LASE JOURNAL OF SPORT SCIENCE IS A SCIENTIFIC JOURNAL PUBLISHED TWO TIMES PER YEAR IN SPORT SCIENCE

Published by the Latvian Academy of Sport Education in Riga, Latvia

INTERNATIONAL EDITORIAL BORD

ISSN 1691-7669
Printed in 200 copies
Technical Editors:
Alīna Kļonova
Juris Kļonovs
Inta Bula – Biteniece

Printed and bound: "Alemande"
Print Agency
Cover projects: Kristīne Janmere

Full-text available free of charge at www.lspa.lv

Editorial Contact Information,
Publisher Contact Information:
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ISSN 1691-7669 (ISO 3297)

LASE JOURNAL OF SPORT SCIENCE
Vol. 1 (2010) No. 1

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Publisher's Note

Dear Friends,

Welcome to the new *Journal of Sport Science* which you are holding in your hands. Every year for several decades the Latvian Academy of Sport Education (LASE) published the Annual Issue in Sport Science Papers, where both original research papers and methodological articles for sport specialists in one of the following languages – Latvian, English or Russian – are included.

The development of this issue of publications is logical and natural. It was determined by the fast time of information society of the 21th century with the necessity of narrow specialization and quick availability of information. Starting from 2010 the issue of publications had two parts, and as a result a new journal in Latvian *Sport in Theory and Practice* for sports practitioners and the new journal in English *LASE Journal of Sport Science* appeared.

Sports Science is an interdisciplinary branch of science that researches the regularities of a man's physical health, development, condition and sports achievements. Thus in the new journal you will find original research papers of sport integrated research in pedagogy, psychology, medicine, biology, biomechanics, sociology and economics, as well as short communications, letters to the Editor, and current news.

On behalf of the Journal Editorial Board,
Prof. Juris Grants

AUTONOMIC NERVOUS SYSTEM PROPERTIES IN MIGRAINE PATIENTS, NONMEDICATION MODULATION AND IMPACT OF PHYSICAL ACTIVITIES ON MIGRAINE FREQUENCY

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Abstract

The aim of this study was to detect the peculiarities of autonomic nervous system (ANS) in migraineurs and to elaborate optimal biofeedback (BFB) training methods. Heart rate (HR), arterial blood pressure and baroreflex sensitivity (BRS) at rest, static workload, arterial occlusion and during recovery period were measured. Migraine patients were mediatized. Twenty two migraineurs (female aged 22.2 ± 2.4) and fourteen healthy age and gender matched controls participated. Migraine patients were divided into 2 groups (M1 and M2) according to HR and BRS at rest. Physical activities were stated to have positive effect on migraine process in patients. At rest 60 % of migraine patients (group M1) had significantly decreased HR vs. control group (P=0.002). M2 group showed tendency to decreased BRS at rest comparing to control group and statistically significant (P=0.004) difference comparing to M1 group. In 10 s precontraction period M1 group had significantly lower HR increase comparing to other analyzed groups (P=0.005). HR was significantly decreased in M1 group during recovery period comparing to control and M2 groups (P=0.018). Both parts of autonomic nervous system – parasympathetic nervous system (PNS) and sympathetic nervous system (SNS) branches were impaired in migraineurs. M2 group had most likely decreased PNS activity and impaired SNS activity. M1 group patients showed increased PNS activity. BFB training sessions reduced migraine attack frequency and medication-intake in M2 group. We concluded that moderate aerobic physical activities are advisable for migraine patients to reduce migraine severity.

Key words: *Physical activity, handgrip, migraine, autonomic nervous system, biofeedback.*

Introduction

Psychological factors that influence pain experience are numerous and can include mood, anxiety, thought processes, personal coping mechanisms, social support, and personality factors for example stress tolerance (Mc Guire et al. 2008). Migraine is a highly prevalent disease affecting individuals, their families, and economies across the world (Lipton et al. 2003). The highest prevalence rates have been reported in North America where 18% of the women and 7% of the men experience one or more migraine attacks per year (Lipton et al. 2001), but figures from Europe are similar (Stovner et al. 2006).

Migraine is a chronic neurologic syndrome characterized by recurrent headaches and associated symptoms (nausea, vomiting, etc.) lasting from 4 to 72 hours (Headache Classification Subcommittee of The International Headache Society 2004; Olesen 2005). Extensive research of the underlying pathophysiological mechanisms of migraine headaches based on the above-mentioned symptomatic features would favour a better understanding of the abnormalities and, thus contribute to the improvement of life-quality

of migraineurs. The knowledge gained would enable to select the most appropriate and effective medical treatment as well as utilize alternative non-medically oriented techniques alongside with the pharmacologically oriented methods, for example, self-regulating biofeedback mechanisms (relaxation trainings etc.)

The studies regarding the function of autonomic nervous system (ANS) of migraineurs are inconclusive. It is stated both hyperfunction (Yakinci et al. 1999) and hypofunction (Peroutka 2004) of sympathetic nervous system (SNS) activity. Likewise, the data on the function of parasympathetic nervous system (PNS) are inconsistent: the evidence of several studies investigating clinical features and mechanisms of headache supports a decreased PNS activity (Sanya et al. 2005), whereas a number of other studies approve an increased PNS activity (Yakinci et al. 1999;Yarnitsky et al. 2003; Avnon et al. 2004).

In contrast, the study conducted by Pierangeli, Parchi, Barletta, Chiogna, Lugaresi and Cortelli (1997) reported no changes in variables of heart rate (HR) and arterial diastolic blood pressure (dBP) in migraineurs in comparison with controls assessed by Valsalva manoeuvre and orthostatic test. The results presented by Cortelli Pierangeli, Parchi, Contin, Baruzzi and Lugaresi (1991) were alike. Although the findings provide no significant disturbances in ANS, increased heart rate (HR) variables at rest and comparatively greater increase in arterial blood pressure (ABP) in migraineurs in comparison with controls implicated non-specific SNS hyperactivity.

In our study, we utilized similar methodology in order to assess the peculiarities of ANS function in migraineurs in comparison with controls.

In many clinics all over the world, non-medical treatment are considered as an alternative or an addition methodology to pharmacological treatment for the reduction of frequency and severity of migraine attacks. One of these approaches is biofeedback method (BFB) (Nestoriuc and Martin 2007; Kabbouche and Gilman 2008) used in our study.

Moreover, there are some considerations that regular aerobic exercises can affect favourably migraine process and reduce pain in migraine attacks (Narin et al. 2003).

Our study orientates specifically on detecting the peculiarities of ANS in migraineurs and elaborate optimal methodology of BFB trainings.

Materials and methods

Participants

Data from 22 migraine patients (female, aged from 18-25, average 22,2±2,4 years) and 14 healthy, non trained age and sex matched control group persons without any other diseases were analysed. All medications, if any, had been discontinued at least 1 week before the study. The migraine patients were divided in two groups (M1 and M2) according to HR and baroreceptor reflex sensitivity (BRS) at rest. We suggested that it could be related with differences in ANS function in M1 and M2 groups. There is no consensus about whether migraine is contributed with decreased HR or increased HR according to previous studies. So, migraine patients were divided according to their HR at rest to see clearly differences between migraine patient groups and control group healthy volunteers.

Procedure

Subjects were interviewed to determine their migraine characteristics and their lifestyle before testing. They were asked to evaluate their physical activities and mark how they affect migraine severity in subjective patient scale from 1 to 5 (1 means doesn't have positive effect on migraine and 5 means have the best positive effect on migraine). Subjects were tested in supine position in a quiet room after 10 min adaptation period. HR,

ABP and BRS were recorded continuously during physical rest, precontraction orientation reaction (10s countdown), static muscular effort (handgrip), afterwork arterial occlusion (AO) on loaded extremity and recovery period by Task Force Monitor device (CNSystems Medizintechnik, Austria). Handgrip (HG) was performed with 50% of maximal voluntary contraction force (MVC) by dominant arm comfortably fixed on the support. The MVC was determined by applying a hydraulic dynamometer system securing optimal visual feedback control. MVC was measured as the mean force obtained in two maximal contractions separated at least 2 min. HG with force 50 % of MVC was performed during 60 s after 10 sec of countdown. During the last 5 sec of HG, a pneumatic cuff was inflated on the upper arm of loaded extremity for AO. Recovery period was 10 min.

Biofeedback 2000 $^{X\text{-pert}}$ device (Schuhfried GmbH, Austria) were used for BFB trainings. Blood volume pulse amplitude (PVA) training of *a. temporalis* was used with aim to optimize ANS function and reduce PVA. Migraine drug usage, pain frequency and intensity were fixed before and during biofeedback training sessions**.**

Statistical analysis of data

Data are presented as mean ± standard deviation (SD). Analysis of variance (ANOVA) and paired Student t-tests were performed to indicate significant differences ($p<0.05$).

