KINETIC COMPARISON BETWEEN HIGH-IMPACT AND LOW-IMPACT STEP AEROBIC DANCES

Lin-Hwa Wang[1], Hsiu-Mei Hsieh[1], Chia-Hui Li[2], and Hong-Wen Wu[3]

Institute of Physical Education, Health & Leisure Studies, National Cheng Kung University, Tainan, Taiwan[1]
Department of Sports Medicine, China Medical University, Taichung, Taiwan[2]
Department of Physical Education & Graduate institute of Physical Education, National Taiwan College of Physical Education, Taichung, Taiwan[3]

KEYWORDS: Joint force, L- step, Lower limb

INTRODUCTION: Step aerobic dance is one of the most popular aerobic exercises. There are two kinds of aerobic dances, high-impact (HI) and low-impact (LI). High-impact aerobic dance is defined as the exercise involving bouncing, hopping or jumping in which both feet are often taken off the ground. Low-impact aerobic dance is defined as the exercise in which there is always one foot on the ground during the exercise. One of the major causes of sports injury in aerobic dance is overuse injuries of the lower extremity (60%; Francis et al., 1985; Mutoh et al., 1988). This high injury rate in aerobic dance may be due to the repetitive, high joint loads in the lower extremities. Therefore, the purpose of this study was to evaluate the effect of impact level on the joint kinetics of lower limb in step aerobic dance.

METHOD: Eighteen participants with the certification of YMCA Cardio and Step Aerobics Instructor were recruited in this study. A Helen Hayes marker set (19 markers) was bilaterally placed on the selected anatomical landmarks for each participant. VICON612 motion analysis system with a sampling rate of 250 Hz, two force plates (AMTI) with a sampling rate of 1000 Hz and a 15-cm aerobic step (REEBOK) were used in this study. The joint forces of the lower limbs were calculated with the inverse dynamics. Several pairs of aerobic shoes (Touch Aero) were provided for each participant for best-fit of their feet. Each participant was asked to perform the specific-choreographed step aerobic dance for 30 minutes, including warm-up and cool-down. Each participant danced with the same tempo varying from129 to135 beats/min in 30-min music. The step aerobic dance program mainly consisted of low-impact (Figs 1) and high-impact L-steps (Fig 2). Five trials of L-steps were collected and the average was calculated. The joint force was then normalized by body weight (BW) for each participant.

