



A COMPARATIVE STUDY ON FOOT MORPHOLOGY BETWEEN TWO DIFFERENT SPORTS

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Abstract

Feet are the terminal portion of a limb which bears weight and allows locomotion. This study aimed at comparing and analysis the pressure differences of the foot in two different sports. Ten male (age = 20.71 ± 2.12 years) all India university level players were selected from Weight - Lifting (n = 5) and Judo (n = 5) using purposive sampling. The subjects were asked to stand on BTS P – Wave modular system (Pressure plate) and the data was recorded for 5 seconds. The results of the study reveal that no statistical differences were found between the two sports suggesting that both the sports have similar type of foot morphological values. In case of comparing the left and right foot, again no significant differences were found concluding that the surface area, force and average pressure in both the feet were found to be similar.

Keywords: Foot Morphology, Pressure plate, Weight – Lifting and Judo

Introduction :

Feet are the supporting base of the human body, and are used in most of the common forms of locomotion. It is the terminal portion of a limb which bears weight and allows locomotion.

The human foot exhibits a wide range of structural variations than in many other parts of the body. During growth, the foot changes not only its dimension but also its shape. Large variations are displayed in the normal population at different ages, especially concerning characteristics of the medial longitudinal arch (Kulthanan et al., 2004). Motoric dominance, the preferential usage of an upper or lower limb based on its primacy or dominant use in motor functions in a specific situation, is a universal, uniform and unique characteristic of all humans. One of the most obvious manifestations of motoric dominance is footedness, the tendency to prefer the use of a consistent foot in performing voluntary motor acts (Grouios et al., 2004; Grouios, 2005).

Footedness has been implicated as a risk factor for the development of pathology in the lower extremity because most individuals place a greater mechanical demand on their preferred foot during voluntary motor acts. Thus, long-term mechanical stress acting inhomogeneously on the preferred lower limb, particularly during high-demand activities, may cause injuries and hazards to that limb (Yamaner, Karacabey, Kavlak and Sevindi, 2011).

Similarly, in sports the domination of the preferred foot can be observed easily specially in sports like football, long jump, high jump etc. But whether this preference also affects the pressure differences between the two feet of the players normal standing postures.

BTS P-Walk is a modular plates system for the measurement and analysis of foot plantar pressure during movement as well as while standing. The system supplies quantitative information about plantar support by calculating such parameters as surface, maximum pressure, average pressure and center of pressure (Btsbioengineering.com, 2015).

The purpose of the study was to analysis and compares the pressure differences of the foot in two different sports i.e. Weight – Lifting and Judo.

Methodology :

A total of 10 male subjects from Weight – Lifting (n = 5) and Judo (n = 5) took part in this study from Lakshmi Bai National Institute of Physical Education, Gwalior. Purposive sampling technique was used for the selection of the subjects. All participants met the following inclusion criteria: (1) no history of congenital deformity in the lower extremity or foot; (2) no previous history of lower extremity or foot fractures; (3) no surgical operation on foot and lower extremity; (4) no systemic diseases that could affect lower extremity or foot

posture; (5) no history of trauma or pain to either foot, lower extremity or lumbosacral region at least 12 months prior to start of the investigation(Yamaner, Karacabey, Kavlak and Sevindi, 2011).

For the measurement of pressure BTS P – Wave Modular single pressure plate was used. This system helps to measure the maximum pressure found under the foot, average pressure under the foot, surface or the points of exert pressure on the floor and the percentage of load on the floor (force). It has 2304 number of Resistivesensors with Acquisition Frequency up to 100 HZ and Pressure range of 30-400 Kpa. Nine independent variables were selected for the purpose of the study. The variables were anterior surface area (APA), anterior force (AF), anterior average pressure (AAP), medial surface area (MSA), medial force (MF), medial average pressure (MAP), posterior surface area (PSA), posterior force (PF), posterior average pressure (PAP).The subjects were asked to stand straight (fundamental standing position) on the pressure plate. The data was recorded for 5 seconds.