Study was approved by Ethics committee of Latvian University Institute of Cardiology for clinical and physiological research, and pharmaceutical product clinical investigations.

Results

Questionnaire results about migraine, everyday lifestyle and physical activities showed that 54 % of migraineurs are physically active and at least for 3 times a week attend sports activities : swimming 27% of all patients, jogging -18% and other activities – 9% (Fig 1).

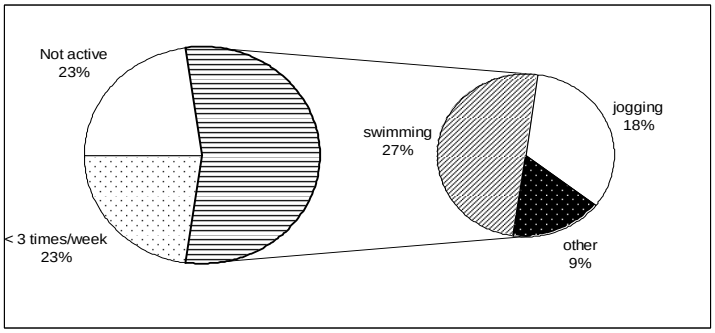

Fig. 1. Attendance of physical activities in migraineurs

In subjective patient scale about aerobic exercise effect on migraine most of the patients (58 %) marked that possibly aerobic exercises have positive effect on migraine (Fig 2).

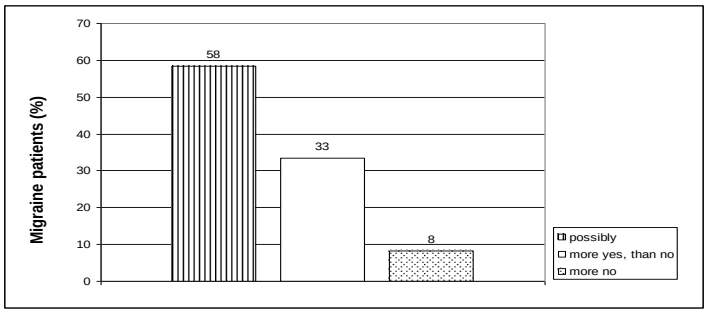

Fig. 2. Positive effect on migraine in subjective patients' opinion (1-5 scale, 1-no effect, 5 – definitely have positive effect)

At rest 60 % of all migraine patients (group M1) had significantly decreased HR comparing to control group (61,9 ± 5,6 beats/min vs. 77,1 ± 4,9; P=0,002) (Fig 3).

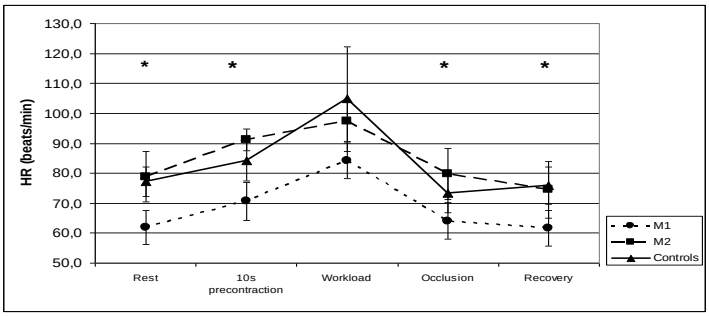

Fig. 3. Heart rate (HR) dynamics during the test in migraine and control group

During 10 s precontraction period (orientation reaction) M2 group showed a tendency toward HR increase in comparison with other analyzed groups (91,0 ± 3,6 vs. 70,7 ± 6,3 vs. 81,2 ± 6,8 beats/min P=0,006), while M1 group had statistically significant lower HR than control group. M1 group had statistically significant lower HR comparing to M2 group (64,1± 6,1 vs. 79,7 ±8,5 beats/min; p = 0,036) during AO. HR was significantly decreased in M1 group comparing to controls and M2 group (61,6 ±5,9 vs. 76,0 ± 6,2 vs. 74,5 ± 9,5 beats/min; P=0,018) during recovery period.

Statistically significant differences in systolic blood pressure (sBP) were found in M2 group comparing with control and M1 groups (123.9 ± 3.9 vs. 109.4 ±5 vs 109.3 ±1.8 mmHg; P=0.002) at rest (Fig 4).

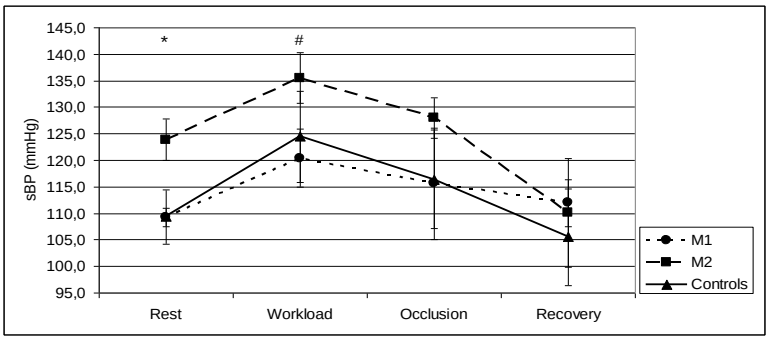

Fig. 4. Systolic blood pressure (sBP) dynamics during the test in migraine and control groups

At the end of static workload, sBP increase showed a trend (P = 0.054) toward significance in M2 group in comparison with control and M1 groups.

M2 group showed statistically significant (P=0,004) decreased BRS at rest comparing to control group (9,5 ± 2,3 vs.15,0 ± 3,4 ms/mmHg) and statistically significant (P=0,004) difference comparing to M1 group (9,5 ± 2,3 vs.29,7 ± 10,1 ms/mmHg) (Fig 5).

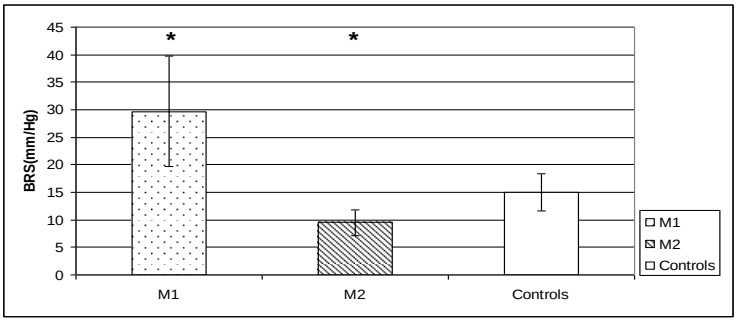

Fig. 5. Baroreflex sensitivity (BRS) at physical rest in migraine and control groups

We have found that PVA training for *a. temporalis* significantly decreased medication use in M2 group comparing to period before nonmedical treatment (Fig 6).

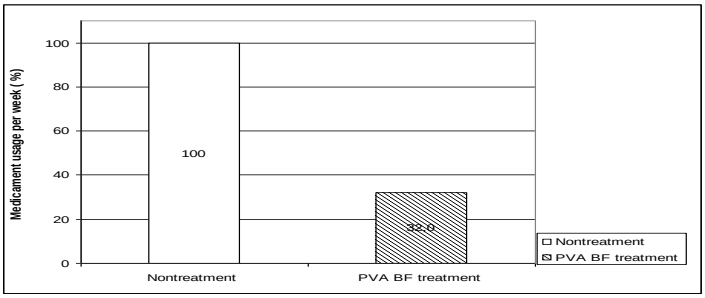

Fig. 6. Medication use (%) per week during nontreatment period and during biofeedback (BFB) treatment

Also, insignificant tendency of decreased pain intensity and migraine attack frequency in biofeedback period was stated. Mentioned tendencies were not found in M1 group.

Discussion

Our results about sports activities in migraine patients are in agreement with previously made some studies (Köseoglu et al. 2003; Lockett and Campbell 2005; Varkey et al. 2009) that aerobic exercises have favourable effect on migraine although in our study there were no specially made fitness programme for migraineurs.

Obtained results agreed with the previously performed studies regarding HR at rest in control group (Agelink et al. 2001). There were not found statistically significant differences in HR between M2 group and controls at relative physical rest. In contrast, statistically significant lower HR was detected in M1 group which could be related with increased PNS activity. It was confirmed also by data gained by BRS analyses. Statistically significant increase in sBP and unchanged dBP variables could be related with inhibition of PNS activity in M2 group patients. Alternatively, in some studies an opposite effect was found. For example, decreased sBP (***Gudmundsson et al. 2006***) and increased dBP

(Shechter et al. 2002) at rest were stated. These discrepancies may be connected with analyses of migraine patients with different ANS activity properties.

