Gazi Beden Eğitimi ve Spor Bilimleri Dergisi
Gazi Journal of Physical Education and Sport Sciences
2016, 21(1-4), 22-28

Effects of Roller Skiing and Running Exercises at the Same Intensities on Fat and Carbohydrate Metabolism in Cross Country Skiers

Ebru ÇETİN[1], Ulviye BİLGİN[1], İmdat YARIM[1]
[1]Gazi Üniversitesi, Spor Bilimleri Fakültesi

Araştırma Makalesi

Abstract

The purpose of this investigation was to determine the effects of roller ski and running exercises on Energy Output, MET, Fat and carbohydrate metabolism of cross- country skiers. Ten subjects 4 women (163.0 ± 6.71cm, 57.50 ± 5.97kg, 17.25 ± 2.18 age) and 6 men (171.33 ± 4.61 cm, 55.16 ±8.23kg, 16.50 ±1.56 age) were tested on 2 occasions using a different mode of exercise for each test: running and roller skiing. The test were completed with a portable breath-by-breath gas exchange measurement system (Version Vmax ST 10). Statistical analyses were performed with SPSS (version 100) Means and standard deviations (SD) are given as descriptive statistics. A repeated measurement ANOVA was used for evaluation within groups and between groups' differences by independent sample ti-test. There is a significant difference between two exercises model Fat Metabolism parameters in 10th and 15th min. There is no significant difference between running and roller skiing exercises at carbohydrate, energy output and MET p>005. Within the rollerskiing and running exercises change no significantly. Result in our study, we suggest that fat metabolism in running exercise between 10-15 minutes significantly increase, while in two exercises modes Q, Met, and CHO metabolism increased at the same degree.

Keywords: *Cross country skiers, roller skiing, fat, carbohydrate, energy output.*

Geliş Tarihi/Received: 2.4.2017
Kabul Tarihi/Accepted: 5.5.2017

Aynı Şiddetteki Tekerlekli Kayak ve Koşu Egzersizlerinin Kayaklı Koşucuların Karbonhidrat ve Yağ Metabolizması Üzerine Etkileri

Öz

Bu çalışmanın amacı, submaximal şiddette yapılan tekerlekli kayak ve koşu egzersizlerinin Kayaklı koşucuların enerji harcaması, MET, yağ ve karbonhidrat metabolizması üzerine etkilerinin incelenmesidir. Bu çalışmaya 4 bayan (163.0 ± 6.71cm, 57.50 ± 5.97kg, 17.25 ± 2.18 yıl) ve 6 erkek (171.33 ± 4.61 cm, 55.16 ±8.23kg, 16.50 ±1.56 yıl) kayaklı koşucu katılmıştır. Araştırma grubuna farklı günlerde submaximal şiddette tekerlekli kayak ve koşu egzersizleri yaptırılmış ve egzersizler sırasında enerji metabolizması dataları breath-by-breath gaz analizi sistemi (Version Vmax ST 10) ile yapılmıştır. İstatistiksel analiz olarak ortalama ve standart sapma tanımlayıcı olarak verilmiştir. Gruplararası karşılaştırmada ANOVA ve t-test kullanılmıştır. Sonuç olarak koşu ve tekerlekli kayak egzersizi arasında sadece yağ metabolizmasında 10. ve 15. dakikalarda istatistiksel olarak anlamlı farklılık tespit edilirken Enerji çıktısı, MET ve Karbonhidrat metabolizmasında anlamlı bir farklılık gözlenmemiştir.

Anahtar Kelimeler: *Kayaklı koşucular, kayak, yağ, karbonhidrat, enerji harcaması*

Introduction

Competitive cross-country skiing has recently experienced rapid changes, with the addition of several new racing forms (Stöggl and Müller, 2009). Cross-country skiing is one of the most demanding endurance sports. Athletes have extraordinarily high aerobic power, both upper and lower body muscles are heavily involved up to various degrees in different skiing techniques (Sandbakk, Holmberg, Leirdal and Ettema, 2011a). Exercises on snow are most effective in increasing the performance of cross-country skiers for this reason, world-class skiers conduct snow exercises on icecaps even during summer months (Gervais, Wronko, 1988). However, this is a method, which can be used limitedly and cannot be carried out by skiers at all levels. Cross-country skiers continue their exercise programs during spring and summer months and apply various exercise models in order to reach the highest performance for winter races. These methods may be ranked by importance as: roller skiing, running, ice-skating, in-line skating, hill running with ski poles, rowing, climbing, cycling, swimming and tennis (Petersen and Lovett, 1999; Abigail, 2006; Mahood, Kenefick, Kertzer and Quinn, 2001).

