DRASSA
DRASSA دراسا
مجلة بحوث وتطوير أنشطة علوم الرياضة
Journal of Development & Research for Sport Science Activities
دراســـــا

ANALYSIS OF EFFORT AND ENERGY EXPENDITURE DURING EXERCISES WITH FREESTYLER™ ELASTIC TUBES OF DIFFERENT RESISTANCE.

Primož Pori, Maja Pori, Tina Jarc Šifrar,& Borut Pistotnik

ABSTRACT

Workouts on Freestyler™ board are performed with stretching elastic tubes which are attached to arms and legs. The aim of the study was to investigate the effects of exercises with Freestyler™ elastic tubes of different resistance on heart rate frequency and prediction of energy expenditure. Eleven males (age 23.4 ± 1.1 years; height 181.6 ± 3.1 cm; weight 81.4 ± 4.9 kg) participated in the study. Effort was assessed with measuring heart rate (HR) frequency. To calculate maximum HR frequency (HR_{max}) an intermittent Fitness test 30-15 (Buchheit, Haddad, Millet, Lepretre, Newton and Ahmaidi, 2009) was used. Predicted energy expenditure was evaluated with Keytel et al. (2005) formula. One-way analysis of variance - repeated measures was used to analyse the effects of exercises with elastic tubes of different resistance. The results shows that both in relative HR frequency (% HR_{max}) ($F_{(4, 40)}$ = 161, 906; p = .000) and predicted energy expenditure ($F_{(4, 40)}$ = 151, 677; p = .000) there are statistically significant differences when performing exercises with elastic tubes of different resistance. It could be concluded that doing the same exercises with higher and higher resistance elastic tubes on the Freestyler™ board, could increase the % HR_{max} (from 19% to 43%) and predicted energy exposure (from 33% to 71%), compared to no additional resistance

Keywords: HR frequency, calories, Freestyler™ board

ISSN 2414-6900

http://dx.doi.org/10.31377/jdrssa.v2i2.522

© 2015 the Authors. Production and hosting by Avicenna FZ LLC. on behalf of JDRSSA – United Arab Emirates. This is an open-access article under the CC BY-NC license

Introduction

Physical activity (PA) is one of several components of a healthy lifestyle. International expert opinion supports at least 150 minutes of moderate or 75 minutes of vigorous (hard) intensity PA a week to maintain health, while 300 minutes of moderate or 150 minutes of vigorous intensity PA a week is needed to improve health (USDHHS, 2008).

Physiological benefits of PA are well established (Seefeldt, Malina, and Clark, 2002; Penedo and Dahn, 2005; USDHHS, 2008; ACSM, 2010); beside all it has great effect on body weight control (Mišigoj-Duraković, 2003; Nielsen and Andersen, 2003). According to WHO (WHO: Obesity, 2009) in 2015 there will be over 2,3 billion overweight people in the world, in Slovenia 70 % of adult Slovenes are overweight (IVZ, 2006). PA is defined as any bodily movement produced by skeletal muscles that require energy expenditure (Penedo and Dahn, 2005) therefore it could be seen also as one of the most effective strategy for reducing weight.

Latest recommendation of PA for health suggests that not only aerobic activities but also strength and flexibility exercises should be included in weekly workouts (Sharkey, 2011). Freestyler™ itself allows even load of all the major muscle groups of the body therefore substantial increase in muscle strength of the whole body could be achieved. Also the duration of workout (from 45 to 60min) could contribute to aerobic capacity improvement. The relative HR frequency known to have the greatest effect on aerobic abilities should be between 55% and 90% of maximum HR (HR_{max}) (Ehrman, Gordon, Visich and Keteyan, 2003).

ISSN 2414-6900
http://dx.doi.org/10.31377/jdrssa.v2i2.522
© 2015 the Authors. Production and hosting by Avicenna FZ LLC. on behalf of JDRSSA – United Arab Emirates. This is an open-access article under the CC BY-NC license

Freestyler™ board is a 120cm long oval platform with two rollers on each ends. A 100cm long elastic tube is placed through each roller, providing constant elastic resistance during every exercise. Workouts on Freestyler™ board are performed with stretching elastic tubes, which are attached to arms or/and legs (either by holding handles or using ankle cuffs). Unique elastic tube placement and the configuration of the Freestyler™ board itself enables full three dimensional body movements in 360°

executed in spiral and diagonal form, maximum range of motion adapted to each individual, synchronized whole body workout using upper and lower body while placing a substantial workload also on trunk muscles (core) by creating instability in the body by changing resistance pulls at each limb attachment (Petrović, 2007).

