Effects Of A Beginning Judo Class On Heart Rate

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Abstract

We evaluated the heart rate responses of 15 adult and six child subjects to beginning judo class sessions. Heart rate responses were compared to cardiovascular intensity ranges recommended by the American College of Sports Medicine (ACSM). Heart rate responses of adults ($n = 15$) averaged 70 percent of age-predicted maximum heart rate with a range of 96 beats/minute to 154 beats/minute. The heart rate responses of the children ($n = 6$) averaged 68 percent of age-predicted maximum heart rate with a range of 133-161 beats/min. Our results show that judo is effective in elevating heart rate to levels recommended by the ACSM for appropriate periods of time to improve cardiovascular fitness.

Key words: adults, cardiovascular, children, grappling, martial arts,

Introduction

Judo is a system of self-defense, and can take many forms. Like wrestling, judo is a grappling sport, but the participants wear a jacket called a Gi. A typical judo competition match may last from 3 to 10 min depending on the tournament and age of the participant. A match may be won by throwing an opponent to his/her back with force, by pinning them for 25 seconds on their back, or by gaining submission through a strangulation or joint locking technique. The opponent submits by "tapping out", tapping the opponent or the mat, signaling defeat (Ogasawara 1988).

Because most judo techniques are relatively safe for students who have been properly taught the fundamentals, techniques can be safely practiced at or near maximal intensity levels with a resisting opponent during training sessions. This is especially true for the judo ground grappling techniques employing positions of control, strangles, and joint locks (Ogasawara 1988).

Judo coaches believe that this activity is an excellent systematic method for improving physical fitness. In fact, Richards (1982) even recommends it as an activity to develop fitness for other sports. However, a literature review yielded no studies showing how judo affects the beginning and/or child participant. It is no secret that our nation's children are becoming less fit. Rates of childhood obesity are higher now than ever before, and the reason for this is usually because of an imbalance between caloric expenditure and intake (Strauss and Pollack 2001, Troiano and Flegal 1998).

The research question guiding this study was, will a beginning judo class increase heart rates to levels recommended by the American College of Sports Medicine (ACSM) for improvement of cardiovascular fitness? Therefore, the primary purpose of this descriptive study was to evaluate heart rate responses of beginning level adults and children and compare average heart rates during judo class sessions to cardiovascular intensity ranges recommended by ACSM.

The ACSM (2000) recommends an intensity of exercise between 55 and 65 percent up to 90 percent of maximum heart rate for improving cardiovascular fitness. This intensity range is intentionally broad so deconditioned or low-fit individuals may be prescribed intensities of 55 to 65 percent. For example, an individual with a maximum heart rate of 200 would be prescribed a heart rate range of 110/130-180 beats/min to improve cardiovascular fitness. If this individual had poor physical fitness, then exercising at a heart rate between 110 and 130 beats/min might be sufficient to improve fitness. A more physically fit individual may not improve cardiovascular fitness from this lower intensity and would probably have to exercise at an intensity corresponding to a heart rate between 130 and 180 to improve cardiovascular fitness.

Exercise activities can usually be sorted into three groups (American College of Sports Medicine 2000):

1. Group one activities require little skill, and energy expenditure is relatively constant. Examples are treadmill walking and cycle ergometry.

2. Group two activities require a moderate amount of skill, and energy expenditure is related to the individual's skill in the particular activity. Examples include swimming and cross country skiing.

3. Group three activities require a high level of skill and exercise intensity may be highly variable. Examples are racquet sports and basketball.

The activity of judo is considered a group three activity. Will relative beginners be able to maintain average heart rates at ACSM recommended levels for cardiorespiratory improvements? That is the question this research addresses.

Literature Review

A comprehensive literature review yielded no studies on heart rate effects from judo on beginners and/or children. One study focused on the effects of judo on substrate utilization during one 5-min match. The study included 16 male judo competitors with an average age of 18.4 years. The subjects were all 2nd or 3rd degree black belts. In other words, they were highly skilled. The researchers reported an average percent heart rate of 92 percent of maximal for the matches (Degoutte et al. 2003).

