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Effect of Psycho-physical Stress on the Preference of Non-Athletic Youths for Intermittent or Continuous Bench-Stepping

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Abstract. This study was conducted to determine the preference of untrained, youths for Intermittent Stepping (IS) or Continuous Stepping (CS) test of cardio - respiratory fitness, based on their perceived exertion. Sixty male non-athletes who were 23.8±4.5 years old, weighed 62.58kg and were 172.6±cm tall, went through 6 minutes each of IS and CS on a 40cm high bench at 15 steps per minute. The IS protocol had one minute rest interspersed between it after 3 minutes. Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), heart rate (HR) and pulse pressure (PP) were obtained pre and post test. They rated their perceived exertion on a standard 15 point perceived exertion scale and later reported their preferred protocol. 70% preferred IS while 30% preferred CS. Significant rise in SBP, DBP, HR was induced by both IS ($P<.05$) and CS ($P<.01$). DBP did not change significantly ($P > .05$). The CS protocol (work intensity ≥13) is therefore recommended for preferential use in testing military and paramilitary recruits while, IS protocol (work intensity ≤12) is recommended for low fit fresh entrants in recreational and other sports and in clinical settings for fitness testing and exercise therapy in low technology environments

Key words: intermittent stepping, continuous stepping, perceived exertion, preference for testing, low fitness

1. Introduction

Maximum oxygen capacity (Vo_2 max) has been estimated from physiological responses to sub - maximal treadmill, cycle ergometry, bench-stepping and other modalities [1]. Over the years, several types of step test of cardio-respiratory fitness have been developed. Examples include: Harvard, Queens College, Chester, Sharkey and Canadian home fitness step tests [2]. Some of these step tests are continuous while others are intermittent lasting for 3 to 6minutes [1, 2].Intermittent stepping (IS) and continuous stepping (CS) ergometry have been found to be equally useful in estimating Vo_2 max [1, 3, 4]. The accuracy of these estimates of Vo_2 max is based on the premise that there is a linear relationship between increased heart rate (HR) and oxygen uptake [3, 5]. This increase in HR is known to be more rapid in the physically unfit than the fit individual at the same optimal or sub optimal work intensity [1, 6, 7].

Optimal work rate has been defined as the work intensity that corresponds to 40% of the individual's Vo_2 max and/or subjectively rated between "fairly light" or "somewhat hard" (ie.,13) in the 15 point category scale of perceived exertion [8]. In addition, it has been recommended that long lasting physical work should be performed at intensity below the individual's anaerobic threshold to avoid fatigue [8, 9]. The musculoskeletal effects of intense physical training of non athletic youths have been reported [10]. However, how musculo-skeletal stress is perceived by non athletic youths while the cordio-respiratory and cardio-vascular systems are being loaded using IS and CS protocols remain empirically unclear.

It is important to consider the subjective feelings of the individual carrying out the test since a test device

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should not only be physiologically efficient but must be subjectively acceptable to the user. The purposes of this study therefore were: 1) to ascertain if there are differences in the level of exertion perceived by subjects using IS and CS, 2) how differences in perceived exertion will influence their choice of bench stepping protocol using a psycho-physical scale.

2. Methods and Procedures

Sixty healthy non-athletic males, 23.8±4. 5 years old (range; 18-29 years) participated in this study. The subjects were on the average 62.58kg in weight (range 52.2 – 78.5kg) and 172.60cm tall (range 158 – 182cm). This study was conducted in two phases. In phase one. A continuous stepping (CS) group comprising 30 subjects was subjected to six minutes of CS, while the intermittent stepping (IS) group did six minutes of bench stepping with one minute rest after three minutes. Bench-stepping (fig.1) was at a cadence of 15 steps per minute on a 40cm high bench [1].

Fig. 1: Bench stepping.

Fig. 2: Measurement of blood pressure and heart rate

Not the stress on the lower limb muscles that may lead to psycho-physical and cardio- vascular stress during step test.

Systolic and diastolic blood pressure (BP) and heart rate (HR) were monitored and recorded before and immediately after stepping using an electronic digital blood pressure mornitor (Taidoc Technology Corporation, Taiwan) for both groups (fig.2). Thereafter the subjects rated their perceived exertion using Borg's 15 point category scale (fig.3) [8]. In the second phase, (after 24 hours rest) the subjects in CS group did IS while those in IS group did the CS test. All the protocols were observed as before. The subjects were then requested to choose the preferred mode of exercise stress testing based on their perceived exertion/discomfort. Their pulse pressure was estimated and the data analyzed using descriptive (mean, standard deviation and percentage) and t-test inferential statistics.