Several researchers have investigated activity in muscles during elastic resistance exercise. Hintermeister, Lange, Schultheis, Bey and Hawkins (1998) and Ebben and Jensen (2002) stated that elastic resistance could represent one of the most effective tools in strength training. Exercises could be performed slowly and under control, which activates muscles in concentric and also in eccentric phase of contraction. Workouts with elastic resistance represent kind of PCT (proprioceptive training) which has positive effects on strength and coordination development as well as on joints' stabilization (Šarabon, Zupanc and Jakše, 2003).

Among different types of PA as strategies for improving physical health workouts on Freestyler™ board could be suitable for participants of all levels of physical fitness.

ISSN 2414-6900
http://dx.doi.org/10.31377/jdrssa.v2i2.522
© 2015 the Authors. Production and hosting by Avicenna FZ LLC. on behalf of JDRSSA – United Arab Emirates. This is an open-access article under the CC BY-NC license

Therefore the aim of the study was to determine what kind of effort is achieved during exercises with Freestyler™ elastic tubes of different resistance and what the energy expenditure is.

Materials and Methods

Participants

Eleven males (age 23.4 ± 1.1 years; height 181.6 ± 3.1cm; weight 81.4 ± 4.9kg; HR_{max} 199.6 ± 4.8 beats/min; VO_{2max} 51.82±2.4ml/kg) participated in the study. They were engaged in general physical activity at least twice a week for more than one hour, but none of them was practising competitive sport. They were new to the workout of elastic tubes. All participants were in good health and have personally volunteered to take part in this study. The study was undertaken in compliance with the Helsinki Declaration.

Instruments

Set of variables consisted of HR frequency (absolute, relative and maximum HR frequency) and predicted energy expenditure. We used Polar Team2 Pro system (Polar, OUL, Finland) for measuring absolute HR frequency (HR_{abs}). To calculate maximum HR (HR_{max}) frequency an intermittent Fitness test 30-15 (Buchheit, Haddad, Millet, Lepretre, Newton and Ahmaidi, 2009) was used, from which relative HR (% HR_{max}) was computed. The Fitness test 30-15 involved 30 seconds of running alternated with 15 seconds of walking on a distance of 40m area. The initial velocity was 8.0km/hr., with increments increased by 0.5km/hr. every 45 second stage. Predicted energy expenditure

ISSN 2414-6900
http://dx.doi.org/10.31377/jdrssa.v2i2.522
© 2015 the Authors. Production and hosting by Avicenna FZ LLC. on behalf of JDRSSA – United Arab Emirates. This is an open-access article under the CC BY-NC license

in calories was evaluated with following Keytel et al. (2005) formula: calories burned = [(age x 0.2017) + (weight x 0.09036) + (HR_{abs} x 0.6309) - 55.0969] x time / 4.184.

Procedure

Workout protocol on Freestyler™ board: All workout protocols conducted were the same in structure and movements used; only intensity of the workload (represented by elastic tubes of different resistance) was changed during 6 week period. Workout protocol consisted of initial phase (warm up) 10min, main phase 20min and final phase (cool down) 10min. Warm up phase of the workout consisted of cyclic moves usually used in the aerobic workouts (step touch, marching, V step, grapevine...) in order to bring heart rate up and prepare participants for the main part of the work. Main part of the workout protocol was constructed as a type of interval training using 6 complex exercises (figure 1) performed each for 30sec in 3 series with 30sec of active rest (step touch exercise) in between. Test subjects performed all series of the same exercise and then moved as quickly as possible to the next one. Speed of the workout protocol was dictated by the 128 beats/min music usually used for group fitness aerobic style workouts.