Several other sources published the metabolic costs of combat sports including judo, boxing, karate, tae kwon do, and wrestling. Kravitz et al. (2003) found a linear increase in heart rate with increasing punching frequencies in 18 trained subjects participating in fitness boxing trials. Punching tempos ranged from 60 to 120 beats/min and heart rates ranged from 67 to 93 percent of maximum depending on tempo.

According to McArdle et al. (1996), a 68-kg (150-lb) individual participating in judo would expend 13.3 kcal/min. Caloric expenditure for a 68-kg individual participating in wrestling, karate, boxing practice and competition is 13.2, 13.2, 9.4, and 15.1 kcal/min, respectively. Nieman's (1995) Compendium of Physical Activities estimates caloric expenditure for judo, jujitsu, karate, kick boxing, and "tae kwan do" as 10 Mets, which equates to 11.9 kcal/min for a 68-kg individual. However, no designation of skill level and energy expenditure exists from these sources.

Maximum volume of oxygen consumed, or Max VO2, is a commonly used measure to evaluate cardiorespiratory fitness, and other researchers reported on the cardiorespiratory fitness of elite grappling athletes. Cipriano (1993) reported Max VO2 values between 60 and 70 $mlkg^{-1}min^{-1}$ for elite wrestlers. Horswill (2000) reported a range of 50-62 $mlkg^{-1}min^{-1}$ for scholastic age to Olympic level wrestlers.

Combat sports, including judo, wrestling, boxing, and karate, are physically demanding, and developing overall physical fitness clearly is a prerequisite for successful participation in these sports. Most of the research in this area has focused on the sport-specific requirements, physiological effects of training methods, and physiological profiles of high-level athletes rather than beginners.

Methods

Subjects

Five female and 10 male adults (age range 19-37 ys) who were registered for a beginning judo class, and six female children (age range 4-10 yrs) who participated in a winter judo camp at Montana Tech of the University of Montana served as subjects. The university approved all procedures and each adult subject and, for the children, a parent/guardian, signed an informed consent document. All subjects completed a physical activity readiness questionnaire, and none of the subjects were using any cardiac or pulmonary medication.

Procedures

We monitored the subjects' heart rates using a Polar T31 Heart Rate Monitor, which provided an average heart rate for the duration of the judo session. The subjects sat quietly for three minutes to establish resting heart rate. After recording resting heart rate, the class began as usual. The coaches were instructed to maintain normal class procedures. A typical judo class consists of the following phases (Dewey 2003):

1. Warm-up – which consisted of judo specific dynamic rhythmic movements that increased body temperature. The specific movements included jogging, free squats, judo falling called ukemi, grappling hip movements called ebbe/shrimping, and more.

2. Instruction – this phase usually includes a short review of past techniques and introduction of new techniques in a step-by-step manner.

3. Drills – making use of repetitive movements to reinforce what has been previously learned.

4. Randori (freestyle practice) – this is the sporting aspect of the session, where the students attempt to execute judo techniques on a resisting opponent for designated periods of time.

5. Fitness/Judo Exercises – this phase allowed for a variety of fun physical activities including judo freeze tag, judo dodge ball, push-ups, sit-ups, judo team soccer, and judo related relay races.

6. Cool-down – In general, the cool down phase allows time for heart rate and body temperature to return towards normal resting levels. Flexibility exercises are done during this phase.

Actual duration of each phase varies depending on various factors including age, experience, and objectives of the participants. For a beginner class, these phases may last anywhere from 5 to 20 min, however with more advanced athletes modifications to this general approach are often made. The major modification would be an increase in time spent during randori/freestyle practice essential for the competitive judo athlete (Pulkkinen 2001, Dewey 2003).

Heart rate monitors were checked at 5-min intervals by palpating a radial pulse for 15 sec and calculating a 1-min heart rate. We compared the palpated heart rate to the monitor's heart rate to ensure accuracy and recorded heart rate averages at the termination of the class. The adult class participated in the study 8-12 wks into the 16-wk semester, and the child class participated during the third and fourth weeks of a 4-wk camp to allow for development of some fundamental skills relative to judo. Because the heart rate monitors were telemetry units, subjects were not paired with each other because monitors would then be disrupted by the other subject's heart rate.

