EXERCISE INTENSITY OF SOLO STYLE JAPANESE DRUM PLAYING AS AN AEROBIC EXERCISE OF 'TAIKOBICS

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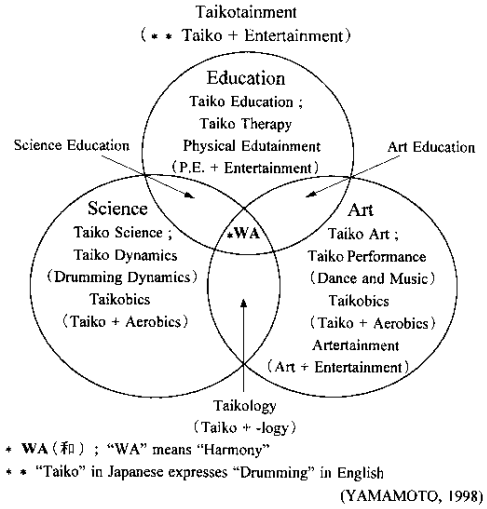
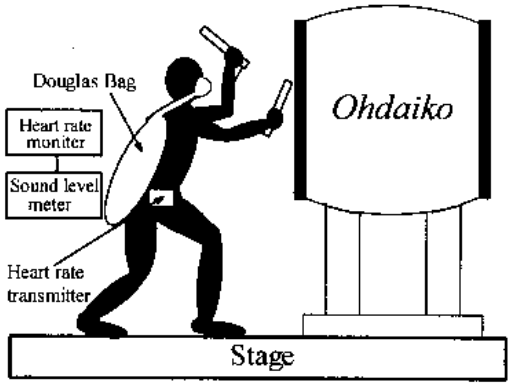
INTRODUCTION: A diversity of forms of Japanese drum playing (JDP) has survived and developed the performance of not only 'traditional styles' in the Japanese drum groups of Kaga-d(t)aiko, Konkoro-d(t)aiko, Gojinjyo-d(t)aiko, and Sagicho-d(t)aiko, etc., but also 'compositional styles' in modern hybrid groups. While historical evidence is elusive, much of the JDP in the rituals and festivals of Japan has clearly consisted of forms derived from ancestors. JDP has now become an art of music and exercise, often performed on stage and taught by professional instructors. Above all, the solo style of Japanese drum playing (SSJDP: Hitori-uchi) has been practiced all over the world. In the impressive variety of JDP, Hitori-uchi exhibits specific features or attitudes of the unique nature that the right and left stick arm movements alternate dynamically. And also, players perform aerobic exercises of 'Taikobics' (Figure 1) with the whole body, using a huge Japanese drum and sticks. Thus Hitori-uchi players have various skills of beating, involving grading, spacing, and timing, just as Japanese drum players themselves deeply appreciate the importance of major 'space' - a concept embracing the silence between sounds as well as the elastic Japanese sense of musical timing (Bowring & Kornicki, 1993). Since Hitori-uchi is an activity as a cultural form of importance especially in Japan and since such an activity would provide an extremely attractive alternative to many other exercises, it seems reasonable to investigate Hitori-uchi's potential as a cardio-respiratory fitness aid. Although some investigators have analyzed the physiological and biomechanical data in music instrument playing (Bejjani & Halpern, 1989; Bouhuys, 1969), such research regarding solo style playing is nonexistent. Therefore, the purpose of this study was to quantify the exercise intensity of Hitori-uchi as an aerobic exercise of 'Taikobics'.

METHODS: Virtuosi Japanese drum players (n=8) participated in this study. Physical characteristics of subjects are presented in Table 1. A huge Japanese drum (Ohdaiko) and sticks (Ohbachi; 40 cm□~3.8 cm, 0.53 kg) were used in this study. Figure 2 illustrates the schematic diagram of the experiment. Each subject performed playing the Ohdaiko for 5 minutes voluntarily in their own preferred rhythms. The sound levels were recorded using a digital sound level meter (NIHON IRYOKIKI NS-311).

For all trials, oxygen uptake (VO2) was measured during the last minute of the 5 min trial. Heart rate (HR) was recorded by radio-telemetry (NIHON KOHDEN EC-6201). Expired respiratory gas was collected using a Douglas bag. VO2 was determined with Douglas bag technique. Gas volume was measured in a dry gas meter (SHINAGAWA SEIKI DC-5). Gas samples were analyzed according to the Scholander technique for O2 and CO2, respectively. An estimate of caloric cost





was obtained by multiplying VO2 (l/min) by 5.05, which represents the caloric equivalent of a respiratory exchange ratio of 1.0 (McArdle, Katch, & Katch, 1991). Ratings of perceived exertion (RPE) were recorded immediately after each trial using the 15-point Borg scale (Borg, 1982). Maximal oxygen uptake (VO2max) tests were conducted on a Jonas body guard bicycle ergometer.

