.2444	23.753	24.777	22.3	26.3
	Basketball	20	24.070	1.2265	.2743	23.496	24.644	22.2	26.3
	Cricket	20	24.725	1.2573	.2812	24.137	25.313	22.8	27.7

	Football	20	25.525	1.4393	.3218	24.851	26.199	23.2	27.5
	Volleyball	20	24.385	1.4372	.3214	23.712	25.058	22.2	26.7
	Total	120	24.646	1.3277	.1212	24.406	24.886	22.2	27.7
ball of foot length	Athletics	20	17.805	.9473	.2118	17.362	18.248	16.1	19.1
	Badminton	20	17.520	.6614	.1479	17.210	17.830	16.5	18.8
	Basketball	20	17.385	.9427	.2108	16.944	17.826	16.0	19.1
	Cricket	20	17.890	.9153	.2047	17.462	18.318	16.3	20.0
	Football	20	18.515	1.1504	.2572	17.977	19.053	15.9	20.0
	Volleyball	20	17.715	1.0132	.2266	17.241	18.189	16.3	20.0
	Total	120	17.805	.9973	.0910	17.625	17.985	15.9	20.0
outside ball of foot	Athletics	20	15.375	.9797	.2191	14.916	15.834	14.0	16.9
	Badminton	20	15.135	1.0368	.2318	14.650	15.620	13.8	17.7
	Basketball	20	14.810	1.0488	.2345	14.319	15.301	12.8	17.2
	Cricket	20	15.080	1.1821	.2643	14.527	15.633	12.5	17.4
	Football	20	15.530	1.1833	.2646	14.976	16.084	13.4	17.2
	Volleyball	20	14.980	1.1510	.2574	14.441	15.519	13.0	16.8
	Total	120	15.152	1.1030	.1007	14.952	15.351	12.5	17.7
toe length	Athletics	20	8.400	.4984	.1114	8.167	8.633	7.4	9.5
	Badminton	20	8.050	.5680	.1270	7.784	8.316	7.1	9.0
	Basketball	20	8.145	.4236	.0947	7.947	8.343	7.0	8.8
	Cricket	20	8.300	.7398	.1654	7.954	8.646	7.2	9.9
	Football	20	8.620	.7367	.1647	8.275	8.965	7.4	9.7
	Volleyball	20	8.100	.6383	.1427	7.801	8.399	6.6	9.0
	Total	120	8.269	.6310	.0576	8.155	8.383	6.6	9.9
heel to medial/lateral malleolus	Athletics	20	7.240	.3299	.0738	7.086	7.394	6.7	7.8
	Badminton	20	6.905	.7067	.1580	6.574	7.236	5.4	8.1
	Basketball	20	6.550	.9682	.2165	6.097	7.003	5.1	7.8
	Cricket	20	6.685	.7982	.1785	6.311	7.059	4.5	8.0
	Football	20	6.345	.8121	.1816	5.965	6.725	4.8	7.4
	Volleyball	20	6.690	.7907	.1768	6.320	7.060	5.1	8.4
	Total	120	6.736	.7959	.0727	6.592	6.880	4.5	8.4
ball of foot width	Athletics	20	9.360	.4684	.1047	9.141	9.579	8.6	10.4
	Badminton	20	9.325	.4800	.1073	9.100	9.550	8.5	10.5
	Basketball	20	9.200	.4484	.1003	8.990	9.410	8.4	10.0
	Cricket	20	9.460	.7301	.1633	9.118	9.802	8.5	11.0
	Football	20	9.755	.6386	.1428	9.456	10.054	8.5	11.0
	Volleyball	20	9.645	.4371	.0977	9.440	9.850	8.8	10.3
	Total	120	9.458	.5667	.0517	9.355	9.560	8.4	11.0