BRS data in control group matched with the variables found in other studies (Kardos et al. 2001). The changed sympatho-vagal balance in both M1 and M2 patient groups was proved by significantly increased BRS in M1 group and decreased BRS in M2 group in comparison with controls. We found studies using spontaneous sequence method where like our findings BRS was increased in migraineurs in comparison with control group at rest (Nilsen et al. 2009). We also studied BRS only at relative physical rest due to methodical restrictions.

Orientation reaction in a pre-load period also showed statistically significant tendency of PNS inhibition in M2 group in comparison with controls. This was approved by a significant HR increase even before the onset of the HG. It could be related with decreased stress tolerance in M2 group patients. In contrary, M1 group showed decreased HR increase comparing to M2 group during preload orientation reaction. There is lack of data in literature regarding orientation feedback in migraine patients.

The decreased HR increase at the end of HG in M2 group might be associated with the already inhibited PNS activity in a pre-load period. Only in some studies HG were used for ANS function detection in migraineurs. It would be mentioned that in one of these studies where another muscle contraction force - 30 % MVC were used significantly decreased HR increment during HG were stated, which was associated with sympathetic hypofunction (Pogacnik et al. 1993) There were not find any substantial differences in dBP dynamics in our study, whereas different results were presented in above mentioned study at static load. Authors reported a tendency toward decreased dBP increase where its absolute value compared with value at rest was decreased. Also study about common migraine and migraine with panic attacks revealed decreased increase of dBP during HG with 30 % MVC in both migraine groups (Osipova 1992). It was also shown that mean blood pressure increase at the end of HG with 30 % MVC was decreased due to SNS hypofunction (Mosek et al. 1999). It was supported by other study where difference in ABP increase during static load (HG) between migraine patients and controls was revealed. Migraine group showed a significantly decreased ABP increase during HG with 50 % MVC what evidenced about SNS dysfunction (Benjelloun et al. 2005).

Also it should be mentioned that different age migraine patients participated in above analyzed studies (Pogacnik et al. 1993; Mosek et al. 1999). Thus, comparing with our study group and found discrepancies might be associated with analyses of different age groups.

The sBP increase was higher in controls comparison to M2 group and M1 group during HG. At after load AO what was connected with activation of III-IV group afferents by metabolites in loaded extremity remaining increase was smaller in M2 group comparing to controls and M1 group. This could be explained by decrease of PNS inhibition by central command, PNS function normalization as well as by re-establishing of ANS balance suggesting that sympathetic part of ANS is also impaired in M2 group. Pressor reaction during AO didn't differ significantly in M1 group comparing with controls. During the recovery period, HR and sBP decreased below the baseline level in M2 group. This suggests about inhibition of PNS function in a pre-load period and lowered stress tolerance.

It is strongly recommended to improve sympatho-parasympathetic balance in migraine patients using BFB training method (Herman and Blanchard 2002; Scharff et al. 2002; Blanchard and Kim 2005; Martin et al. 2007; Nestoriuc and Martin 2007; Kabbouche and Gilman 2008; Nestoriuc et al. 2008). The migraineurs were trained using BFB training method with aim to estimate the efficacy and elaborate an optimal training regimen. The most used and effective training methods for migraine therapies are

temperature training and PVA training (Herman and Blanchard 2002). We preferred to use PVA training due to its proven efficacy showed in previous investigations (Blanchard and Kim 2005).

In BFB training sessions female migraineurs aged 18 - 25 years participated. We didn't find related literature data regarding trainings of migraineurs in this age group in taking into account peculiarities of ANS function.

We found that the average training period when biofeedback gives effect was 6 weeks for each person in M2 group. The optimal training session lasted at least 20 min and would be performed 2 -3 times weekly. To our opinion, better results could be possible with longer biofeedback training period. We didn't find approval for our hypothesis in previous studies, so longitudinal studies would be necessary. It was suggested that elaborated relaxation training methodology which include 2-3 sessions weekly for 1-1, 5 months was optimal for improving of ANS function in migraine patients with decreased stress tolerance. It was also shown that PVA training was the most suitable and effective method in comparing with other methods recommended for non medication migraine treatment (electromyography -EMG , temperature trainings) for M2 group about what suggested reduced frequency of migraine attacks as well as the medication-intake, so providing evidence of beneficial potential of elaborated training session methodology.

Such beneficial effects was not found in M1 group suggesting that elaboration of optimal BFB methodology would be connected with assessment of ANS peculiarities in migraineurs. In future optimal training regimen for other migraine group will be elaborated.

Conclusions

Obtained data regarding function of ANS in migraineurs suggested about impairment of both parts of ANS activity. There was most likely impairment in both branches of ANS in M2 group with decreased PNS activity and impaired SNS activity, but M1 group patients showed increased PNS activity.

According to subjective migraineurs opinion and literature data we suggest elaborate aerobic training regimen in addition to BFB trainings to reduce migraine severity in M1 group patients. To evaluate the longitudinal effect of BFB training, larger patient groups must be studied.

References

1. Agelink, M. W., Malessa, R., Baumann, B., Majewski, T., Akila, F., Zeit, T. & Ziegler, D. (2001). Standardized tests of heart rate variability: normal ranges obtained from 309 healthy humans, and effects of age, gender, and heart rate. *Clinical Autonomic Research, 11,* 99–108. DOI: 10.1007/BF02322053.
2. Avnon, Y., Nitzan, M., Sprecher, E., Rogowski, Z. & Yarnitsky, D. (2004). Autonomic asymmetry in migraine: augmented parasympathetic activation in left unilateral migraineurs. *Brain; 127*, 2099–2108.DOI: 10.1093/brain/awh236.
3. Benjelloun, H., Birouk, N., Slaoui, I., Coghlan, L., Oulad Amar Bencheikh, B., Jroundi, I. & Benomar, M. (2005). Autonomic profile of patients with migraine. *Neurophysiologie clinique*, *35*(4), 127-134. DOI: 10.1016/j.neucli.2005.06.001.
4. Blanchard, E. B. & Kim, M. (2005). The Effect of the Definition of Menstrually-Related Headache on the Response to Biofeedback Treatment. *Applied. Psychophysioogy of. Biofeedback*, *30*(1), 53–63. DOI: 10.1007/s10484-005-2173-z.
5. Cortelli, P., Pierangeli, G., Parchi, P., Contin, M., Baruzzi, A. & Lugaresi, E. (1991). Autonomic nervous system function in migraine without aura. *Headache*, *31*(7), 457–462. DOI: 10.1111/j.1526-4610.1991.hed3107457.x.

6. Gudmundsson, L. S., Thorgeirsson, G., Sigfusson, N., Sigvaldason, H. & Johannsson, M. (2006). Migraine patients have lower systolic but higher diastolic blood pressure compared with controls in a population-based study of 21 537 subjects. The Reykjavik Study. *Cephalalgia*, 26 (4), 436-444. DOI: 10.1111/j.1468-2982.2005.01057.x.
7. Headache Classification Subcommittee of the International Headache Society. (2004). The international classification of headache disorders, 2nd edition. *Cephalalgia 24*(suppl 1), 1–150.
8. Hermann, C. & Blanchard, E. B. (2002). Biofeedback in the Treatment of Headache and Other Childhood Pain. *Applied Psychophysioogy of. Biofeedback*, *27* (2), 143–162. DOI: 10.1023/A:1016295727345.
9. Kabbouche, M. A. & Gilman, D. K. (2008). Management of migraine in adolescents. Neuropsychiatric Disease Treatment, *4* (3), 535–548.
10. Kardos, A., Watterich, G., de Menezes, R., Csanady, M., Casadei, B. & Rudas, L. (2001). Determinants of spontaneous baroreflex sensitivity in a healthy working population. *Hypertension*, *37*, 911–916.
11. Köseoglu, E., Akboyraz, A., Soyuer, A. & Ersoy, Aö. (2003). Aerobic Exercise and Plasma Beta Endorphin Levels in Patients with Migrainous Headache Without Aura *Cephalalgia*, *23*(10), 972-976. DOI: 10.1046/j.1468-2982.2003.00624.x.
12. Lipton, R. B., Bigal, M. E., Scheer, A. I. & Steward, W. F. (2003). The global burden of migraine. *Journal of Headache and Pain*, *4*, 3–11. DOI: 10.1007/s101940300001.
13. Lipton, R. B., Stewart, W. F., Diamond, S., Diamond, M. L. & Reed, M. (2001). Prevalence and burden of migraine in the United States: data from the American Migraine Study II. *Headache*, *41*, 646–657. DOI: 10.1046/j.1526-4610.2001.041007646.x.
14. Lisspers, J. & Ost, L. G. (1990). BVP-biofeedback in the treatment of migraine. The effects of constriction and dilatation during different phases of the migraine attack. *Behaviour Modification*, *14* (2), 200-221. DOI: 10.1177/01454455900142006.
15. Lockett, D. C. & Campbell, J. F. (2005). The effects of aerobic exercise on migraine. *Headache*, *32*(1), 50-54. DOI: 10.1111/j.1526-4610.1992.hed3201050.x.
16. Martin, P. R., Forsyth, M. R. & Reece, J. (2007). Cognitive – behavioural Therapy Versus Temporal Pulse Amplitude Biofeedback Training for Recurrent Headache. *Behavior Therapy*, *38*, 350–363. DOI: 016/j.beth.2006.10.004.
17. McGuire, B. E, Hogan, M. J. & Morrison, T. G. (2008). Dimensionality and Reliability Assessment of the Pain Patient Profile Questionnaire. *European Journal of Psychological Assessment, 24* (1), 22–26. DOI: 10.1027/1015-5759.24.1.22.
18. Mosek, A., Novak, V., Opfer- Gehrking, T. L., Swanson, J. W. & Low, P. A. (1999). Autonomic dysfunction in migraineurs. *Headache*, *39*, 108–117. DOI: .1046/j.1526-4610.1999.3902108.x.
19. Narin, S., Pinar, L., Erbas, D., Oztürk, V.& Idiman, F. (2003). The effects of exercise and exercise-related changes in blood nitric oxide level on migraine headache *Clinical Rehabilitation*, *17*(6), 624-630. DOI: 10.1191/0269215503cr657oa.
20. Nestoriuc, Y., Martin, A., Ref, W. & Andrasik, F. (2008). Biofeedback Treatment for Headache Disorders: A Comprehensive Efficacy Review. *Applied Psychophysiology and Biofeedback*, *33*, 125–140. DOI: 10.1007/s10484-008-9060-3.