Results

We calculated age-predicted maximum heart rate (APMHR) by subtracting the subject's age from the constant 220 (American College of Sports Medicine 1995). Heart rate responses of the adults averaged 70 percent of age-predicted maximum heart rate with a range of 96 to 154 beats/min (Table 1). Heart rate responses of the children averaged 68 percent of age-predicted maximum heart rate with a range of 133 to 161 beats/min (Table 2). The classes were about 50 min in duration. Fourteen of 15 adult subjects and all six of the child subjects elevated their

Table 1. Adult heart rates.

Subject	Age	Mean HR*	% APMHR**
1	22	147	74
2	19	122	61
3	23	126	64
4	23	154	78
5	24	96	49
6	34	145	78
7	20	135	68
8	21	146	73
9	24	146	74
10	26	145	75
11	24	120	61
12	19	141	70
13	37	133	73
14	37	148	81
15	21	135	68
Mean	**24.93**	**135.93**	**69.80**
Std Dev	**6.09**	**14.97**	**8.33**

** Heart Rate*
*** Age Predicted Maximum Heart Rate*

heart rates to within the range of 55-90 percent of maximal heart rate recommended by ACSM to improve cardiovascular fitness.

Discussion

The adult subjects elevated their heart rates to 70 percent of APMHR, and the children elevated their heart rates to 68 percent of APMHR. The ACSM recommends elevating heart rate to 55/65—90 percent of maximum heart rate for at least 20 minutes for 3-5 days each week to improve cardiovascular efficiency, manage weight, and protect against chronic lifestyle-related disorders like heart disease.

Although many judo coaches state that their art is effective in improving overall physical fitness, a comprehensive literature search found no research on this topic as it pertains to beginners and children. Our results show that judo can be effective in elevating heart rate to levels recommended by the ACSM for appropriate periods of time to improve cardiovascular fitness. One adult subject only raised heart rate to 96 beats/minute (49% of APMHR), and some children were less enthusiastic than others during the classes. In a class with a variety of personalities, one can expect some

Table 2. Child heart rates.

Subject	Age	Mean HR*	% APMHR**
1	6	154.5	72.0
2	4	137.0	63.0
3	8	133.0	63.0
4	10	140.0	67.0
5	7	139.0	65.0
6	7	161.0	76.0
Mean	**7**	**144.08**	**67.67**
Std Dev	**2**	**11.05**	**5.28**

** Heart Rate*
*** Age Predicted Maximum Heart Rate*

students to try harder than others, which we observed among our subjects. So, repeat studies may show more variability in their results depending on the personalities of the subjects.

Still, the average effect on heart rate is important because of the state of health of Americans, especially American children. Studies show that American children are becoming increasingly overweight (Strauss and Pollack 2001, Troiano and Flegal 1998). There are many compounding factors, but the overall cause is a positive energy balance; a mismatch between caloric intake and caloric expenditure.

Another heath concern is type 2 diabetes. Type 2 diabetes used to be referred to as "Adult Onset Diabetes." However, it has been described as a new epidemic effecting American children (Ratner-Kaufman 2002). Obesity and sedentary lifestyle are risk factors for the development of type 2 diabetes. The importance of identifying healthy but somewhat non-traditional activities such as judo may be a part of the solution for many American adults and children.

Further research should focus on the changes of the various components of health related fitness over greater periods of time, including body mass index (a height-weight measure), body composition, muscular strength, endurance and flexibility, oxygen consumption, and tracking heart rate changes during the specific phases of the judo session. These recommendations would provide more information about the overall effects of judo training on physical fitness.

Practical Applications

Although this is a descriptive study, and no causal relationships can be derived, our results imply that judo can be an effective method for improving cardiovascular fitness. However, benefits that may be derived from training with a judo club, or any athletic club for that matter, may vary depending on a variety of factors, including overall mission of the club and coaching quality.

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