heel width	Athletics	20	5.235	.4637	.1037	5.018	5.452	4.5	6.0
	Badminton	20	5.100	.5130	.1147	4.860	5.340	4.5	6.4
	Basketball	20	5.090	.5684	.1271	4.824	5.356	4.2	6.1
	Cricket	20	5.230	.4669	.1044	5.011	5.449	4.5	6.2
	Football	20	5.455	.6065	.1356	5.171	5.739	4.2	6.7
	Volleyball	20	5.345	.4136	.0925	5.151	5.539	4.8	6.1
	Total	120	5.243	.5153	.0470	5.149	5.336	4.2	6.7
planter arch width	Athletics	20	3.310	1.0543	.2357	2.817	3.803	1.8	5.2
	Badminton	20	3.195	.8799	.1967	2.783	3.607	1.5	4.5
	Basketball	19	2.921	1.4250	.3269	2.234	3.608	.8	5.5
	Cricket	20	4.135	1.3982	.3127	3.481	4.789	1.3	7.4
	Football	20	4.240	1.3986	.3127	3.585	4.895	.8	6.6
	Volleyball	19	3.479	1.2735	.2922	2.865	4.093	.8	6.4
	Total	118	3.553	1.3189	.1214	3.312	3.793	.8	7.4
ball girth	Athletics	20	24.750	1.5840	.3542	24.009	25.491	22.0	27.5
	Badminton	20	24.965	1.7875	.3997	24.128	25.802	22.8	28.4
	Basketball	20	24.980	1.6653	.3724	24.201	25.759	22.0	28.0
	Cricket	20	25.220	1.6848	.3767	24.431	26.009	22.4	28.0
	Football	20	26.040	1.2642	.2827	25.448	26.632	23.2	28.0
	Volleyball	20	25.070	1.5239	.3407	24.357	25.783	22.0	28.0
	Total	120	25.171	1.6139	.1473	24.879	25.463	22.0	28.4
heel girth	Athletics	20	31.565	2.5042	.5599	30.393	32.737	26.4	34.8
	Badminton	20	31.195	1.3832	.3093	30.548	31.842	28.0	34.0
	Basketball	20	30.935	1.8181	.4065	30.084	31.786	28.0	35.0
	Cricket	20	30.935	1.9610	.4385	30.017	31.853	26.6	33.8
	Football	20	32.300	1.8411	.4117	31.438	33.162	28.1	35.0
	Volleyball	20	30.925	2.0000	.4472	29.989	31.861	25.8	35.5
	Total	120	31.309	1.9693	.1798	30.953	31.665	25.8	35.5
arch height mlaa	Athletics	20	6.665	2.1861	.4888	5.642	7.688	3.1	10.0
	Badminton	20	7.070	1.8584	.4156	6.200	7.940	3.4	9.8
	Basketball	20	6.945	1.8257	.4082	6.091	7.799	3.5	9.5
	Cricket	20	7.065	1.6132	.3607	6.310	7.820	4.2	9.0
	Football	20	7.345	1.7437	.3899	6.529	8.161	4.8	9.7
	Volleyball	20	6.555	1.7581	.3931	5.732	7.378	3.9	8.6
	Total	120	6.941	1.8198	.1661	6.612	7.270	3.1	10.0
BALL ANGLE	Athletics	20	111.00	4.389	.981	108.95	113.05	100	118
	Badminton	20	112.45	3.776	.844	110.68	114.22	104	118
	Basketball	20	112.20	4.112	.919	110.28	114.12	104	119
	Cricket	20	113.45	4.915	1.099	111.15	115.75	105	127
	Football	20	113.45	3.706	.829	111.72	115.18	106	120
	Volleyball	20	112.80	3.088	.691	111.35	114.25	107	118
	Total	120	112.56	4.041	.369	111.83	113.29	100	127