21. Nestoriuc, Y. & Martin, A. (2007). Efficacy of biofeedback for migraine: A meta – analysis. *Pain*, *128*, 111-127. DOI: 10.1016/j.pain.2006.09.007.
22. Nilsen, K. B, Tronvik, E., Sand, T., Gravdahl, G. B. & Stovner, L. J. (2009). Increased baroreflex sensitivity and heart rate variability in migraine patients. *Acta Neurologica Scandinavica*, *120* (6), 418-423. DOI: 10.1111/j.1600-0404.2009.01173.x .
23. Olesen, J. (2005). *The Classification and Diagnosis of Headache Disorders*. Oxford. Oxford University Press.
24. Osipova, V. (1992). Psychoautonomic approaches to migraine. *Functional Neurology*, *7*, 263–273.
25. Peroutka, S. J. (2004). Migraine: A Chronic Sympathetic Nervous System Disorder. *Headache*, *44*, 53–64. DOI: 10.1111/j.1526-4610.2004.04011.x.
26. Pierangeli, G., Parchi, P., Barletta, G., Chiogna, M., Lugaresi, E. & Cortelli, P. (1997). Power spectral analysis of heart rate and diastolic blood pressure variability in migraine with and without aura. *Cephalalgia*, *17*, 756–760. DOI: 10.1046/j.1468-2982.1997.1707756.x
27. Pogacnik, T., Sega, S., Pecnik, B. & Kiauta, T. (1993). Autonomic function testing in patients with migraine. *Headache*, *33*, 545–550. DOI: 10.1111/j.1526-4610.1993.hed3310545.x
28. Sanya, E. O., Brown, C. M., von Wilmowsky, C., NeundoØrfer, B. & Hilz, M. J. (2005). Impairment of parasympathetic baroreflex responses in migraine patients. *Acta Neurologica Scandinavica*, *111*, 102–107.DOI: 10.1111/j.1600-0404.2004.00358.x.
29. Scharff, L., Marcus, D. A. & Masek, B. J. (2002). A controlled study of minimal – contact thermal biofeedback treatment in children with migraine. *Journal of Pediatric Psychology*, *27* (2), 109–119.
30. Shechter, A., Stewart, W. F., Silberstein, S. & Lipton, R. (2002). Migraine and autonomic nervous system function. A population – based, case – control study. *Neurology*, *58* (3), 422–427.
31. Speckenbach, U. & Gerber, W. D. (1999). Reliability of infrared plethysmography in BVP biofeedback therapy and the relevance for clinical application. *Applied Psychophysiology and. Biofeedback*, *24* (4), 261-265. DOI: 10.1023/A:1022286930738.
32. Stovner, L. J., Zwart, J. A., Hagen, K., Terwindt, G. M. & Pascual, J. P. (2006). Epidemiology of headache in Europe. *European Journal of Neurology*, *13*, 333–345. DOI: 10.1111/j.1468-1331.2006.01184.x.
33. Varkey, E., Cider, A., Carlsson, J. & Linde, M. (2009). A Study to Evaluate the Feasibility of an Aerobic Exercise Program in Patients With Migraine. *Headache*, *49*(4), 563-570. DOI: 10.1111/j.1526-4610.2008.01231.x.
34. Yakinci, C., Mungen, B., Er, H., Durmaz, Y. & Karabiber, H. (1999). Autonomic nervous system function in childhood migraine. *Pediatrics International*, *41*, 529–533. DOI:10.1046/j.1442-200x.1999.01101.x.
35. Yarnitsky, D., Goor-Aryeh, I., Bajwa, Z. H., Ransil, B. I., Cutrer, F. M., Sottile, A. & Burstein, R. (2003). 2003 Wolff Award: Possible Parasympathetic Contributions to Peripheral and Central Sensitization During Migraine. *Headache*, *43*, 704–714. DOI: 10.1046/j.1526-4610.2003.03127.x.

Submitted: July 8, 2010
Accepted: November 2, 2010

BIOMECHANICAL ANALYSIS OF FOREHAND IN MODERN TENNIS

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Abstract

Modern World level tennis is a game with high dynamics and tempo, it is required of a sportsmen to be well physically and technically prepared as well as have an understanding of modern game. A great deal of controversy in tennis strokes has involved the changes in the forehand technique. Despite the existing researches in this area, currently no consensus about the implementation of most effective forehand. Aim of this study was biomechanical model of forehand in tennis. To investigate the scale of forehands application in modern tennis were analyzed Sony Ericsson WTA Tour final game 2010. Six experienced tennis players (age 23,2 ± 4,4) were studied using three-dimensional video analysis system "Qualisys" and force plate "AMTI". Results: sum of all strokes (except serves and smashes) in Sony Ericsson WTA Tour final 2010 were 283 strokes, included 138 forehands 94 in open stance and only 44 in square stance. Forehand movement organization principle is whip's mechanism. The open stance forehands developed slightly lower racquet velocities (32,5 ± 4,6 m/s vs. 34,2 ± 4,5 m/s) at impact compared with the traditional square stance. Horizontal component of ground reaction forces were considerably greater in the direction of the main movement in square stance forehands (90,3 ± 9,3 N vs. 70,3 ± 25,9 N). Conclusions: forehand in open stance is more applied in modern tennis game. Forehand movement organization principle is whip's mechanisms. Stance version of forehand is situation specific and it has nothing to do with development of largest racquet velocities. Ground reaction forces addict of stance form. In square stance horizontal component were greater, it may be involved with developing linear momentum.

Key words: *forehand, open stance, square stance, modern tennis*

Introduction

Modern World level tennis – it's a game with high dynamics and tempo, it is required of an athletes to be well physically and technically prepared as well as have an understanding of modern game. A great deal of controversy in tennis strokes has involved the changes in the forehand technique [1, 2, 3, 4, 9].

The forehand (table 1) groundstroke has developed as a key offensive weapon. The main feature of this stroke is the ability to hit considerable power combined with heavy topspin for control. Professor Bruce Elliot and Associates in the Department of Human Movement and Exercise at the University of Western Australia presented that in the earlier style, sometimes referred to as "unit" forehand; the hitting arm was rotated around the shoulder. For the modern forehand the hitting arm is rotated around the elbow and the shoulder. This is an important difference because the latter techniques enables increased racquet speed and therefore power. The "unit" style forehand was generally more suited to the relatively contact heights typical of grass courts. On the other hand, the modern forehand is adapted well for contact at waist height and above. This is important in allowing players to manage the higher bounce of the ball encountered in today's game with tournaments predominantly played on hard and clay court surfaces [3, 4].