6
7 Very, very light
8
9 Very light
10
11 Fairly light
12
13 Somewhat hard
14
15 Hard
16
17 Very hard
18
19 Very, very hard
20

Fig.3. Borg's 15-point category scale for rating of perceived exertion.

3. Results

Out of the 64 individuals who volunteered to participants in this study, four were found to be university level athletes. There data was accordingly excluded during statistical analysis. Results of the work rating and subject preference are presented in table 1. Eleven (18%) subjects: 8 (13%) from the 1S and 3 (5%) from the CS, considered 6minutes bench stepping a very mild work. Twenty seven (45%) subjects: 15 (25%) from the IS and 12 (20%) from the CS group saw this test as fairly light; 20 (34%) subjects: 15(25%) from CS and 5 (8%) from the CS group rated this work as somewhat hard. Only 2(3%) subjects perceived CS as hard work. Forty two (70%) of the subjects preferred IS while 18 (30%) preferred the CS testing protocol.

Table 1. Rating of work intensity and subject preference.

R P E	Continuous	intermittent	All Subjects
Very mild	3(5%)	8 (13%)	11(18%)
Fairly light	12(20%)	15(25%)	27 (45%)
Somewhat hard	15(25%)	5(8%)	20 (34%)
Hard	2(3%)	-	2 (3%)
Subject preference	18(30%)	42(70%)	60 (100%)

RPE = Rating of Perceived Exertion

The changes in cardiovascular parameters induced by IS and CS protocols are presented in Table 2. It could be observed from this table that the resting cardiovascular parameters of the subjects in this study were similar. However, there were significant differences between the resting and post test cardiovascular responses in both IS ($P<.05$) and CS ($P<.01$) groups except the diastolic blood pressure which did not significantly ($P > .05$) change.

Table 2. Pre and Post test Cardiovascular Parameters of Subjects

Cardiovascular Parameter	Step-testing Intermittent		Protocol Continuous	
	Pre	Post	Pre	Post
Systolic BP	118.2±2.11	129.5*±3.41	122.4±2.20	141.3±4.10**
Diastolic BP	76.5 ±1.80	78.3 ±2. 10	80.3 ±2.11	83. 1± 2.22
Heat rate	72.2±3 01	100.4*±4.14	72.6±3.14	122.2±2.46**
Pulse Pressure	41.7± 3. 11	51.2*± 3.01	42.1± 2. 41	58.2* ±3.31

BP = blood pressure.

In each row for each protocol scores without asterisk are not significantly ($P>0.05$) different. Therefore, pre and post test diastolic blood pressure was not significantly different in both test protocols. However, in each row for each protocol, scores with one ($P<0.05$) or two ($P<0.01$) asterisks are significantly different from those without. Therefore, post test systolic blood and pulse pressures were significantly different in both test protocols.

4. Discussion

Many different types of scale have been developed to measure the perception of exertion during physical work [8, 9]. However, Borg's 15-point category scale is the most commonly applied psychophysical tool used to assess subjective effort [8]. The reliability and validity of the scale has been extensively studied. It was found to be reliable and applicable across different types of exercise modalities [9].

It was observed in this study that majority (63%, N=38) of the subjects found step test to be a light work (ie., <12 on Borg's 15 point scale). This suggests that bench stepping test of cardio-respiratory fitness is an easy test at least among people of age range 18 to 29. Applying psycho-physical principles, Purveys and Cureton[11] found that young men and women perceived an exercise intensity equal to the anaerobic threshold (AT) as "somewhat hard" (ie., 13). This indicates that bench stepping was below the AT of most subjects in this study. However, 20 (34%) of the subjects considered this test as "somewhat hard" thus pointing to the fact that 58 (97%) of this non athletes were working at an intensity that was less than or equal to their AT. Nevertheless, most of the subjects (N=47, 79%) were working at an optimum intensity [8].

Increase production of lactic acid and decreased tissue pH are known physiological changes that occur at exercise intensities above AT [6]. Decreased tissue pH is thought to be one of the major causes of muscle fatigue which may be the experience of the two subjects with very low fitness who found the test hard [1, 6].

This study further reveals that both IS (P<.05) and CS (P<.01) protocols induced a significant rise in cardiovascular variables. Such a rise in cardiovascular variables according to Longman et al [12] is to be expected. A rise in cardiovascular parameters observed in the present study is also in agreement with previous research that has shown high correlation between rating of perceived exertion and physiological parameters [7, 9]. However, the continuous step-test induced relatively higher cardiovascular responses indicating a higher demand on the cardio circulatory system.