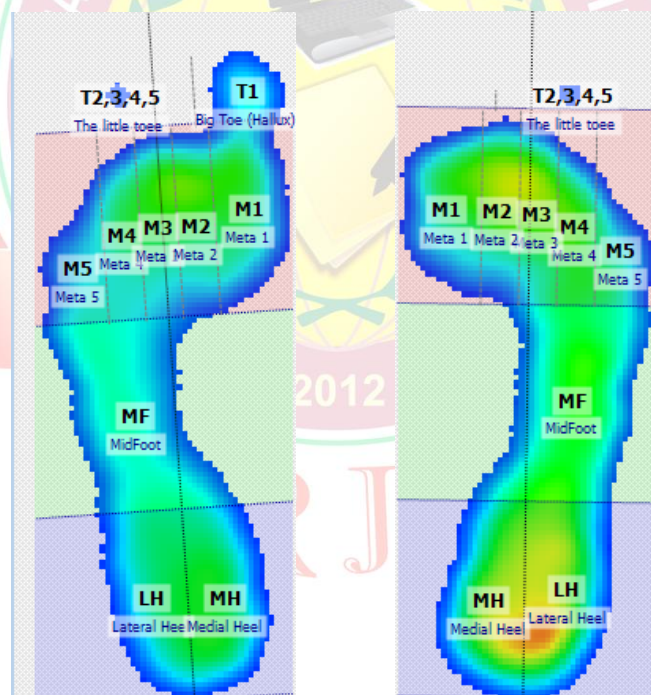


Figure 1: An example of footprint images which were obtained from the BTS system

Statistics

The descriptive statistics (mean, standard deviation, skewness, kurtosis etc.) histograms, normal probability plots, and Shapiro–Wilk’s test was used for testing the assumption of

normality and to know the nature of data. All data are presented as mean with standard deviations. Individual T – test was used to detect the mean differences between two different sports and paired T – test was used to detect the mean differences between the left and right foot. For this purpose Statistical Package for Social Science (SPSS) version 20.0 was used. The level of significance was set at 0.05.

Results and discussion

As we know that the skewness value more than twice its standard error indicates a departure from symmetry. Here, none of the variables skewness is greater than twice its standard error; hence all the variables are symmetrically distributed. Similarly, the value of kurtosis for the data to be normal of any of the variable is not more than twice its standard error of kurtosis hence none of the kurtosis values are significant. In other words the distribution of all the variables is meso-kurtic.

Table 1: Descriptive Statistics and Test of Normality

		Mean		Std. Deviation		Skewness		Std. Error of Skewness	Kurtosis		Std. Error of Kurtosis	Shapiro – Wilk (p-vaule)	
		WL	Judo	WL	Judo	WL	Judo	WL/Judo	WL	Judo	WL/Judo	WL	Judo
ANTERIOR SURFACE AREA	Left	41.64	41.82	2.931	2.275	1.357	.172	.913	1.790	1.819	2.000	.372	.626
	Right	41.64	42.52	1.937	1.939	1.579	.855	.913	3.111	-.236	2.000	.175	.591
ANTERIOR FORCE	Left	41.74	41.34	3.673	3.223	.665	-1.063	.913	-.758	.096	2.000	.765	.385
	Right	41.08	40.58	3.504	4.126	-.676	-1.776	.913	-1.032	3.636	2.000	.679	.088
ANTERIOR AVERAGE PRESSURE	Left	57.90	57.82	4.856	6.776	1.932	-.491	.913	3.960	-2.726	2.000	.072	.270
	Right	58.64	58.32	2.021	5.490	.209	-.570	.913	-1.177	-2.898	2.000	.599	.148
MEDIAL SURFACE AREA	Left	23.70	23.84	2.215	1.728	.126	.149	.913	-1.554	-2.179	2.000	.717	.669
	Right	23.94	23.66	2.117	2.496	.708	.358	.913	2.049	1.299	2.000	.543	.891
MEDIAL FORCE	Left	20.56	18.06	4.632	5.272	-1.174	.449	.913	1.326	-2.448	2.000	.545	.427
	Right	20.98	18.44	5.081	4.374	-1.183	.286	.913	.736	-1.720	2.000	.399	.732
MEDIAL AVERAGE PRESSURE	Left	9.50	9.36	.719	1.555	-.868	-.257	.913	.376	-1.024	2.000	.574	.952
	Right	9.58	9.35	1.250	1.465	.508	.886	.913	-1.012	-1.478	2.000	.820	.131
POSTERIOR SURFACE AREA	Left	34.66	34.34	4.403	1.425	-.707	-.079	.913	-2.400	-2.419	2.000	.111	.589
	Right	34.42	33.82	1.061	1.591	-.240	-1.453	.913	-1.001	2.164	2.000	.964	.276
POSTERIOR FORCE	Left	37.70	40.60	5.779	3.421	.517	-.628	.913	.023	1.789	2.000	.745	.699
	Right	37.94	40.98	3.672	2.622	.111	-.530	.913	-2.190	-1.350	2.000	.689	.623

POSTERIOR AVERAGE PRESSURE	Left	32.59	32.81	4.274	5.602	-1.827	.216	.913	3.560	-2.753	2.000	.065	.381
	Right	31.80	32.32	1.877	4.193	-.098	.700	.913	-.990	-1.798	2.000	.871	.365

Further for testing the normality Shapiro – Wilks test was used. It compares the scores in the sample to a normally distributed set of scores with the same mean and standard deviation. If the test is non – significant ($p > .05$) it tells that the distribution of the sample is not significantly different from a normal distribution (i.e. it is probably normal) and vice – versa. Here from table – 1 we can see that none of the variables p – value is less than .05, hence the data is normally distributed.