Cross-country skiers commonly use several types of dryland training to improve or maintain performance; these training techniques include running, ski striding, bounding, and roller skiing (Washbum, Sharkey, Narum and Smith, 1983). Due to the short on-snow season, most of a skier's training is done using similar exercise modes (Abigail and Larson, 2006). Each level of cross-country skiers must include a certain amount of endurance exercise in the program. Over distance training are important components for developing and maintaining aerobic capacity and maximal oxygen consumption (Sleamaker, 1996) low intensity over distance training sessions are most effective if the intensity is between 55 and 65 percent of VO2 max. Two important determinants of fat oxidation are exercise intensity and duration. Several studies have described the relationship between exercise intensity and fat oxidation in young individuals in which

the rate of fat oxidation increased from low to moderate intensity became high. Moreover, the contribution of fat as an energy source increases when exercise is continued for a prolonged period (Romijn, Coyle, Sidossis, Gastaldelli, Horowitz, Endert, Wolfe, 1993; Washbum, Sharkey, Narum and Smith, 1983; Thompson, Townsend, Boughey, Patterson and Bassett, 1998).

In cross country skiing, the physiological factors affecting performance are high maximal oxygen compsumption and high oxidative enzyme activity. The purpose of this investigation was to determine the effects of roller ski and running exercises on Energy Output, MET, Fat and carbohydrate metabolism of cross- country skiers.

Method

This study used a repeated measures design to examine the effect of different exercise modes on the relationship between 30 min submaximal roller ski and running exercise stage and energy output, met, fat and carbohydrate metabolism were measured during each trial.

Ten subjects 4 women (*163.0 ± 6.71cm, 57.50 ± 5.97kg, 17.25 ± 2.18 age*) and 6 men (*171.33 ± 4.61 cm, 55.16 ±8.23kg, 16.50 ±1.56 age*) were tested on 2 occasions using a different mode of exercise for each test: running and roller skiing. Subjects were well-trained, regional or international level competitors. All were ranked in the top 10 % Turkish skiers, and several had been competitors at National Turkish Cross-country team. Subjects had at least 6 years of competitive experience in cross-country skiing and roller skiing. The test sequence was randomly assigned to each subject over a 1-week period. Tests were conducted in April, 2008. Subjects used the same pair of Eagle Skate, ratcheted roller skis (100 mm) for the roller skis exercise. Subjects used their own boots, poles, and helmet, which they commonly used in training. Skate poles generally reached the subject's upper lip. All tests were performed on the same motorized method; it was a 30 minutes sub-maximal field roller skiing and running test. Roller ski exercise applied on 1 km flat asphalt course and running was 400 m standard track and field stadium. Athletes had rested one week between the roller ski and running exercises. Exercise intensity was determined as a 75 %, according to individual Heart Rate by Carvonen method. Subjects performed a warm-up, using the mode of exercise to be tested, for 15 minutes. Data collections during the submaximal exercises were completed with a portable breath-by-breath gas exchange measurement system (Version V_{max} ST 10). Statistical analyses were performed with SPSS (version 100) Means and standard deviations (SD) are given as descriptive statistics. A repeated measurement ANOVA was used for evaluation within groups and between groups' differences by independent sample ti-test P-values, <0,05 and <0,01 were considered to be statistically significant.