Table 1

Comparative table about the forehand drive [6, 9]

Aspect	Traditional technique	Modern technique
Recommended grip	Eastern	Semi Western or Western
Position in readiness	Closed	Open
First work of the foot	Step forward	Step displaced towards the side
Movement of preparation of the racquet	Pivoting from the shoulder	Many segments
Action of the articulations	Similar action of the articulations which is used for generating force in the movement towards the impact in both forehands	
Area of impact	More precision in the area of impact	Reduction of the area of mistakes in which the ball may by successfully impacted
Position of knees	Flexed during impact	Extended during impact
Risk of lesion	Similar in both cases	
Covering of court	Slow	Fast
Stroke's ending	More forward	On the shoulder
Foot's position	In contact with the ground	In the air
Feet's work	It takes more execution time	It enables the player to hit in running

Despite the existing researches in this area (Elliot B., Bahamonde R., Knudson D. and others), currently no consensus about the implementation of most effective forehand [1, 2, 5].

The aim of the study: open and square stances forehand technical capabilities.

The hypothesis of the research:

1) forehand in open stance is more applied in modern tennis today;
2) the racquet velocities do not depends of stance form.

The tasks of study:

1. To investigate the scale of open and square stances applications in forehand.
2. To investigate forehand stroke movement organization features.
3. To evaluate the influence of stance form to racquet velocities.
4. To assess effect of stance form to ground reaction forces horizontal component.

Material and methods

To investigate the scale of open and square stances application in forehand in modern tennis today we made visual analysis of SONY ERICSSON Tour women's final game 2010 (Kim Clijsters vs. Venus Williams. Miami, USA). Game recorded on video cassette by video-recorder "Toshiba".

The experiment was organized in Russian University of Physical Education, Sport and Tourism laboratory of biomechanics in Moscow. Six experienced tennis players (age 23,2 ± 4,4) took part in this event – three of them had "sport master" class and three "sport master's candidate" class by Russian standards. To investigate forehand stroke movement organization features and to evaluate the influence of stance form to racquet velocities were utilized high-speed video registration and analysis system "Qualisys" (Sweden). This system consisted from six digital cameras, measuring unit, body segment's markers. Cameras maximal frequency was 1000 frames per second. For our experiment cameras

were set to 250 frames per second. Body segment's markers were put at lateral part of body.

To assess effect of stance form to horizontal component of ground reaction forces were used force plate "AMTI" (ASV). Size of force plate was 100 x 100cm, independent fluctuations was 1000 Hz. Both systems "Qualisys" and "AMTI" were synchronized.

Results

Analyze of SONY ERICSSON WTA Tour final 2010: sum of all strokes in game, except the serves and smashes (strokes under the head) were 283 strokes, included 138 forehand groundstrokes. 68% of all forehands in game were executed in open stance (94 strokes) and only 32% of all forehands in final game were executed in square stance (44 strokes). This is demonstrated in next graphic (Fig. 2).

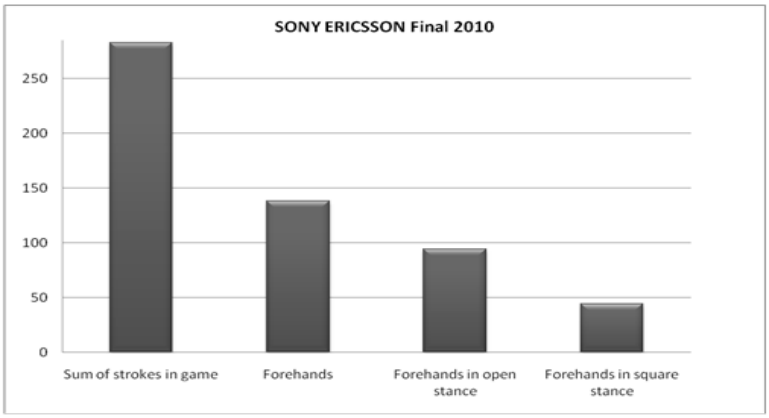

Fig. 2. SONY ERICSSON Final game 2010 analysis

Regardless of the type of forehand stance, all experienced subjects showed gradual increase body segment's velocity from proximal to distal segments. This fact allows us to conclude that forehand movement organization principle is whip's mechanism. The body segment's and racquet velocity increases progressively step by step (Fig.3).

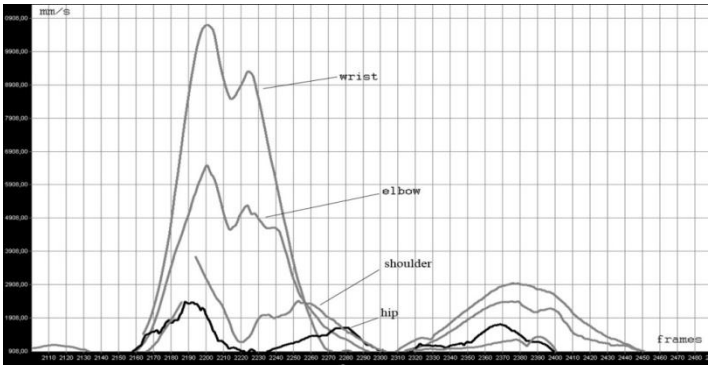

Fig. 3. Forehand – movement organization features

Summarizing and analyzing the data of racquet velocities during the impact from open and square stance, we have obtained the following results: the open stance forehands developed slightly lower racquet velocities (32,5 ± 4,6 m/s vs. 34,2 ± 4,5 m/s) at impact compared with the traditional square stance (Fig. 4). In our opinion the differences in the

racquet velocities in forehand groundstroke from open and square stance were not significant.

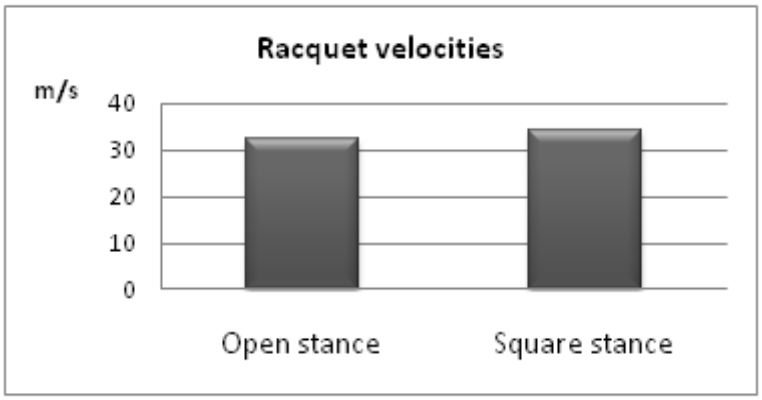

Fig. 4. Racquet velocities to perform forehand in open and square stances

Any movements of a human are realized in interaction with the ground. To get features of ground reaction forces during the forehand in different stances, we compared one of the three components of ground reaction forces – horizontal component. Ground reaction forces horizontal component were considerably greater in square stance forehands (90,3 ± 9,3 N vs. 70,3 ± 25,9 N) (Fig.5). We expect that this may be involved with developing linear momentum: in forehand from open stance exist a greater rotation, in turn, in forehand from square stance is pronounced movement in the direction of the stroke.

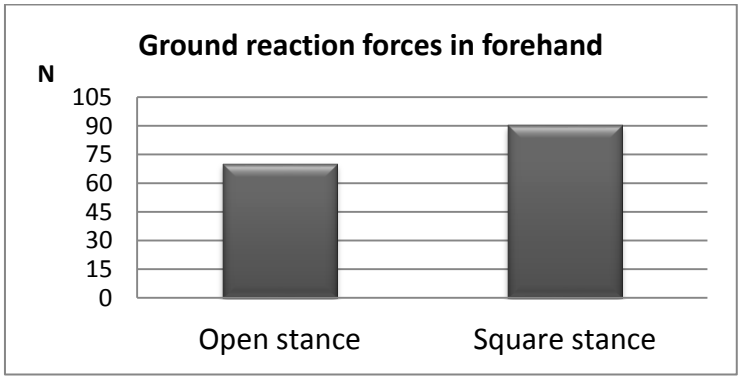

Fig. 5. Ground reaction forces horizontal component to perform forehand

Discussion

Forehand groundstroke's movement in tennis is based on whip's mechanism. Whip technique: coordinated translator movement of the proximal to distal segments that involves consecutive acceleration and deceleration of the joints. At the beginning of the movement the proximal joints moves quickly in the direction of the stroke, but afterwards it's actively decelerated. Such movement organization principle allows using muscle's, ligament's, tendon's energy of elastic deformation and low of kinetic momentum conservation which helps to increase the speed of the distal segments [7, 8].

