Proceeding

9th INSHS International Christmas Sport Scientific Conference, 4-6 December 2014. International Network of Sport and Health Science. Szombathely, Hungary

The running economy difference between running barefoot and running shod

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ABSTRACT

Kalina, T., Cacek, J., & Kmetova, L. (2015). Comparison of maximum lactate between course navette test and hoff test in soccer players at 2600 meters above sea level. *J. Hum. Sport Exerc., 9*(Proc1), pp.S399-S403. Barefoot (BF) running is very popular topic among runners and coaches, and very often discussed in papers and even mass-media point is health aspect. The aim of this study is verify influence BF on physiological indicators. Nine women (age 21.1 ± 1.79 y.o., weight 59.7 ± 5.86 kg, height 164.8 ± 4.02 cm, no previous BF running experience, athletes, non-runners) completed two tests of running economy (RE) in minimal gap of 48 hours. Test of RE consisted of dynamic stretching warm-up and 7 minutes run on treadmill (constant velocity 7 km·h^{-1}, inclination +1 %) BF and shoed (RS). Hearth rate (HR; beats·min-1) and oxygen uptake (RE, running economy; ml·kg-1·min-1) were collected in last two minutes of each test. There were found insignificant differences (α = .05) in HR (BF 160.92 ± 22.62 vs. RS 163.5 ± 20.99; p = .214) a RE (BF 31.5 ± 2.65 vs RS 30.21 ± 2.91; p = .086). There were been discovered seven individual lower values of RE in BF, as well as same number of lower values of HR (BF). Running barefoot is insignificant economical in among non-experienced barefoot women athletes. **Key words** JOGGING, COST OF RUNNING, ENERGY, WOMEN, BREATH-BY-BREATH, TREADMILL.

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9th INSHS International Christmas Sport Scientific Conference, 4-6 December 2014. International Network of Sport and Health Science. Szombathely, Hungary.
JOURNAL OF HUMAN SPORT & EXERCISE ISSN 1988-5202

doi:10.14198/jhse.2015.10.Proc1.31

INTRODUCTION

Barefoot (BF) running is widely discussed topic nowadays among sport scientists, fitness trainers and general public. This discussion took larger sizes after the publication of the book Born to Run (McDougall, 2010). In parallel with the debate about the appropriateness and inappropriateness of running shoes (and types), opens topics on the biomechanics of running gait and training-induced injuries (Lieberman, 2012).

One of the most discussed factors that determine the performance is running economy (RE), which indicates how much oxygen is consumed by runner at a specific velocity. Lower oxygen consumption at the same speed means a better RE (Saunders, Pyne, Telford & Hawley, 2004; Bassett & Howley, 2000).

This study focuses on monitoring differences in running economy BF and running in shoes (RS) with the participating females (non-runners) that have no previous experience with BF.

MATERIAL AND METHODS

Participants

The research was conducted in nine randomly selected female recreational athletes, non-runners, students of the Masaryk University without previous barefoot running experience. Participants characteristics are shown in table 1. All students participated in the study voluntarily.

Table 1. Descriptive statistics of participants

	Mean	SD
Height (cm)	165	4
Age (years)	22,1	1,8
Weight (kg)	59,7	5,9
Body fat mass (kg)	13,9	3,3
Body fat mass (% of body mass)	23,2	3,9
Body mass index (kg·m2)	21,9	1,7
Muscle mas (kg)	25,2	2,3

Procedures

The difference between barefoot and shod running on indicators of running economy and heart rate was exanimated thought two separate test session (BF and RS) in random order. Gap between each test was at least 48 hours. Both tests were conducted between 8 AM and 10 AM. Each test was performed with (RS) or without shoes (BF). Standard warm-up (10 minutes of dynamic stretching) was followed by 5 minutes of passive rest and actual testing protocol on running treadmill (Catana, Lode, The Netherlands). Running protocol lasted 7 minutes, treadmill was set 1 % inclination (Jones & Doust, 1996) and speed was set to 7 $km \cdot h^{-1}$ (see figure 1). During last two minutes of test, hearth rate (HR; Forerunner 91XT HR, Garmin, USA) and oxygen uptake (Metalyzer 3b, Cortex, Gernany), the breath-by-breath analysis, data were been collected. Body composition analysis were performed before first test session (InBody 720, Biospace, Korea).

Figure 1. One of participants during test protocol (condition: barefoot)

The testing was conducted at a constant temperature of 20 ± 1 °C, always in the same clothes. Participants used shoes with similar attributes (stiffness, weight, etc.), which are commonly classified by manufactures as cushioned running shoes. Two days before the first testing session and during the research, the tested subjects were asked to refrain from any sports activities. Before each measurement, the calibration of Metalyzer 3b was performed by a calibration syringe (3 Liter Calibration Syringe, Cortex, Germany).

Analysis

The obtained data were expressed as VO_2 (ml·kg^{-1}·min^{-1}) and HR (beats·min^{-1}) and changes between DS and BF were observed by Wilcoxon signed-rank test. The level of $p < 0.05$ was considered as statistically significant. Differences between DS and BF were also described by Cohen d coefficient (effect size). The software program Statistica 12 (StatSoft, USA) was used for all statistical analyses.

