



## **Kinetic Analysis of Korean Traditional Dance Movements by Using Ground Reaction Force**

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### **Dear Editor-in-Chief**

The art of dancing is conveyed through various combinations of body movements. Korean dance represents a unique challenge as this creative art form combines rapid tempo and large movement that commonly exceed the limits of stability of the body, placing a high demand on the structures of the musculoskeletal system which can result in injury (1-3). Among the various movements of Korean dance, three require skill for performance and are associated with frequent injury: the DiDimCha, which mimics the Jeong or Pal as a Chinese character and requires movement forward on the heels; the jump on one foot, and the YeonPungDae, a dance step in which dancers turn round and round as if flying through the sky, with repetitive flexion and extension at the waist.

In kinetic analysis, the superior-inferior vector of the ground reaction force (GRF) provides an index of the up-and-down power generated by dancers and the resultant effect on the body. Therefore, the aim of our study was to identify the difference in the magnitude of the superior-inferior GRF according to injury area and the three representative movements of Korean traditional dance, namely the DiDimCha, the jump on one foot and the YeonPungDae.

Participants were 18 female dancers, classified into three groups based on their history of lower

limb injury: the knee injury group (n=5; age, 19.86±0.90 yr; height, 164.79±3.69 cm; weight, 53.50±3.51 kg; dance experience, 100.57±52.79 months); the ankle injury group (n=5; age, 19.43±0.79 yr; height, 165.50±4.51 cm; weight, 50.67±5.86 kg; dance experience, 91.14±48.61 months); and the no injury group (n=8; age, 21.00±1.05 yr; height 166.60±4.35 cm; weight, 49.62±2.13 kg; dance experience, 132.60±39.84 months).

The GRF was subdivided into three events for analysis, defined as follows: event 1, touch-down of the left foot on the force platform; event 2, body support on the left foot; and event 3, the moment immediately preceding the left foot coming off the force platform. All three events are included in the DiDimCha, jump on one foot and YeonPungDa. All GRF were recorded using a 9260AA6 Kistler force platform (Winterthur, Switzerland).

The mean ± standard deviation was calculated for the GRFs for each movement, with between-group differences analyzed using a one-way analysis of variance. Statistical analyzes were performed using SPSS (version 18.0; Chicago, IL, USA). Statistical significance was set at  $P<0.05$ .

The superior-inferior GRF for the three-movement types is summarized in Table 1. There were no between-group differences in the magni-

tude of the superior-inferior GRF across each of the three events ( $P>0.05$ ).

The knee, ankle, and no injury groups could not be differentiated by the superior-inferior GRF across the three basic movements of Korean traditional dance. Therefore, other factors may explain differences in injury pattern, including dif-

ferences in diet, the relative strength and power of the lower limbs, and technical skill in absorbing the GRF. Future studies, including larger sample sizes, a more diverse injury group, and stringent control are needed to identify risk factors for injury in Korean traditional dance.

**Table 1:** Magnitudes of the superior-inferior ground reaction force for the three common movement patterns in Korean dance: DiDimCha, jump on one foot, and the YeonPungDae

Korean traditional dance movements	Group	Superior-inferior ground reaction force (N)	F	P
DiDimCha Event 1	Knee injury	6.67 ± 1.32	0.635	0.544
	Ankle injury	6.23 ± 1.24		
	No injury	7.08 ± 1.40		
DiDimCha Event 2	Knee injury	599.00 ± 40.71	2.106	0.156
	Ankle injury	552.44 ± 46.25		
	No injury	566.56 ± 27.87		
DiDimCha Event 3	Knee injury	5.83 ± 0.69	1.585	0.237
	Ankle injury	9.32 ± 7.42		
	No injury	5.63 ± 0.48		
Jump on one foot Event 1	Knee injury	18.17 ± 16.00	0.892	0.431
	Ankle injury	41.53 ± 54.19		
	No injury	21.82 ± 12.59		
Jump on one foot Event 2	Knee injury	1136.92 ± 293.38	1.169	0.337
	Ankle injury	988.91 ± 148.58		
	No injury	1168.49 ± 183.87		
Jump on one foot Event 3	Knee injury	5.88 ± 0.59	2.748	0.096
	Ankle injury	7.56 ± 3.03		
	No injury	5.46 ± 0.28		
YeonPungDae Event 1	Knee injury	7.63 ± 3.08	0.977	0.399
	Ankle injury	12.00 ± 5.90		
	No injury	9.31 ± 5.32		
YeonPungDae Event 2	Knee injury	75.42 ± 33.73	0.603	0.560
	Ankle injury	160.96 ± 71.98		
	No injury	110.63 ± 39.11		
YeonPungDae Event 3	Knee injury	6.79 ± 0.95	1.559	0.243
	Ankle injury	9.52 ± 3.78		
	No injury	5.19 ± 5.56		

Data are presented as mean ± standard deviation

Knee injury, 5 dancers; ankle injury, 5 dancers; no injury, 8 dancers.

Event 1, contact of the left foot with the force platform; event 2, body support on the left foot; and event 3, the moment just preceding the left foot coming off the force platform. //P-value, evaluated using a one-way analysis of variance

### Conflict of Interest

The authors declare that there is no conflict of interests.

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