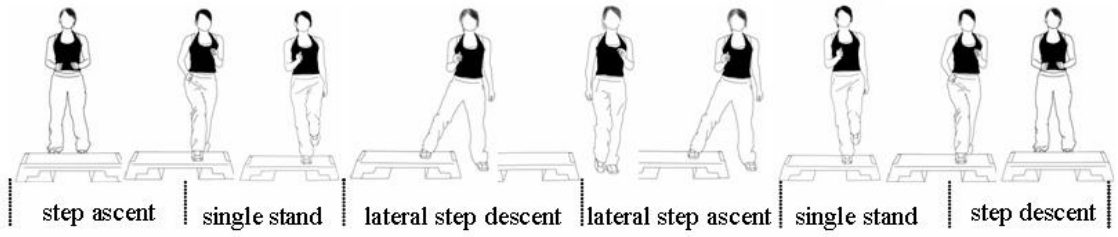

Figure 1. Low-impact L-step movement

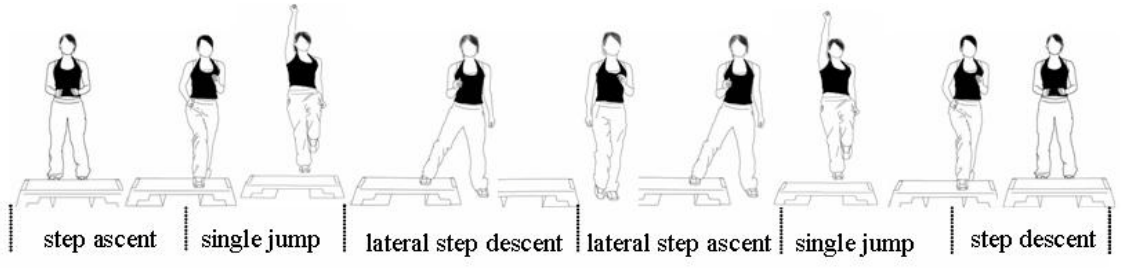

Figure 2. High-impact L-step movement

RESULTS: The joint forces of lower extremity in low-impact and high-impact L-step movements were shown in Table 1. Most of the joint forces in high-impact step aerobic dance were significantly greater than in low-impact step aerobic dance ($p<0.05$), except for four parameters; the anterior hip joint force, the medial knee joint force, and the posterior and medial ankle joint forces. The compression forces showed the greatest magnitude among the six directional forces, corresponding to 1.14 – 1.19 BW in low-impact dance and 1.71 – 1.79 BW in high-impact dance.

Table 1. The joint forces (BW) in the L- step movement (∗*p*<.05, NS: Non-significant).

mean(SD)		Low-impact	High-impact	*p*	Comparison
Hip	Anterior	0.22 (0.05)	0.23 (0.05)	.158	NS
	Posterior	0.40 (0.05)	0.53 (0.06)	.000∗	LI< HI
	Medial	0.05 (0.02)	0.07 (0.03)	.015∗	LI< HI
	Lateral	0.15 (0.03)	0.17 (0.03)	.005∗	LI< HI
	Tensile	0.39 (0.03)	0.43 (0.04)	.000∗	LI< HI
	Compressive	1.14 (0.10)	1.71 (0.20)	.000∗	LI< HI
Knee	Anterior	0.55 (0.09)	0.85 (0.11)	.000∗	LI< HI
	Posterior	0.14 (0.01)	0.15 (0.02)	.000∗	LI< HI
	Medial	0.10 (0.03)	0.10 (0.03)	.060	NS
	Lateral	0.19 (0.01)	0.32 (0.09)	.000∗	LI< HI
	Tensile	0.28 (0.03)	0.30 (0.03)	.000∗	LI< HI
	Compressive	1.19 (0.12)	1.79 (0.20)	.000∗	LI< HI
Ankle	Anterior	0.32 (0.04)	0.55 (0.07)	.000∗	LI< HI
	Posterior	0.09 (0.01)	0.08 (0.01)	.129	NS
	Medial	0.08 (0.04)	0.08 (0.02)	.782	NS
	Lateral	0.29 (0.012)	0.33 (0.13)	.013∗	LI< HI
	Tensile	0.09 (0.01)	0.10 (0.01)	.000∗	LI< HI
	Compressive	1.27 (0.13)	1.95 (0.23)	.000∗	LI< HI

DISCUSSION AND CONCLUSION: Our study illustrated that the joint forces in high-impact step aerobic dance would generate substantial joint loadings in the lower extremities. Compared with the findings in previous studies of stair climbing (Costigan et al., 2002; Riener et al., 2002), the joint compression forces in low-impact step aerobic dance were very close to the joint compressions in stair climbing, while the joint forces in high-impact step aerobic dance were relatively larger, about 1.5 to 2 times of that in stair climbing. Whereas the shear forces in high-impact step aerobic dance were quite similar to the shear forces in stair climbing. This study demonstrated that high-impact step aerobic dance would create a significant axial loading as well as the considerable shear force, especially the anterior knee joint forces (0.85 BW). There would be possibly a risk for the development of joint wear if sustaining long-term high shear force in lower extremity. Our findings suggest that high-impact step aerobic dance might be improper for those who have chronic injury in lower extremity or the novices.

REFERENCES:

Costigan, P. A., Deluzio, K. J., & Wyss, U. P. (2002). Knee and hip kinetics during normal stair climbing. *Gait Postur*e, 16, 31-37.

Francis, L. L., Francis, P. P. & Welshons-Smith, K. (1985). Aerobic dance injuries: A survey of instructors. *Physician and Sportsmedicine*, 14(5), 105-111.

Mutoh, Y., Sawai, S., Takanashi, Y. & Skurko, L. (1988). Aerobic dance injuries among instructors and students. *The Physician and Sportsmedicine*, 16(12), 81-88.

Riener, R., Rabuffetti, M. & Frigo, C. (2002). Stair ascent and descent at different inclinations. *Gait Posture*, 15, 32-44.