RESULTS

We found no statistical significant differences in running economy indicator (VO_2) and heart rate (HR) according different condition (participants ran with and without shoes). BF mean of VO_2 was 1.26 ml·kg^{-1} ·min^{-1} lower then DS (p = .086, d = .45, 4.16 % difference) and HR was different by 6.27 beats·min^{-1} (p = .173, d= .30, 3.99 % difference). Total and individual values are shown in table 2 and figure 2.

Table 2. Results of heart rate (HR) and oxygen uptake (VO_2) between running barefoot and shod

	VO_2 (ml·kg^{-1}·min^{-1})		HR (beats·min^{-1})	
	Mean	SD	Mean	SD
With shoes	31,46	2,65	163,52	20,99
Barefoot	30,21	2,91	157,26	20,73

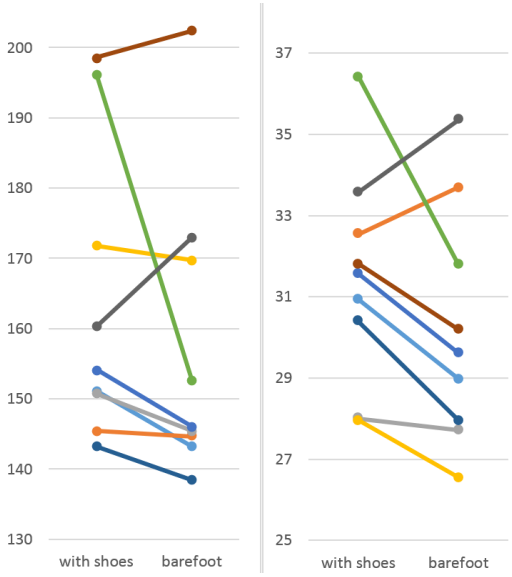

Figure 2. Individual Changes in HR (beats·min-1; left part) and VO_2 (leftml·kg^{-1}·min^{-1}; right part) between running barefoot and shod

DISCUSSION

The documented changes of VO_2 and HR induced by different shoe condition (RS & BF) were not statistically significant. Nevertheless, it is interesting that most changes had same trend, both observed variables (VO_2 & HR) were lower for BF than RS. In fact, the most of tested subjects reported that the subjective assessment of fatigue was higher and more uncomfortable during RS test. This case suggest that even unexperienced barefoot runners are more economical (less oxygen uptake even lower hearth rate) are during barefoot running than running in traditional running shoes. These findings correspond with previous studies which shown barefoot running are more efficient (Divert, Mornieux, Baur, Mayer, Belli, 2005; Hanson, Berg, Deka, Meendering & Ryan, 2011; Squadrone & Gallozzi, 2009). Otherwise, there is still some unanswered questions about barefoot running such a long-term health risks, top-elite long distance application during the race.

CONCLUSIONS

This study found that the values of oxygen consumption and heart rate are lower when running submaximal efforts at athletes who have no previous experience with barefoot running. The differences are not statistically significant (VO_2 p = .086, d = .45, 4.16 % difference; HR p = .173, d= .30, 3.99 % difference), but the trend and the size of small to moderate changes is obvious.

SOURCE OF FUNDING FOR THE STUDY

This investigation was conducted within the framework of a specific students' research at the Masaryk University 0867/2013 "Factors affecting the economy of running 3".

REFERENCES

1. Bassett, D.R., & Howley, E.T. (2000). Limiting factors for maximum oxygen uptake and determinants of endurance performance. *Med Sci Sport Exer, (32)*, pp.70-84.
2. Divert, C., Mornieux, G., Baur, H., Mayer, F., & Belli, A. (2005). Mechanical Comparison of Barefoot and Shod Running. *I J Sports Med*, *26*, pp.593-598.
3. Hanson, N.J., Berg, K., Deka, P., Meendering, J.R., & Ryan, C. (2011). Oxygen cost of running barefoot vs. running shod. *I J Sports Med, 32*(6), pp.401.
4. Jones, A. M., & Doust, J. H. (1996). A 1% treadmill grade most accurately reflects the energetic cost of outdoor running. *J Sport Sci, 14*(4), pp.321-327.
5. Lieberman, D.E. (2012). What we can learn about running from barefoot running: an evolutionary medical perspective. *Exercise Sport Sci R, 40*(2), pp.63-72.
6. McDougall, C. (2010). Born to run: the hidden tribe, the ultra-runners, and the greatest race the world have ever seen. Profile Books Hoff, J., Wisloff, U., Engen, L.C., Kemi, O.J., & Helgerud, J. (2002). Soccer specific aerobic endurance training. *Br.J Sports Med., 36*(3), pp.218-221.
7. Saunders, P.U., Pyne, D.B., Telford, R.D., & Hawley, J.A. (2004). Factors affecting running economy in trained distance runners. *Sports Med, 34*(7), pp.465-485.
8. Squadrone, R., & Gallozzi, C. (2009). Biomechanical and physiological comparison of barefoot and two shod conditions in experienced barefoot runners. *J Sport Med Phys Fit, 49*(1), 6-13.