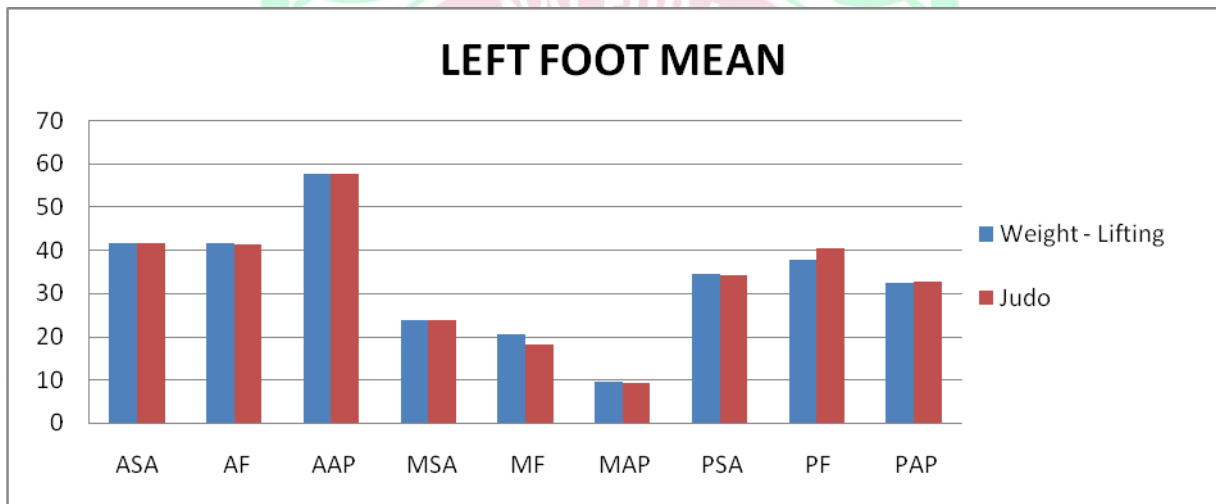


Figure 2: Mean values of surface area, force and average pressure of left foot (Anterior, Medial and Posterior part) in two different sports.

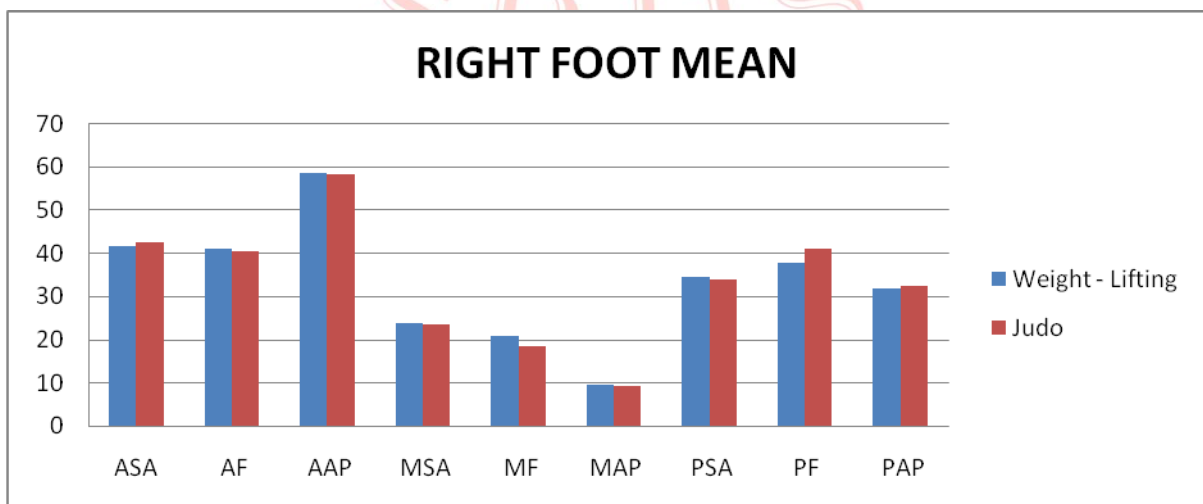


Figure 3: Mean values of surface area, force and average pressure of right foot (Anterior, Medial and Posterior part) in two different sports.