Table 1. Physical characteristics of subjects (Mean ± SD)

N	Age (yrs)	Height (cm)	Body weight (kg)	$\dot{V}O_2$max (l/min)	$\dot{V}O_2$max (ml/kg/min)	HRmax (beats/min)
8	29.5±5.2	171.7±4.0	66.4±11.6	3.02±0.65	45.6±7.5	188.3±9.4

RESULTS: Descriptive characteristics of subjects in Hitori-uchi are presented in Table 2. Absolute VO2 (l/min) and relative VO2 (ml/kg/min) averaged 2.33±0.59 and 35.7±9.0, respectively, and also, the energy cost represented 11.6±3.0 (kcal/min) and 176.5±43.6 (cal/kg/min), respectively. Additionally, HR revealed 173.0±11.1 (beat/min). %VO2max and %HRmax showed 78.2±15.3 and 92.0±6.0, respectively.

Table 2. Descriptive characteristics of subjects (Mean±SD)

N	$\dot{V}O_2$		HR	Energy cost		%$\dot{V}O_2$max	%HRmax	RPE	Sound level
	(l/min)	(ml/kg/min)	(beats/min)	(kcal/min)	(cal/kg/min)				
8	2.33±0.59	35.7±9.0	173.0±11.1	11.63±2.96	176.5±43.6	78.2±15.3	92.0±6.0	15.9±1.8	122.5±1.8

DISCUSSION: The mean values of %VO2max and %Hrmax in Hitori-uchi for virtuosi players (n=8) were 78.2 and 92.0, respectively. For these players, it is possible that the VO2 at the end of this specific 5-min exercise period in Hitori-uchi may have closely approached VO2max. In addition, virtuosi players perceived high levels of intensity. The sound volume obtained in this experiment was 122.5±1.8 dB, which almost corresponds to the recordings close to the aircraft engine. It can be inferred from the finding that virtuosi performers beat the Ohdaiko, manipulating the upper and lower extremity. In addition, in order to play the Ohdaiko effectively, players may increase exercises by keeping their stance and changing their wrist movements and stick strokes. These motions are the combined result of all the complicated physiological and biomechanical processes and actions peculiar to Hitori-uchi. The average individual in this study exercising at an RPE of 15 would expend approximately 176.5 cal/kg/min. The American College of Sports Medicine (ACSM) recommends that individuals obtain regular aerobic exercise for the development of cardio-respiratory fitness. If the individual is apparently healthy, the recommended intensity level is 60 to 90% of Hrmax or 50 to 85% of VO2max (ACSM, 1995). These intensities correspond with an RPE range of approximately 12 to 16. The energy cost of various modes of exercises are shown in Table 3. The value calculated in Hitori-uchi for virtuosi players is comparable to that of figure skating, and also, it is higher than that of high impact aerobic dancing and classical ballet on center floor. Thus, %VO2max and %Hrmax corresponded to the intensity range of ACSM recommendation.

Table 3. Comparison of energy cost among various modes of exercise

Exercise	Sex	n	Energy cost (kcal/min)	Energy cost (cal/kg/min)	References
Marching	male	12	5.90±0.91	-	Edholm, O. G., J. G. Fletcher, E. M.
Running	male	10	11.80±1.24	-	Widdowson and R. A. McCance, 1955
Cycling	male	10	7.79±0.98	-	
Tennis	male	7	7.13±0.91	-	
Squash	male	6	10.18±1.48	-	
Archery	male	2	5.24	-	
Cross-country skiing	male, female	4	9.27±0.92		Christensen, E. H. and P. Hogberg, 1950
Figure skating	female	2	9.56	182.5	Gordon, T. I., E. W. Banister and B. P. Gordon, 1969
Aerobic dancing					Igbanugo, V. and B. Gutin, 1978
Low	male, female	4	4.06±0.16	70±10	
Medium	male, female	4	6.58±0.55	100±10	
High	male, female	4	8.59±0.99	140±20	
Disco dancing	male	7	11.60±3.60	-	Leger, L. C., 1982
Classical ballet					Cohen, J. L. and K. R. Segal, 1982
Barre	male	4	5.85±1.04	90±10	
Center floor	male	4	8.38±1.54	130±20	
Hitori-uchi	male	8	11.63±2.96	176.5±43.6	Present study

CONCLUSION: The results obtained in this study suggest that Hitori-uchi has appropriate intensity level as an aerobic exercise of 'Taikobics', which can be useful for improving the cardio-respiratory fitness of Japanese drum players.

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