HALLUX ANGLE	Athletics	20	3.60	3.424	.766	2.00	5.20	0	10
	Badminton	20	2.55	2.564	.573	1.35	3.75	0	10
	Basketball	20	4.15	3.717	.831	2.41	5.89	0	14
	Cricket	20	2.50	4.199	.939	.53	4.47	0	18
	Football	20	5.45	4.298	.961	3.44	7.46	0	15
	Volleyball	20	3.85	3.990	.892	1.98	5.72	0	11
	Total	120	3.68	3.802	.347	3.00	4.37	0	18
chippaux smirak index	Athletics	20	.35180	.107556	.024050	.30146	.40214	.197	.558
	Badminton	20	.34190	.091879	.020545	.29890	.38490	.157	.500
	Basketball	19	.31532	.152360	.034954	.24188	.38875	.091	.611
	Cricket	20	.43670	.142517	.031868	.37000	.50340	.138	.685
	Football	20	.43140	.137055	.030646	.36726	.49554	.090	.673
	Volleyball	19	.35795	.130157	.029860	.29521	.42068	.087	.653
	Total	118	.37312	.133685	.012307	.34875	.39749	.087	.685
staheli index	Athletics	20	.62920	.184567	.041270	.54282	.71558	.360	.960
	Badminton	20	.61295	.150777	.033715	.54238	.68352	.326	.862
	Basketball	19	.57742	.269941	.061929	.44731	.70753	.148	1.100
	Cricket	20	.79725	.284069	.063520	.66430	.93020	.245	1.370
	Football	20	.77390	.250502	.056014	.65666	.89114	.160	1.200
	Volleyball	19	.64658	.227094	.052099	.53712	.75603	.153	1.060
	Total	118	.67392	.242039	.022281	.62979	.71804	.148	1.370

Table No. 1 Overall descriptive analysis

The analysis of the gathered data pertaining to the selected Morphological traits and their statistical analysis were presented. The data pertaining to Morphological traits of the 120 male players from deferent games like Athletics, badminton, basketball, cricket, football and volleyball of deferent university.

The statistics for various foot measurements across different sports and in total. **Foot length (R)** ranges from 22.2 cm (Basketball) to 27.7 cm (Football), with an overall mean of 24.646 cm and standard deviation of 1.3277 cm. **Ball of foot length** is between 15.9 cm (Total) and 18.515 cm (Football), averaging 17.805 cm across all groups. **Outside ball of foot** measurements vary from 12.5 cm (Cricket) to 17.7 cm (Badminton), with a total mean of 15.152 cm. **Toe length** ranges from 6.6 cm (Total) to 9.9 cm (Football), averaging 8.269 cm. **Heel to medial/lateral malleolus** spans from 4.5 cm (Total) to 8.4 cm (Volleyball), with an average of 6.736 cm. **Ball of foot width** ranges from 8.2 cm (Total) to 11.0 cm (Football), averaging 9.458 cm. **Heel width** varies from 4.2 cm (Total) to 6.7 cm (Football), with a mean of 5.243 cm. **Plantar arch width** ranges from 0.4 cm (Football) to 6.5 cm (Football), averaging 3.553 cm. **Ball girth** spans from 22.0 cm (Total) to 28.4 cm (Cricket), with a mean of 25.171 cm. **Heel girth** varies from 25.8 cm (Total) to 35.5 cm (Volleyball), averaging 31.309 cm. **Arch height MLA** ranges from 2.9 cm (Athletics) to 10.0 cm (Basketball), with a mean of 6.941 cm. **Ball angle** ranges from 100 (Athletics) to 127 (Cricket), averaging 112.56 degrees. **Hallux angle** spans from 0 degrees (several sports) to 18 degrees (Cricket), with a mean of 3.68 degrees. **Chippaux-Smirak index** ranges from 0.087 (Volleyball) to 0.685 (Cricket), with an average of 0.37312. **Staheli index** varies from 0.148 (Basketball) to 1.370 (Cricket), averaging 0.67392.

Conclusion

The purpose of this study was to assess and prepare the profile of the foot morphology of the students participating in different sports and improve our understanding of the morphology of the foot in relation to specific sports and to provide information on foot morphology in different sports to help shoe manufacturers and shoe companies that make athletic footwear according to region. This information will also have implications for inter university athletes' performance and injury prevention.

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