Findings

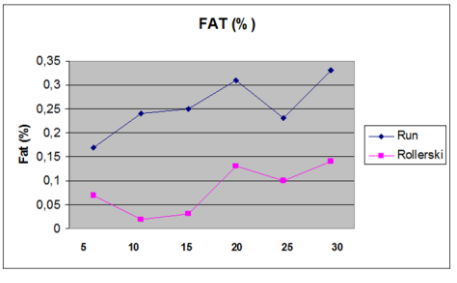
According to the results, At the end of this study, the results are shown in table 1. There is a significant difference between two exercises model Fat Metabolism parameters in 10^{th} and 15^{th} min. There is no significant difference between running and roller skiing

exercises at carbohydrate, energy output and MET p>005. Within the rollerskiing and running exercises change no significantly.

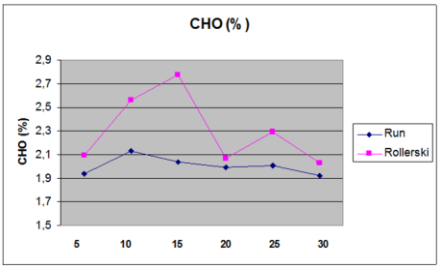
Table 1. Measuremental results of Q, Met, Fat and CHO metabolism changes in running and roller skiing exercises

Parameters	Exercise mode	5 min	10 min	15 min	20 min	25 min	30 min
Q	Run	210,35±96,27	491,55±150,09	767,53±223,28	1033,89±300,46	1294,70±380,43	1550,25±455,10
	Rol.ski	165,44±86,40	395,14±171,75	638,38±220,49	876,89±281,93	1108,20±345,23	1336,45±402,96
	Sig.	NS	NS	NS	NS	NS	NS
MET	Run	14,04±3,49	14,92±2,97	13,89±3,43	14,09±3,14	13,24±3,17	14,03±3,45
	Rol.ski	12,57±2,30	12,75±2,42	13,75±3,46	11,84±3,19	12,63±2,29	13,02±3,22
	Sig.	NS	NS	NS	NS	NS	NS
Fat (%)	Run	0,17±0,05	0,24±0,03	0,25±0,12	0,31±0,14	0,23±0,03	0,33±0,13
	Rol.ski	0,07±0,01	0,02±0,01	0,03±0,01	0,13±0,09	0,10±0,01	0,14±0,06
	Sig.	NS	*	*	NS	NS	NS
CHO (%)	Run	1,94±1,08	2,13±0,97	2,04±0,59	1,99±0,66	2,01±0,87	1,92±0,57
	Rol.ski	2,09±1,11	2,56±0,80	2,78±1,01	2,07±0,87	2,29±0,79	2,03±1,04
	Sig.	NS	NS	NS	NS	NS	NS

*P<0,05 **P<0,01 NS: no significant



Within run exercise and rollerskii exercise change no significantly



Within run exercise and rollerskii exercise change no significantly

Discussion and Conclusion

The purpose of this investigation was to determine different modes of exercise. Endurance training has always been the major method (Losnegard, Mikkelsen, Rønnestad, Hallén, Rud, and Raastad, 2011) and the off-season involves a highly percentage of the annual training hours for cross-country skiers. Also the off-season is a vital training period to improve skiers' performance. Skiers commonly use running and roller-ski trainings in summer months (McGawley, Juudas, and Holmberg, 2013). Dry land exercise devices which roller skiing and running. Skiers compete different types of terrain at widely varying speeds. Therefore, physical and technical abilities are determining factors for skiers and also they need to alter their rate of work and techniques during a ski race.

Thus, fitness development through training is a complex process that includes an increase strength, power maximal oxygen consumption (VO2max) and time to exhaustion and lactate threshold (Mahood, Kenefick, Kertzer and Quinn, 2001). It was hypothesized that submaximal roller ski exercises could develop endurance capacity as running exercise. All analyses were indicated there are no significant differences between the exercises modes in Q, MET, and CHO metabolism except fat metabolism between 10^{th} and 15^{th} minutes in running exercises. The reason for increasing fat metabolism in 10-15 minutes of exercise may be explains to lowering exercise intensity or fatigue mechanism in that intensity. As intensity of exercise increase CHO using also increase by the same way. Economy the oxygen cost of walking or running at varying speeds. The basic generalization about economy is that, over a wide range of velocities, the energy cost is rectilinearly related to the speed (Romijn, Coyle, Sidossis, Gastaldelli, Horowitz, Endert, Wolfe, 1993) . On the other hand, differences among individuals in terms of running economy are often extensive, ranging from 20-30%, in subjects of equal training and performance status. The reason for this observation has not been determined (Conley, Krahenbuhl, 1980). Roller ski and running exercises has different velocity and fatigue. The improvement performance was observed in both groups. A potential explanation for these findings could be due to the fact that increased aerobic and anaerobic metabolism. Furthermore, previous studies reported that it might also be induced by higher training speeds during intervention periods performed as rollerski (Sandbakk, Welde and Holmberg, 2011b). The applications from this study apply both for coaches and scientists by showing that same intensity running and roller skiing can be improved both by adding similar physiological parameters. With reference to the training effects found in our study, we suggest that fat metabolism in running exercise between 10-15 minutes significantly increase, while in two exercises modes Q, Met, and CHO metabolism increased at the same degree.