During our experiment we have observed an interesting fact that "sport masters" had slightly higher velocity of racquet in stroke from square stance, in turn "sport master's

candidates" had slightly higher velocity of racquet in forehand from open stance. In our opinion it may be related to the elaborated stereotype of movement. Representatives of "sport master" class were students of the "classic" tennis school – all stroke technique was based mainly on closed and square stances. On the other hand representatives of "sport master's candidate" class (younger athletes) were students of "modern" tennis school and hence in training process were taught and applied strokes mainly in open stance.

One more fact which drew our attention is that ground reaction forces don't significantly affect on racquet velocity during forehand groundstroke. Our experiment showed, that the apparent change of ground reaction forces horizontal component in strokes from different stances don't observed significant changes in racquet velocities.

We can conclude, that the choice of the stance form in forehand ground-strokes is not associated with the desire of athletes to increase racquet velocity, but is more game situation specific. Game dynamics and tempo in last ten years has grown and as a result biomechanics of on-court movement and stroke technique has been changed. Open stance requires less time to perform the stroke, and therefore is more demand and more suitable in tennis game today.

Conclusions

1. Forehand in open stance is more applied in modern tennis game.
2. Forehand movement organization principle – whip's mechanisms.
3. Stance version of forehand is situation specific and it has nothing to do with development of largest racquet velocities.
4. Ground reaction forces depend on stance form. In square stance horizontal component is greater, it may be involved with developing linear momentum.

References

1. Bahamonde R., Knudson D. (2003) Linear and angular momentum in stroke production. In Elliot B., Reid M., Crespo M. (Eds.) *Biomechanics of advanced tennis* (pp. 65 – 68). ITF Ltd.
2. Bahamonde R., Knudson D. (2003) Kinetics of the upper extremity in the open and square stance forehands. *Journal of Science and Medicine in Sport*, 6(1), pp. 88 – 102.
3. Christmass M., Bruce E. (2002) Groundstrokes. *In development coaching manual* (pp. 3 -6). TCA.
4. Groppel J.L. (1995) Injury prevention through proper biomechanics. USTA 2nd National Conference on Sports Medicine and Science in Tennis.
5. Knudson D., Bahamonde R. (1999) Trunk and racquet kinematics at impact in the open and square stance tennis forehand. *Biology in Sport,* 16 (1), pp. 3 – 10.
6. Kopsic Segal D. (2002) *Tennis biodynamic system.* BNP Paribas, ITF, pp. 97 – 115.
7. Lanka J. (2007) *Šķēpa mešanas biomehānika.* lpp. 163. – 165.
8. Lanka J. (2000). Shot putting. In Zatsiorsky V.M. (Eds.) *Biomechanics in sport: Throwing and Hitting.* (pp. 448 – 450). Blackwell Science, Ltd, Oxford.
9. Roetert P., Gropper L. (2001) *World-class tennis technique.* Human Kinetics.

Submitted: August 1, 2010
Accepted: November 11, 2010

CORRELATION BETWEEN FUNCTIONAL FITNESS RESULTS AND SELF-ASSESSMENT OF HEALTH RELATED QUALITY OF LIFE AND PHYSICAL ACTIVITY IN OLDER ADULTS

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Abstract

In spite of consistent evidence that physical activity (PA) affect to functional fitness and health-related quality of life (HRQOL), related papers show ambiguous results with large dispersion. This study examined the relationship between fitness test results, self-rated PA and HRQOL in older adults. 96 persons aged 60 years and older participated in this study. Data was collected using Senor Fitness Test (SFT), international generic European Quality of Life Questionnaire – EuroQol (EQ-5D Latvian version), International Physical Activity Questionnaire (IPAQ) short version. Expressing the SFT results by age and gender adjusted percentile scale, no significant correlations with PA and HRQOL data appear. Only changes of PA significantly influenced on HRQOL (IPAQ- EQ-5D Index = 0.343 $p<0.05$; IPAQ-EQ-5D VAS = 0.468 $p<0.01$). Results show the significance of PA in maintaining quality of life, but do not answer the importance of fitness for higher level of life satisfaction.

Key words: *Elderly, fitness, physical activity, quality of life.*

Introduction

Previous researches show that regular physical activity, fitness, and exercises are important components for people of all ages to remain healthy and well. Physical Activity and Health report, which were issued under Acting Surgeon General Audrey Manley (1996), shows that theoretically all individuals can benefit from regular physical activity, whether they participate in vigorous exercise or some type of moderate health-enhancing physical activity. The maintenance of functional capacity, and thereby the independence of the older person, is beneficial for the individual and society alike.

The growing number of older people in society has both social and economic implications affecting most nations. The age-related decline in physical and cognitive performance has been the focus of many studies and the health benefits from physical activity (i.e., decreased risk for cardiovascular disease, diabetes, hypertension, cancer, and all-cause mortality) are well established (Siscovick et al. 1997). Kelley and colleagues (2009) found out a significant standardized effect size improvement for physical function as a result of physical activity. Thus mobility and functioning can be improved through physical activity.

Relationships between physical activity, health related fitness, and health are fairly well known. The health related fitness concept indicates that physical activity shows an interaction with health related fitness and health. The interactions between these three main components are widely described on Toronto model by Bouchard and Shephard (1994).

Maintaining a high level of quality of life into advanced age is a growing public health concern as the older adult population continues to increase. Stewart and King (1991) have conceptualized quality of life (QOL) as two broad categories, function and well-being. Shephard (1993) noted that physical activity plays an important part in increasing the health related quality of life (HRQOL) of the older adult, by improving physiological and psychological function, which helps to maintain personal independence and reduces

the demands for short term and long term care services. A number of recent studies have suggested a consistent association between physical activity and quality of life in older adults (McAuley et al. 2006; Rejeski and Mihalko 2001). Low physical activity is considered a primary marker of physical frailty, which predicts subsequent disability (Fried et al. 2001).

Physical activity has been shown to produce improvements in functional fitness as strength, mobility, flexibility and cardiovascular conditions. Rikli and Jones (2001) are defined functional fitness as the capacity to perform normal daily activities in a safe and independent fashion without undue fatigue or pain. In the beginning of this decade was published the functional fitness fest for older people that had been designed by the physiotherapists Rikli and Jones (2002) in Lifespan Wellness Clinic at California State University in Fullerton. In literature it is called as Fullerton or Senior Fitness Test. Based on the studies conducted by the authors, normal values for the population of healthy elderly persons in the United States were determined. 7183 persons aged 60 to 94 years participated in these studies.

Good data are a prerequisite for systematic research and knowledge-based polity building. Internationally comparable data on physical activities, health related fitness and self rated health indicators of elderly people are still lacking in Latvia. Unfortunately, normative data for the elderly population in Latvia have not been determined yet. For this reason it is necessary to adapt a well developed and validated research instruments for further researches.

The aim of this study was to conduct the adaptation process for Senior Fitness Test (SFT) for Latvian older adults and compare results with self rated physical activity and health related quality of life.

Material and methods

Participants

Subjects were volunteers, community dwelling adults who were older than 60 years, without serious cardiovascular or musculoskeletal diseases, performing activities of daily living without mobility aids. All participants before testing had medical clearance in Heart Health Cabinet. We recruited 96 persons for this study (29 men and 67 women). The mean age± SD of the samples was 67±4.75 years (60-75years). All this respondents took part in the interviewing stage of survey, but by medical reasons SFT could complete 82 persons (25 men and 47 women).

Functional fitness

The Senior Fitness Test consists of six assessment items. The chair stand test assesses lower body strength. Each subject completed two practice repetitions and one 30 second test trial. The score was the total number of stands executed correctly within 30 seconds. The arm curl test assesses upper body strength. Each subject completed two practice repetitions and one 30 second test trial. The score was the total number of hand weight curls through the full range of motion in 30 seconds. The chair sit and reach test assesses lower body flexibility. Each subject completed two practice trials and two test trials. The score was the best distance achieved between the extended fingers and the tip of the toe. The back scratch test assesses upper body flexibility. Each subject completed two practice trials and two test trials. The score was the best distance achieved between the extended middle fingers. The 8 foot up and go test assesses agility and dynamic balance. Each subject completed one practice trial and two test trials. The score was the shortest time to rise from a seated position, walk 8 feet, turn, and return to the seated position. The six minute walk test assesses aerobic endurance. Each subject completed one practice trial

two days before the test and one test trial. The score was the total distance walked in six minutes along a 45.72 m rectangular course, which was marked every 4.57 m.