Continuous bench stepping protocol was also found to place relatively more exertion on the musculoskeletal system of participants resulting in 70% subject preference for the intermittent protocol. This result corroborates earlier reports where subjects preferred 3 minutes step-testing intervals instead of the progressive step-testing of cardio respiratory fitness [13, 14]. These observations are further supported by additional findings that the number of subjects who found IS to be light (ie., <12, Very light – Fairly light) were more (N=23, 38%) than those who rated CS (N=15, 25%) the same way. Similarly, subjects that found CS (N=17, 28%) to be hard (ie., >12; somewhat hard – hard) were more than those who rated IS (N=5, 8%) same way. It is the summary of this work rating that reflected in the choice of step test protocol which suggest that IS is easier to perform.

However, based on job demand, there is need for certain category of low fit individuals such as military recruits to be tested at optimum work intensity to determine their ability to withstand stress. Borg [8] 1982 had defined subjective work rating of "fairly light"-"somewhat hard" (Vo_2 max 40%) as optimum work intensity. A combination of the findings of Borg [8] and Purvis and Cureton [11] suggest that young men working at an intensity that is somewhat hard work at their anaerobic threshold which is optimum.

Therefore, the CS protocol (work intensity ≥13) is recommended for preferential use in testing military and paramilitary recruits on the one hand, since it is more physically exerting but optimal. On the other hand, IS protocol (work intensity ≤12) is recommended for low fit fresh entrants in recreational and other sports such as youth corpse conscripts since it is less physically exerting [9, 10]. In addition, IS will be particularly useful in clinical settings for fitness testing and exercise therapy in low technology environments, where sophisticated equipment may not be available [15, 16].

This study was conducted in the Human Performance Laboratory, Department of Medical Rehabilitation, College of Health Sciences, Obafemi Awolowo University, Ile-Ife, Nigeria.

5. References

[1] P. L.Pollock, J. H. Wilmore. *Exercise in Health and disease*. Philadephia: W. B Saunders Company, 2001. Wikipedia 2006

[2] American College of Sports Medicine. *Guidelines for exercise testing and prescription.* Philadelphia : Lea and Febigar, 1991.

[3] J. P. McDougal, H.A. Wenger and H. Green. *Physiological testing of high performance athletes.* Champaign IL: Human Kinetics, 1991.

[4] W.F. Ganong Review of Medical Physiology 15TH edn. California: Lange Medical Publications. 2001

[5] P.O. Astrand and K. Rodahl. Text book of work Physiology. 3rd edition. New York: McGraw Hill, 1986.

[6] J.A. Gwani, W.B.Lawal, K.Venkateswarlu. effect of intermittent and continuous training on blood pressure ofadolescents and children*. Journal of Research in Health and sport Science.* 2000, **2**: 17-21.

[7] G.A.V. Borg. Psychophysical Bases of perceived exertion. *Medical Science in Sports and Exercise.*1982, **14**: 172 - 381.

[8] J.A. Balogun. Optimal rate of work during transportation on the head and by yoke. *Industrial Health.* 1986, **24**: 75-86.

[9] M.O. Egwu. The Musculoskeletal effect of intense physical training of Non-athletic youth corps conscripts. *British journal of sports medicine.* 1996, **30**: 211 - 214.

[10] J.W. Purvis, K.J. Cureton. Rating of perceived exertion at the anaerobic threshold. *Ergonomics.* 1981, **24**: 295-300.

[11] R. M. Longman, D.T. Sohtmeingart and M.E. Foss. Exercise as a Partial Therapy for the Extremely Obese. *Medicine and Science in Sports and Exercise.* 1988, **18**: 19-24.

[12] R.J. Shepherd. The current status of the Canadian home fitness test. *British Journal of Sport Medicine.* 1980, **14**: 114 - 125.

[13] M. Jette. The Standardized test of fitness in occupational health: Pilot Project. *Canadian Journal of Public Health.* 1978, **69**: 431 - 438.

[14] A.Gwani, M.S.Mohamed, M.A.Chado. Effects of regular exercise on insulin dependent diabetics. *Journal of Research in Health and sport Science.* 2001, **3**: 40-44.

[15] A.O.Adekunle, S.R.A.Akimbo, M.O.Kehinde. Effect of submaximal exercise therapy on immunity of HIV positive patients. *Nigerian Journal of Medical Rehabilitation.* 2004, **9**(17): 9-12.