Exercise 1	Step touch (alternating leg adduction and knee up) with alternating single arm shoulder press	

ISSN 2414-6900
http://dx.doi.org/10.31377/jdrssa.v2i2.522
© 2015 the Authors. Production and hosting by Avicenna FZ LLC. on behalf of JDRSSA – United Arab Emirates. This is an open-access article under the CC BY-NC license

Exercise 2	reverse butterfly (tubes crossed) with squat (90 degrees knee angle) in between	
Exercise 3	squat (90 degrees knee angle) into shoulder press (with forearm pronation)	
Exercise 4	walk (with knees high and biceps curl)	
Exercise 5	squat into alternating leg curl	
Exercise 6	alternating hip extension in standing position with straight arms moving forward (palms in supinated position)	

Fig.1. Six complex exercises performed on Freestyler™ board during workout protocol.

Experiment lasted for 6 weeks. In the first week we performed intermittent Fitness test 30-15. In the next 5 weeks each Monday morning at the same time and after 48 hour rest was assured (on weekends) participants performed above mentioned workout protocol on Freestyler™ board. In the second week, workout protocol was performed without any outside elastic resistance. Third, fourth, fifth and the sixth week we increased intensity of the work by using elastic tubes of higher resistance (Petrovič, 2007):

ISSN 2414-6900
http://dx.doi.org/10.31377/jdrssa.v2i2.522
© 2015 the Authors. Production and hosting by Avicenna FZ LLC. on behalf of JDRSSA – United Arab Emirates. This is an open-access article under the CC BY-NC license

- Level EASY, tube length 100cm, inner diameter 5mm, outer diameter 9mm
- Level MEDIUM, tube length 100cm, inner diameter 6mm, outer diameter 10mm
- Level STRONG, tube length 100cm, inner diameter 5mm, outer diameter 10mm
- Level SPORT, tube length 100cm, inner diameter 6mm, outer diameter 11mm.

Statistical methods

The acquired data was analysed using the SPSS program. First basic descriptive statistics was calculated. One-way analysis of variance - repeated measures was used to analyse the effects of exercises with elastic tubes of different resistance. Statistical significance was tested at 5% Alpha error level.

Results

The results show that HR_{abs} increased when performing exercises with elastic tubes of higher resistance. The average values HR_{abs} reached during workouts were between 129 and 185 beats/min of (table 1). Participants increased the HR_{abs} from 19% to 43% compared to no additional resistance.

Table 1. Average HR_{abs} during exercises with Freestyler™ elastic tubes of different resistance.

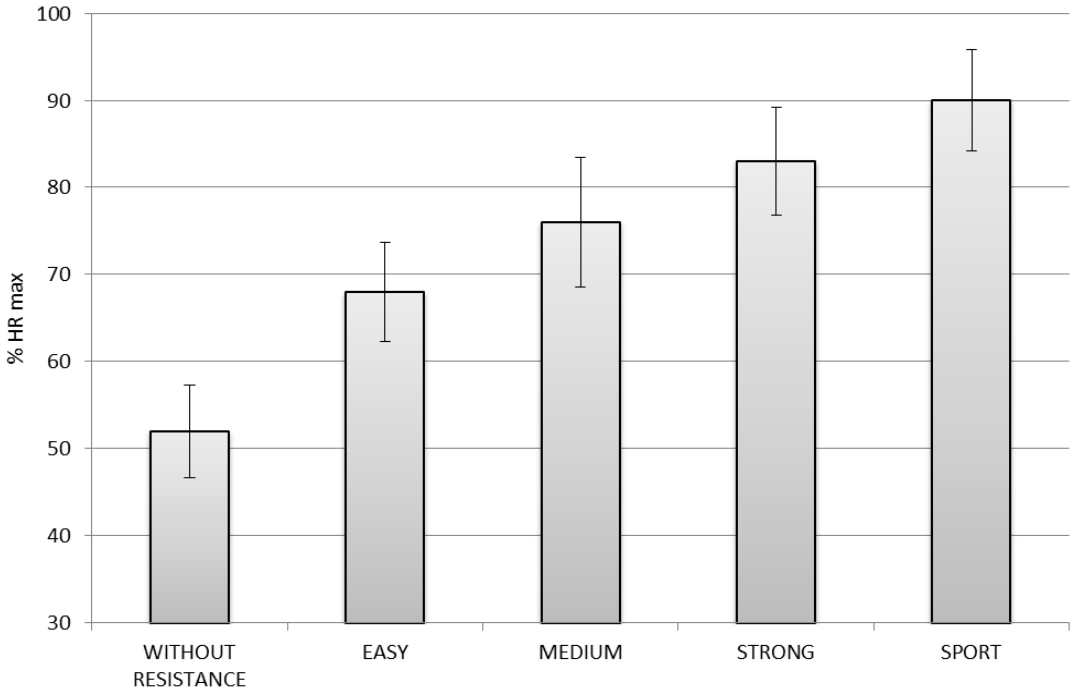
Resistance of elastic tubes	Mean	Std. Dev.	Increas of HR in %
NONE	129,27	6,6	
EASY	153,27	7,9	18,56
MEDIUM	164,64	10,7	27,36

