Research Papers

Medial side foot length from the horizontal axis of the ankle and Foot area while standing plantar flexed as determinants in long jump performance among previously untrained school children

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Abstract

Background: *Take off part largely determines the long jump performance. Longer the time spent by the foot at the take off board and loss of force into the ground could lead to ineffective take off. Longer foot need more angular distance before it is cleared at the take off board and also the take off area of the foot becomes larger may also lead to the loss of force transmission due to force dissipation through the larger area of foot.*

Objective of the study: *This study was to analyze the correlation among the medial side foot length from the horizontal axis of the ankle, foot area while standing plantar flexed and long jump performance.*

Methods: 200 school boys in the age group of 12 to 14 years participated. Foot area while standing plantar flexed was measured by graph weighing method. Medial foot length was measured from the horizontal axis of the ankle ie centre of medial maleolus. All the subjects height was 5 ft and non obese without any prior regular athletic training. Partial correlation was applied to analyze the correlation. Results: Significant negative correlations were found between foot area and the performance($r = -0.325$; $P < 0.003$) and between foot area and performance (-0.418) at 0.05 level of significance (0.1948). The negative correlation between foot area and the performance was found decreased slightly but remained significant ($r = -0.263$: $P = < 0.0087$) when the effect of foot area was removed through first order partial correlation. The negative correlation between foot area and performance was also found slightly reduced but still to significant level ($r = -0.375$; $P < 0.0001$), when the effect of foot length was removed through partial correlation of first order.

Conclusion: The long jump performance among the individuals decreases with the increase in the area of the foot and increase in length of the foot.

Key words: Foot area, ineffective take off, force dissipation, loss of force.

The kinetics of the foot may play a vital role in performances like running, jumping and other sporting activities (Orendurff MS et.al. 2008) Different aspects of the foot like foot arch, length of the foot, forefoot and rear foot ratio and angle, structure of the metatarsophlangeal joint of the foot etc are important one which may play role in influencing the force factors of the performance of activities(Nachbauer W et.al. 1992 and Queen RM et.al. 2009). The very vital phase of the long jumping is take off and this phase certainly has lot of influence on the long jump performance. The take off from the ground needs ground reaction force created at the take off point. The force sent into the ground by the plantar flexion force of the foot may be one factor that influences much. But, the force generated from the muscles of the leg and sent through the foot into the ground must not be dissipated and lost to create an effective take off through effective ground reaction forces (Davis DS et.al. 2006,

Ledoux WR et.al. 2002 and Nagano A et.al. 2005). The kinetics of the foot could lead loss of force generated leading to ineffective take off (Dorn TW et.al. 2011, Freychat P et.al. 1996 and Lees A et.al. 2005). The effective and precise transmission of the force generated at the foot contact point into the ground requires positive kinetics of the foot (Nigg BM. 2005).

Methods:

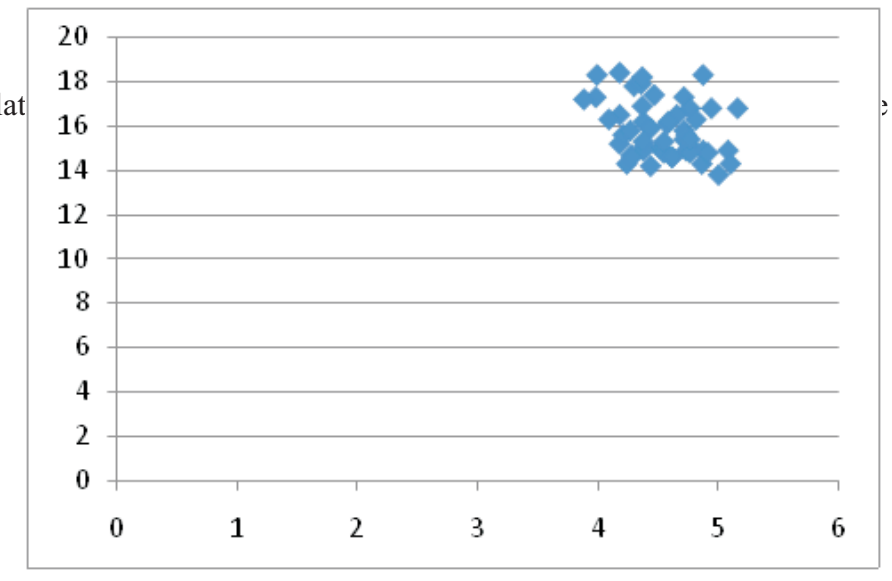
Two hundred male school children in the age group of 12 to 14 years participated in the study. The individuals for the study were included on the basis individual acceptance and voluntary participation. The height of the individuals was also ranged between 148 cm to 152 cm and this restriction of height neutralized one factor that might influence the long jump performance. The two variables of foot kinetics correlated with the Long jump performance (X) were medial side foot length from the horizontal axis of the ankle (Y) and fore foot area while standing plantar flexed (Z). The medial foot length of the individuals was measured from the horizontal axis of the ankle ie from the centre of the medial malleolus to the tip of the big toe in centimeters. The fore foot area while standing plantar flexed was measured through the graph weighing method in square centimeters. The inked fore foot area was initially marked on the graph papers while the individuals stood on the planter flexed position ie heel raised position. If the length of the foot is more the angular distance of the take off to the tip of the toe also increases and if the fore foot area while standing plantar flexed increases the ground reaction force may come down as the force dissipation or loss of force during the take off may be more. Zero order correlation and First order partial correlations were applied to analyse the correlational aspects of the long jump performance and other two independent foot kinetic variables.

Results:

The zero order correlation as indicated in table 1 reveals that there are significant negative correlations between the long jump performance and the medial side length of the foot from the horizontal axis of the ankle (-0.325), and between Long jump performance and the fore Table 1. Zero order correlation between the three variables: Long Jump performance (X), Medial Foot length (Y) and Fore foot area while standing Plantar flexed (Z). Critical value of r = 0.195

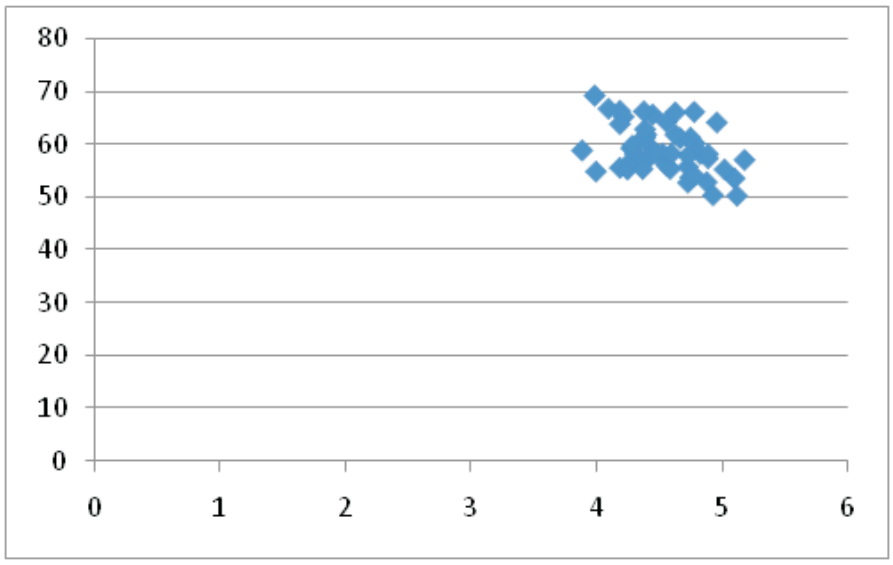
Correlated variables	Correlation (r)	P
XY	-0.325(Sig)	<0.0007
XZ	-0.418(Sig)	<0.00089
YZ	0.221 (Sig)	0.0013

Fig 1. Correlat



e foot length(Y).