HRQOL assessment

We used latvian version of an international generic European Quality of Life Questionnaire – EuroQol (EQ-5D). The EQ-5D consisting of five three-level items, representing various aspects of health: mobility, self-care, usual activities, pain/discomfort and anxiety/depression (mood). Respondents were able to evaluate their health in each domain by reporting whether they are experiencing none (score 1), some (score 2) or extreme (score 3) problems. These scores result in a health profile, e.g. a patient with profile 12113 has no problem with mobility, usual activities and pain/discomfort, some problems with self-care and extreme problems with anxiety/depression. Data of a visual analogue scale (VAS) are also included in the EQ-5D and used by subjects to rate their health status between worst imaginable health state (score 0) to best imaginable health state (score 100). A utility index score was calculated for each subject's EQ-5D health status by applying the time trade-off-based valuations from a general EU population sample to the observed EQ-5D profile, as data from Latvian norm are not available at the present time.

Physical activity

For assessment of the physical activity level we used International Physical Activity Questionnaire (IPAQ) short version, because compared with long version we avoid risks to overestimate self-rated activity. The short version systematically underestimates physical activity level, since it consists of fewer questions (7 questions in the short version compared with 27 questions in the long version). The items in IPAQ are structured to provide separate domain-specific scores for walking, moderate-intensity, and vigorous-intensity activity. All questions refer to the previous 7 days. The results were presented as the estimation of energy expenditure in metabolic equivalent-minutes per week (MET/min/week). To calculate physical activity scores we have analyzed the activities which lasted at least 10 minutes.

Data Analysis

All obtained data were statistically analyzed and expressed as the mean, median and standard deviation (SD). Data were analyzed using specific software called SPSS version 15.0 for Windows OS.

Results

For estimating the level of physical activity, the short form Latvian version of IPAQ was used. The median of total physical activity for the whole sample was 3786 MET/min/week. The mean value was 4757 (SD±2998.1) MET/min/week.

HRQOL was assessed using the generic instrument EQ-5D. The utility index median score was 0.78, mean – 0.80; SD±0.13. The median and mean value of a visual analogue scale were 69; SD±15.9.

After completing the questionnaires respondents performed the Senior Fitness Test. Respondents who did not pass medical inspection were not admitted to perform the test. All results have been transfiguring as percentile data based on normal values for the gender and age as it is given by the authors (Rikli and Jones 2002). The SFT results are shown in Table 1.

Table 1

The results of the Senior Fitness Test in the percentile scale

	Chair stand	Arm curl	Sit and reach	Back scratch	Up and go	6 min walk
Mean	61.7	74.4	47.4	38.3	60.2	40.7
Median	60	85	40	35	60	40
SD	27.4	23.4	24.6	28.9.	19.3	24.4

The next set of analyses examined the correlation between SFT result and self rated physical activity and health related quality of life data. All correlations coefficients are shown in Table 2.

Table 2

The correlation matrix for health related quality of life, physical activity and fitness

	EQ-5D Index	EQ-5D VAS	IPAQ	SFT
EQ-5D Index	1			
EQ-5D VAS	0.331	1		
IPAQ	**0.343***	**0.468****	1	
SFT	0.085	0.232	0.115	1

* $p<0.05$,** $p<0.01$

Total results show that being more active significantly correlates only with health related quality of life data. The primary findings were that healthy older adults who participated in regular physical activity for at least moderate intensity for more than one hour per day had higher values in all five domains of HRQL than those who were less physically active. We found no significant relationship between functional fitness and physical activity or HRQOL results.

Discussion

The health-related quality of life defined as a person's or group's perceived physical and mental health over time (Centers for Disease Control and Prevention 2007). This is important variable to determining the health benefits of various interventions or detecting the baseline level of population. A focus on HRQOL versus the broader concept of quality of life is especially relevant in our study because, for example income, that is more distant from health and may not be modifiable. One potential approach for improving HRQOL in older adults is physical activity, a relatively low-cost, non-pharmacological intervention that is available to the vast majority of the general public. Our study results concur with recently conducted a meta-analysis that addressed the effects of physical activity on psychological well-being in older adults. Across all designs and categories, there was a statistically significant (small to moderate) improvement in psychological well-being compared to the control group (Netz and Wu 2005).

Our findings of functional fitness results show that samples have higher scores in muscular and dynamic balance, but are lower than average in flexibility and cardiovascular parameters. Although many studies suggest that functional fitness and physical activity is interacted variables, our research did not find such pathway. This fact leads us to conclude that subjective method for assessment of physical activity does not provide the real evaluation of the person functional abilities. Available data generally suggest that fitness level more strongly predicts health benefits than physical activity patterns (Blair et al. 2001; Williams 2001). The reason for this might be that the assessment of fitness is more

objective than activity. Fitness is generally determinate directly from exercise testing of functional abilities, whereas activity level is dependent on person recollection of activities and subjective judgment of different variables (frequencies, intensity, and duration). That can lead to misestimating of the real physical activity level. The same circumstances associated with questionnaires limitations apply to results of correlations between fitness test and HRQOL assessment.

Our study has several limitations. Although relations between fitness, activity and health benefits have been shown to be similar between men and women, our sample include mostly women. Our sample was comparatively small and results cannot be generalized. As with any questionnaire approach, the responses were dependent on subject recollection and how attentive subjects may have been in their responses.

Conclusions

The only hypothesized pathway between fitness and HRQOL results was supported. In this study we funded significant correlation between 6 minute walking test and EQ-5D Index results ($r=0.436$, $p<0.01$). As it is expected, it was mostly correlated in EQ-5D mobility domain.

In summary, our study provides the adaptation process for SFT procedure and our findings are useful for further researches. It is well known that physical activity offers an effective, non-pharmacological, public health intervention for increasing and maintaining quality of life among older adults. According to Rejeski and Mihalko (2001), persons who are more active report higher level of life satisfaction. Quality of life is an important component of "successful aging" for older persons. The emphasis of physical activity promotion should be moved from a focus upon achieving "fitness" towards optimisation of quality of life.

References

1. Blair, S. N., Cheng, Y., & Holder, J.S. (2001). Is physical activity or physical fitness more important in defining health benefits? *Med Sci Sports Exerc*., 33 (Suppl 6): S379 –S399.
2. Bouchard, C., & Shephard, R. J. (1994). Physical activity, fitness and health: the model and key concepts. In: C. Bouchard, R.J. Shepard, T.Stephens (Eds.) *Physical activity, fitness and health, International Proceedings and Concensus Statement* (pp.77-88). Champaign, IL: Human Kinetics.
3. Centers for Disease Control and Prevention. (2007). *Health-related quality of life findings.* Retrieved May 01, 2010, from http://www.cdc.gov/hrqol/
4. Fried, L. P., Tangen, C. M., Walston, J., Newman, A. B., Hirsch, C., Gottdiener, J., Seeman, T., Tracy, R., Kop, W. J., Burke, G., & McBurnie, M. A. (2001). Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci*. 56: M146-156.
5. Jones, C. J., & Rikli, R. E. (2002). Senior Fitness Test Manual. *J Aging & Physical Activity*. 10; 1, 110.
6. Kelley, G. A., Kelley, K. S., Hootman, J. M., & Jones, D. L. (2009). Controlled Trials Community-Dwelling Adults: A Meta-Analysis of Randomized Exercise and Health-Related Quality of Life in Older. Journal of Applied Gerontology 28: 369-394.
7. McAuley, E., & Elavsky, S. (2006). Physical activity, aging, and quality of life. In: W. Zhu, W.Chodzko-Zajko (Eds.) *Measurement issues in aging and physical activity*. Champaign: Human Kinetics.

8. Netz, Y., & Wu, M. (2005). Physical activity and psychological well-being in advanced age: A meta-analysis of intervention studies. *Psychol Aging.* 20(2): 272–284.
9. Rejeski, W. J., & Mihalko, S. L. (2001). Physical activity and quality of life in older adults. J Gerontol A Biol Sci Med Sci. 56 (Spec No 2): 23-35.
10. Rikli, R. E., & Jones, C. J. (2001). Senior fitness test manual. Champaign: Human Kinetics.
11. Shephard, R. J. (1993). Exercise and aging: extending independence in older adults. *Geriatrics.* 48:61–64.
12. Siscovick, D. S., Fried, L., Mittelmark, M., Rutan, G., Bild, D., & O'Leary, D.H. (1997). Exercise intensity and subclinical cardiovascular disease in the elderly. The Cardiovascular Health Study. *Am J Epidemiol.* 145: 977-986.
13. Stewart, A. L., & King, A. C. (1991). Evaluating the efficacy of physical activity for influencing quality of life outcomes in older adults. *Ann Behav Med.* 13(3): 108–116.
14. U.S. Department of Health and Human Services (1996). *Physical Activity and Health:A Report of the Surgeon General*. Washington, D.C.: U.S. Department of Health and Human Services.
15. Williams, P.T. (2001). Physical fitness and activity as separate heart disease risk factors: a meta analysis. *Med Sci Sports Exerc*. 22: 754 –761.