References

Abigail, J. L. (2006). Variations in heart rate at blood lactate treshold due to exercise model in elite cross-country skiers. *Journal of Strength and Conditioning Research, 20*(4), 855-860.

Conley, D. L. & Krahenbuhl, G. S. (1980). Running economy and distance running performance of highly trained atletes. *Medicine and Science in Sports and Exercise, 12*(5), 357-360.

Gervais, P. & Wronko, C. (1988). The Marathon Skate in Nordic Skiing Performed on Roller Skates, Roller Skis, and Snow Skis. *Int J Sport Biomech, 4*(1), 38-48.

Losnegard, T., Mikkelsen, K., Rønnestad, B. R., Hallén, J., Rud, B., & Raastad, T. (2011). The effect of heavy strength training on muscle mass and physical performance in elite cross country skiers. *Scandinavian Journal of Medicine & Science in Sportsi, 21*(3), 389-401.

Mahood, N. V., Kenefick, R. W., Kertzer, R. & Quinn, T. J. (2001). Physiological determinants of cross-country ski racing performance. *Medicine and Sciance in Sports and Exercise, 33*(1), 1379-1384.

McGawley, K., Juudas, E. & Holmberg, H. C. (2013). Block interval training in highly-trained cross-country skiers. *Paper presented at the 6th International Congress on Science and Skiing*, Christoph a. Arlberg, Austria.

Petersen, P. & Lovett R. (1999). *The essential cross-country skier a step by step guide*. USA: Ragged Mountain Pres.

Romijn, J., Coyle, E. F., Sidossis, L. S., Gastaldelli, A., Horowitz, J. F., Endert, E. & Wolfe, R. R. (1993). Regulation of endogenous fat and charbohydrate metabolism in relation to exercise intensity and duration. *Am J Physiol 265*, E380–E391.

Sandbakk, O., Welde, B. & Holmberg, H. C. (2011a). Endurance training and sprint performance in elit junior cross-country skiers. *The Journal of Strength and Condition Research, 25*(5), 1299-305.

Sandbakk, Ø., Holmberg, H. C., Leirdal, S. & Ettema, G. (2011b). The physiology of world class sprint skiers. *Scand J Med Sci Sports, 21*, 9-16.

Sleamaker, R. (1996). *Serious training for endurance athletes*. Human Kinetics, 2-6.

Stöggl, T. & Müller, E. (2009). Competition analysis of the last decade (1996-2008) in cross-country skiing In: Müller E, Lindinger S and Stöggl T, (eds). *Science and skiing* V. Ox- ford: Meyer and Meyer Sports. UK, 657-677.

Thompson, D. L., Townsend, K. M., Boughey, R., Patterson, K. & Bassett, D. R. (1998). Substrate use during and following moderate- and low-intensity exercise: implications for weight control. *Eur J Appl Physiol Occup Physiol, 78*(1), 43–49.

Washbum, R. A,. Sharkey, B. J., Narum, J. A. & Smith, M. H. (1983). Dryland training for cross country skiers. *Ski Coach, 6*(2), 9-16.

Wolfe, R. R., Klein, S., Carraro, F. & Weber, J. M. (1990). Role of triglyceride-fatty acid cycle in controlling fat metabolism in humansduring and after exercise. *Am J Physiol, 258*(2 Pt 1), E382–E389.