ISSN 2414-6900
http://dx.doi.org/10.31377/jdrssa.v2i2.522
© 2015 the Authors. Production and hosting by Avicenna FZ LLC. on behalf of JDRSSA – United Arab Emirates. This is an open-access article under the CC BY-NC license

STRONG	175,09	8,9	35,44
SPORT	184,91	8,6	43,04

Calculated relative HR frequency was ranging between 52% and 90% of HR_{max}. The lowest value was achieved during workouts with no additional elastic resistance (figure 2). We have found statistically significant differences in relative HR frequency (% HR_{max}) ($F_{(4, 40)}$ = 161, 906; p = .000) when performing exercises with elastic tubes of different resistance. There were significant difference between the scores for all pairs of elastic tubes (None vs Sport $F_{(1, 10)}$ = 221, 309; p = .000; Easy vs

Sport $F_{(1, 10)}$ = 533,028; p = .000; Medium vs Sport $F_{(1, 10)}$ = 347,270; p = .000; Strong vs Sport $F_{(1, 10)}$ = 213,626; p = .000).



ISSN 2414-6900
http://dx.doi.org/10.31377/jdrssa.v2i2.522
© 2015 the Authors. Production and hosting by Avicenna FZ LLC. on behalf of JDRSSA – United Arab Emirates. This is an open-access article under the CC BY-NC license

Fig. 2: Average relative HR frequency during exercises with Freestyler™ elastic tubes of different resistance.

The results showed that performing exercises with different elastic tubes of higher resistance on Freestyler™ board could statistically significantly increase the predicted energy exposure from 33% to 71% compared to no additional resistance ($F_{(4, 40)}$ = 151, 677; p = .000) (figure 3).