The above figures 2 & 3 shows that the mean value of the two different sports in relation to nine different variables was almost similar. It can also be seen that the contribution of the medial area of both the foot in relation to surface area, force and average pressure is less than the anterior and posterior area of the feet. It may due to the reason that all the subjects have a good arch that reduces the chances of flatfoot.

Table 2: A summary of the Individual t - test among the two different sports (i.e. Weight – Lifting and Judo), in relation with nine selected independent variables.

	Foot	Levene's Test for Equality of Variances		t	t-test for Equality of Means		
		F	Sig.		Sig. (2-tailed)	Mean Difference	Std. Error Difference
ANTERIOR SURFACE AREA	Left	.525	.489	-.108	.916	-.18000	1.65952
	Right	.120	.738	-.718	.493	-.88000	1.22597
ANTERIOR FORCE	Left	.140	.718	.183	.859	.40000	2.18591
	Right	.000	.995	.207	.842	.50000	2.42112
ANTERIOR AVERAGE PRESSURE	Left	2.148	.181	.020	.984	.07600	3.72863
	Right	16.241	.004	.122	.906	.32000	2.61653
MEDIAL SURFACE AREA	Left	.400	.545	-.111	.914	-.14000	1.25682
	Right	.126	.732	.191	.853	.28000	1.46397
MEDIAL FORCE	Left	.514	.494	.796	.449	2.50000	3.13898
	Right	.131	.727	.847	.422	2.54000	2.99833
MEDIAL AVERAGE PRESSURE	Left	2.637	.143	.185	.858	.14200	.76628
	Right	.462	.516	.274	.791	.23600	.86172
POSTERIOR SURFACE AREA	Left	16.983	.003	.155	.881	.32000	2.06983
	Right	.422	.534	.701	.503	.60000	.85545
POSTERIOR FORCE	Left	1.272	.292	-.965	.363	-2.90000	3.00383
	Right	.941	.360	-1.506	.170	-3.04000	2.01817
POSTERIOR AVERAGE PRESSURE	Left	1.159	.313	-.069	.947	-.21800	3.15152
	Right	6.768	.032	-.253	.807	-.52000	2.05485

*Significant at 0.05 level

Degree of freedom= 8

To test the equality of variances, Levene’s test was used. The F-value for testing the homogeneity of variances is insignificant as the p-value is more than .05. Thus the null hypothesis of equality of variances may be accepted, and it is concluded that the variances in the two different sports in respect to surface area, force and average pressure in both the feet are equal. From the above table it can be seen that none of the variables were found to be significant as the p – value is more than .05. It means the null hypothesis of the equality of

means was failed to be rejected. Hence it can be concluded that the surface area, force and average pressure in both the groups were found to be similar.

Table 3: A summary of the paired t - test among the left and right foot

Pair		Paired Differences			t	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean		
LASA – RASA	W.L	0.00000	4.60217	2.05815	0.000	1.000
	Judo	-.70000	2.95296	1.32061	-.530	.624
LAF – RAF	W.L	.66000	6.20024	2.77283	.238	.824
	Judo	.76000	2.26451	1.01272	.750	.495
LAAP – RAAP	W.L	-.74400	4.75005	2.12428	-.350	.744
	Judo	-.50000	1.61357	.72161	-.693	.527
LMSA – RMSA	W.L	-.24000	2.89879	1.29638	-.185	.862
	Judo	.18000	2.62526	1.17405	.153	.886
LMF – RMF	W.L	-.42000	2.38265	1.06555	-.394	.714
	Judo	-.38000	2.25211	1.00717	-.377	.725
LMAP – RMAP	W.L	-.08400	1.41283	.63184	-.133	.901
	Judo	.01000	1.12265	.50207	.020	.985
LPSA – RPSA	W.L	.24000	4.24417	1.89805	.126	.905
	Judo	.52000	2.54303	1.13728	.457	.671
LPF – RPF	W.L	-.24000	4.70670	2.10490	-.114	.915
	Judo	-.38000	2.18678	.97796	-.389	.717
LPAP – RPAP	W.L	.79200	3.84733	1.72058	.460	.669
	Judo	.49000	2.36165	1.05616	.464	.667

It can be seen from table 3 that the t – value is insignificant as the p – value is more than .05. Thus, the null hypothesis of equality of average mean score of nine independent variables among left and right foot in two different sports is fail to be rejected, and therefore, it may be concluded that both the foot has similar kind of responses in relation with surface area, force and average pressure in two different sports.

Conclusion

The study analysis and compares the pressure differences of the feet in two different sports i.e. Weight – Lifting and Judo. The results of the study reveal that no significant differences were found concluding that the variances in the two different sports in respect to surface area, force and average pressure in both the feet are similar. In case of comparing the left and right feet, again no statistical differences were observed and similar kind of responses was found.

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