Fig 2. Correlation scatter gram between long jump performance(X) and fore foot area while standing plantar flexed(Y).



foot area while standing plantar flexed (-0.418). This initially indicates that the medial side length of the foot increases the long jump performance decreases and if the fore foot area while standing plantar flexed increases the long jump performance decreases and vice versa. When the effect of the fore foot area while standing plantar flexed was partialled out the negative correlation between the long jump performance and the medial side length of the foot from the horizontal axis of the ankle slightly reduced but the correlation was significnat (-0.263). When the effect of the medial side length of the foot from the horizontal axis of ankle was partialled out, the negative correlation between the long jump performance and the fore foot area while standing plantar flexed was also decreased slightly but still the correlation was significnat 9-0.375).

Table 2. First order Partial correlation for the three variables of the study (Critical value = 0.195)

Correlated variables	First order Partial Correlation ®	P
XY.Z	-0.263(Sig)	<0.0087
XZ.Y	-0.375(Sig)	<0.0001
YZ.X	0.099 (N. Sig)	0.3295

Discussion:

Foot kinetics play important part in channelizing the force elements during the take off. The force inserted into the ground at the take off point through the foot must not get dissipated or spread to get back the maximum ground reaction force and to insert maximum velocity in to the take off. The loss of force may lead to the loss of final velocity at the take off point and loss in the distance achieved in long jump. The minimum loss in ground reaction force makes the take off velocity maximum and the performance to maximum and vice versa. Longer the foot needs more time to complete the take off process and in the process may lose some portion of the force produced by the muscles of lower leg, as longer foot takes longer angular distance (Powell DW et.al. 2011 and Wong PL et.al. 2007). The results of the study indicated that there was negative correlation between the long jump performance and the medial side foot length from the axis of the ankle, which predicts that the longer the foot the long jump performance may get affected negatively. This could be because of more time needed to travel the longer angular distance before the take off which may cause to lose vital percentage of force into the ground and hence

the ineffective ground reaction force ultimately. Another aspect of foot kinetics, ie foot area and the size of the foot may also sow significant influence on the long jump performance (Queen RM et.al. 2007). The foot area while standing plantar flexed (heel raised) is the area of the fore foot under pressure of body weight. This indicates the gross area from which the force is sent into the ground at the take off of long jump activity. If the area of the foot at this stage is more, there may be considerable loss of force that is generated by the muscles of the lower leg while sending into the ground. This loss of force show significant negative influence on the achieved ground reaction force (Cheung RT et.al. 2008 and Molloy JM et.al. 2009) at the take off and this could lead to the loss of final velocity of the body at the take off point. The foot area while standing plantar flexed indicates inter metatarsal distance and the strength of the muscles associated at the area of the foot. If the inter metatarsal distance is more the force that is sent into the ground through the fore foot might get dissipated and a lot of force might be lost making the take off most ineffective (Chuckpaiwong B et.al. 2008). This could lead to the loss of ground reaction force and loss of final velocity to the body at the take off point leading to considerable loss in long jump performance (Ridola C et.al. 2001). The study results also indicated that there was negative correlation between the long jump performance and the foot area while standing plantar flexed. When the effect of medial side foot length was partialled out through first order correlation, the negative correlation between long jump performance and foot area while standing plantar flexed reduced and this further supports that the medial side foot length influences negatively on the long jump performance. When the effect of foot area while standing plantar flexed was partialled out through the first order correlation, the negative correlation between long jump performance and the medial side foot length reduced further and this further supports that the foot area while standing plantar flexed influences negatively on the long jump performance along with the medial side foot length.

Conclusion: The selected two aspects of foot kinetics have significant negative impact on the long jump performance. Longer the medial side foot length and larger the foot area while standing plantar flexed would cause negative influence on the ground reaction force achieved at the take off leading to loss in the long jump performance of the individuals.

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