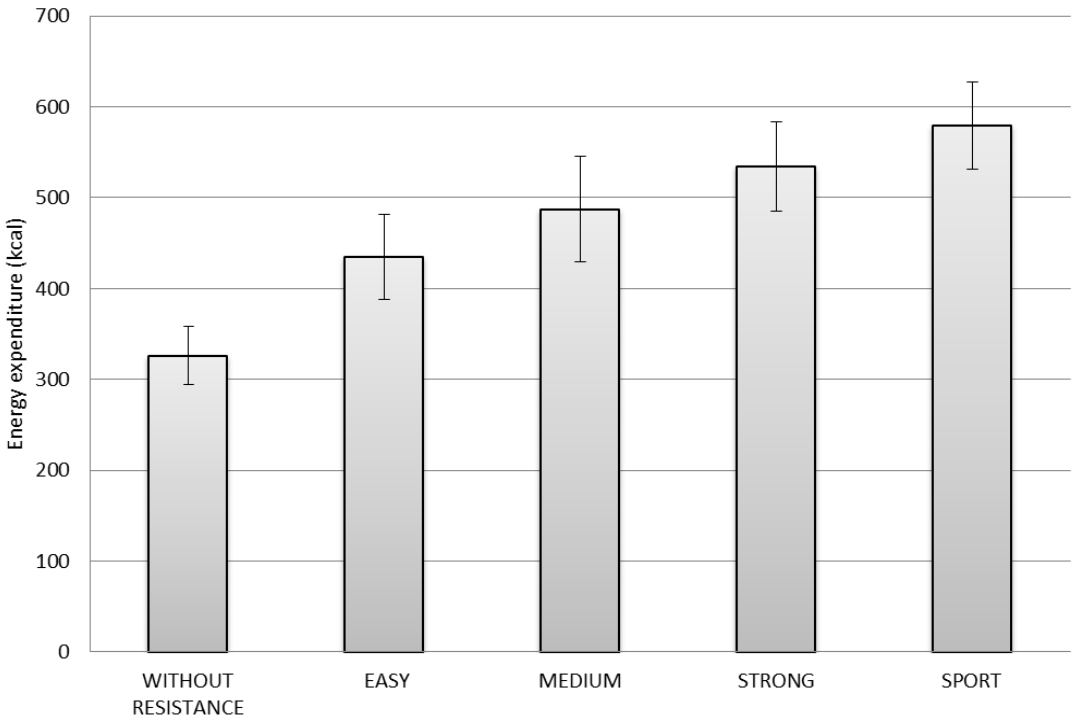


Fig. 3: Average prediction of energy expenditure during exercises with different Freestyler™ elastic tubes of higher resistance.

Discussion and Conclusions

ISSN 2414-6900
http://dx.doi.org/10.31377/jdrssa.v2i2.522
© 2015 the Authors. Production and hosting by Avicenna FZ LLC. on behalf of JDRSSA – United Arab Emirates. This is an open-access article under the CC BY-NC license

The purpose of this study was to evaluate the potential increase in heart rate frequency and predicted energy expenditure during different intensity of workouts on Freestyler™ board. Increase in intensity was assessed with using Freestyler™ elastic tubes of four levels of resistance (from EASY to SPORT) and produced by overcoming higher elastic resistance.

Freestyler tubing set has linear strength increase, which is very important in defining the correct workload during workouts. Generally it is recommended that exercise is performed between 25% and 250% elongation and that resistance increase by progressing to the next tubing strength rather than increasing the stretch on the tubing (Igmat d.d., 2011). The resistance could easily be adapted to

individual's abilities either by increasing or decreasing of stretch of elastic tubes in starting position of each exercise (Hintermaister et al., 1998) or using tubes of different resistance level.

The lowest relative HR frequency was achieved when performing exercises without elastic tubes (52%), which indicated light level of aerobic workout intensity (Ehrman et al., 2003). Using elastic tubes showed an increase in average values of HR frequency, which reached 90% of HR_{max} when using the strongest elastic resistance. According to recommendation of PA for health the lowest level achieved during exercise should be 140 beats per minute (HR_{abs}) (Mišigoj Duraković et al., 2003). In our case this level was achieved already when EASY elastic tubes were used. ACSM (2012) determined that

ISSN 2414-6900
http://dx.doi.org/10.31377/jdrssa.v2i2.522
© 2015 the Authors. Production and hosting by Avicenna FZ LLC. on behalf of JDRSSA – United Arab Emirates. This is an open-access article under the CC BY-NC license

the greatest increase in aerobic capacity can be achieved if practising at 60% to 85% of $HR_{max.}$ We could conclude that exercises performed with elastic resistance are already very effective at the lowest workout resistance level and could provide a substantially increase of aerobic capacity of the organism. This fact is of great importance especially for beginners, who should start with low intensity of workout. Only when performing exercises with the strongest elastic resistance (SPORT) the HR_{max} increased to 90% which is by ACSM recommendation (2012) classified as very hard intensity and should not be exceeded for longer time in workouts for health purposes.

Heart rate frequency is strongly correlated with energy expenditure, which was calculated with a Keytel et al. (2005) formula. We observed substantial increase in caloric expenditure when performing exercises with elastic tubes of different resistance compared to no resistance. The greatest increase (71%) was achieved when using elastic tubes with the strongest resistance (SPORT). Energy expenditure increased due to higher load which was assessed during exercises with elastic tubes of higher resistance.

To conclude, this study shows that even lowest elastic resistance produces substantial increase in efficiency of the workout of measured sample. The results could support the thesis that workouts on Freestyler™ board are suitable for individuals of all levels of physical fitness and could contribute to better aerobic capacity as well as to increasing energy expenditure.

ISSN 2414-6900
http://dx.doi.org/10.31377/jdrssa.v2i2.522
© 2015 the Authors. Production and hosting by Avicenna FZ LLC. on behalf of JDRSSA – United Arab Emirates. This is an open-access article under the CC BY-NC license

References

ACSM - American College of Sports Medicine (2010). **ACSM's guidelines for exercise testing and prescription** ,8th edition. Philadelphia: Lippincott Williams& Wilkins.

ACSM - American College of Sports Medicine (2012). **Foundation of Strength Training and Conditioning**. Indianapolis: Lippincott Williams and Wilkins Customer.

Buchheit, M., Haddad, H., Millet, G.P., Lepretre, P.M., Newton, M. & Ahmaidi S. (2009). Cardiorespiratory and cardiac autonomic responses to 30-15 intermittent fitness test in team sport players**. Journal of Strength and Conditioning Research** 23 (1), 93-100.

Ebben, W. & Jensen, R. L. (2002). Electromyographic and kinetics analysis of traditional, chain and elastic bands squats. **Journal of Strength and Conditioning Research** 16 (4), 547-550.

Ehrman, J.K., Gordon, P.M., Visich, P.S. & Keteyan, S.J. (2003). **Clinical Exercise Physiology.** Champaign, Il: Human Kinetics.

Hintermeister, R.A., Lange, G.W., Schultheis, J.M., Bey, M.J. & Hawkins, R. J. (1998). Electromyographic activity and applied load during shoulder rehabilitation exercises using elastic resistance. **The American Journal of Sport Medicine** 26 (2), 210-219.

ISSN 2414-6900

http://dx.doi.org/10.31377/jdrssa.v2i2.522

© 2015 the Authors. Production and hosting by Avicenna FZ LLC. on behalf of JDRSSA – United Arab Emirates. This is an open-access article under the CC BY-NC license

Igmat d.d. (2012). Quality tests & Warranty. **Gotten** 14.6.2013 z: http://www.igmat.si
IVZ (2006). Gotten 7.3.2012 z: http://www.ivz.si

Keytel, L.R., Goedecke, J.H., Noakes, T.D., Hiiloskorpi, H., Laukkanen, R., van der Merwe, L. & Lambert, E.V. (2005). Prediction of energy expenditure from heart rate monitoring during submaximal exercise. **Journal of Sports Sciences** 23 (3), 289-297.

Mišigoj Duraković, M. et al. (2003). **Telesna vadba in zdravje. Znanstveni dokazi, stališča in priporočila zveze društev športnih pedagogov Slovenije**: Fakulteta za šport, Zavod za šport Slovenije: Zagreb: Kineziološka fakulteta.

Nielsen, G.A. & Andersen, L.B. (2003). The association between high blood pressure, physical fitness, and body mass index in adolescents. **Preventive Medicine** 36 (2), 229-234.

Penedo, F.J. & Dahn, J.R. (2005). Exercise and well-being: a review of mental and physical health benefits associated with physical activity. **Current Pinion of Psychiatry** 18 (2), 189-193.

Petrović, S. (2007). Manual of basic to multi axis exercises on Freestyler. **Gotten** 14.6.2013 z: http://www.ivz.si

Seefeldt, V., Malina, R.M. & Clark, M.A. (2002). Factors affecting levels of physical activity in adults. **Sports Medicine** 32 (3), 143-168.

ISSN 2414-6900
http://dx.doi.org/10.31377/jdrssa.v2i2.522
© 2015 the Authors. Production and hosting by Avicenna FZ LLC. on behalf of JDRSSA – United Arab Emirates. This is an open-access article under the CC BY-NC license

Šarabon, N., Zupanc, O. & Jakše, B. (2003). Pomen proprioceptivnega treninga v košarki. **Šport** 51 (3), 26-29.

WHO (2009). Obesity. Geneva**: World Health Organization**.

USDHHS - United States Department of Health and Human Services (2008). Gotten 5.8.2011 z: http://www.nhlbi.nih.gov/health/dci/Diseases/phys/phys_what.html

ISSN 2414-6900

http://dx.doi.org/10.31377/jdrssa.v2i2.522

© 2015 the Authors. Production and hosting by Avicenna FZ LLC. on behalf of JDRSSA – United Arab Emirates. This is an open-access article under the CC BY-NC license