Submitted: July 6, 2010
Accepted: October 14, 2010

CORRELATIONS OF SPECIAL ENDURANCE AND PEAK FORCE TESTS IN THE WATER AND ON THE LAND OF QUALIFIED SWIMMERS

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Abstract

In order to achieve high results in swimming it is important to pay a lot of attention to physical qualities, absence of which might limit the growth of the results. The use of tests allows controlling sportsmen's functional condition, as well as determining different levels of endurance and force and its sufficiency. The aim of our work is to optimize the management of swimmers' training process on the basis of special testing results. In experiment were involved 11 Lithuanian junior national team swimmers (age 18±3, height 183±4 cm, weight 75±9 kg, BMI (body mass index) 22±2). In two weeks we accomplished special endurance tests in pool: 2x25m with 80s interval, 4x50m with 45s interval, 4x50m with 10s interval, 8x50 with 10s interval. Force tests consisted of pulling force in water swimming only with hands, swimming only with legs, swimming with full coordination, swimming in 30 second and fixed force endurance index. We have measured isometric torque, maximal force moment, and maximal force moment at muscle stimulation (20 Hz/s, 100Hz/250ms, 100Hz/s), force moment at the angular velocity of 30, 90, 180 degrees per second of curved and straighten upper shank and thigh extensor muscles was measured using an isokinetic dynamometer (System 3; Biodex Medical Systems, Shiley, New York). After the tests we calculated group average results and made correlative analysis and estimation of swimmers' results.

Key words: *Sport swimming, special endurance, peak force.*

Introduction

Previous researches show that the use of tests allows controlling sportsmen's functional condition and helps to optimise training process and improve the swimmer's distance result Guzman (2007), Fomičenko (2001), Petrovič (2001), Platonovs (2000).

In experiment we determined anthropometric parameters of swimmers, peak force parameters of swimmers in the water and on the land, special endurance parameters of swimmers in the water and mutual coherence of obtained parameters.

Our research data allows Lithuanian junior national team swimmers to learn the necessary control of their training process, helps determine strengths and weaknesses of their preparation, and succeed to apply operative corrections. Our research tests can help to determinate efficiency of different levels of endurance and peak force and its sufficiency. Testing results can help to plan and predict results of competitions. Using specific sets can improve all the levels of endurance and peak force in each individual, as well as in whole group of swimmers.

Materials and Methods

Eleven Lithuanian junior national team swimmers were involved in our research. To achieve results following six methods were used.

1. Analysis

We have analysed following related scientific works available in literature for scientific research and topicality basis: Gančar (1998); Fomičenko (2001); Sokolovas (1999); Platonov (2000); Bulatova (1996); Petrovič (2001); Allakin (1991); Bulgakova (1990); Onoprienko (1973).

2. Anthropometry

We have obtained following average results of group (see Figure 1) in the determination of swimmer anthropometric parameters (with the meter TBF-300, Tanita UK Ltd. Philpots Close, UK): the average age, height, weight, body mass index, fat mass in percentage, fat mass in kilograms of swimmers.

3. Dynamometry

We have measured maximal traction force (with dynamometer Np 120, TPG, Ivanovo, PSRS) and gained average results of the group (see Figure 2) in the determination of swimmers' special force in the water: traction force of hands, legs, in full coordination and traction force during 30 seconds. All participants have made repetitions after standard warming. Swimmer in the water had to pull out rubber, which included dynamometer. We registered results of swimmers, who seven seconds tried to reach peak force. The best result was gained after two attempts.

4. Testing

We have calculated average results of group (see Figure 3) 2x25 m in the test with interval 80 s (anaerobic-ablactate power), 4x50 m in the test with interval 45 s (anaerobic-lactate power), 4x50 m in the test with interval 10 s (anaerobic-lactate power), 8x50 m in the test with interval 10 s (aerobic power) in the determining of swimmers' special endurance in the water (fixing time with the chronometer in the tests "CASIO"). Only one test was performed during one day. All participants made repetitions after warming up, from low start after the signal. The time was stopped, when swimmer touched the pool wall. Two synchronized chronometers were used to evaluate time measures.

5. Functional diagnostics of muscles

Direct muscle stimulation was applied using two carbonized rubber electrodes, covered with a thin layer of electrode gel (ECG-EEG Gel; Medigel, Modi'in, Israel). One of the electrodes (0,06 x 0,11 m) was placed transversely across the width of the proximal portion of the quadriceps femoris. Another electrode (0,06 x 0,20 m) covered the distal portion of the muscle above the patella. A standard electrical stimulator (MG 440; Medicor, Budapest, Hungary) was used. The electrical stimulation was applied by 0.5- ms square wave pulses. Isometric torque of knee extensor muscles was measured using an isokinetic dynamometer (System 3; Biodex Medical Systems, Shiley, New York). The subjects sat upright in the dynamometer chair with the knee joint positioned at 90 and 130 degrees angle. The subjects were asked to perform as fast as possible the maximal voluntary isometric contraction torque (MVC) at knee angles of 90 and 130 degrees (top of the MVC was reached and maintained some three seconds before relaxation; twice at each angles). In all cases muscle torque registrations at different angles were used randomly. The rest interval between MVC measurements was 1 min. In isokinetic torque (IT) measurements subjects were asked to perform three continuous repetitions of knee extension with maximal intensity at angle velocity 30, 90, 180 deg/s. The equipment and procedures for electrical stimulation of arm extensor muscles were essentially the same as previously described.

6. Mathematical statistical methods

We have calculated Pearson's correlation coefficient, based on alpha level of 0.05 and s\criteria of student to the independent test groups.

Results

1. Anthropometric parameters of swimmers

Average results of group were obtained (as shown in Figure 1.) in the determination of swimmer anthropometric parameters (with the meter TBF-300, Tanita UK Ltd. Philpots Close, UK): the average age of swimmers was 18±3 years, height 183±4 cm, weight 75±9 kg, ĶMI 22±2, fat mass percentage 10±4 %, fat mass in kilograms 8±4 kg.

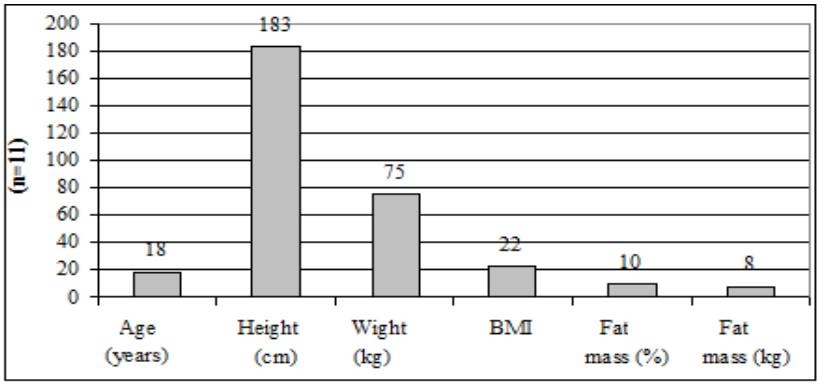

Fig. 1. Anthropometric parameters, mean results of group (n=11)

2. Special force parameters of swimmers in the water

We have measured maximal traction force (with dynamometer Np 120, TPG, Ivanovo, PSRS) gaining following average results of the group (see Figure 2) in the determination of swimmers' special force in the water: traction force of hands 13±3 kg, traction force of legs 9±1 kg, traction force in full coordination 17±3 kg, traction force during 30 seconds 12±3 kg.

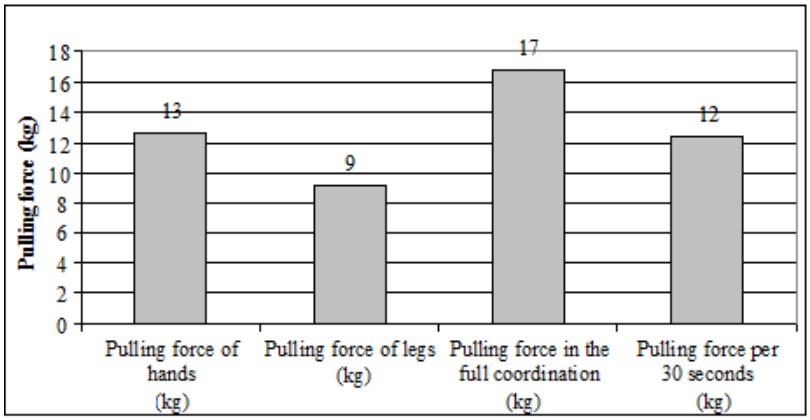

Fig. 2. Maximal pulling force, mean results of group (n=11)

3. Special force parameters of swimmers on land

We have measured maximal force moment of thigh (see Figure 3).

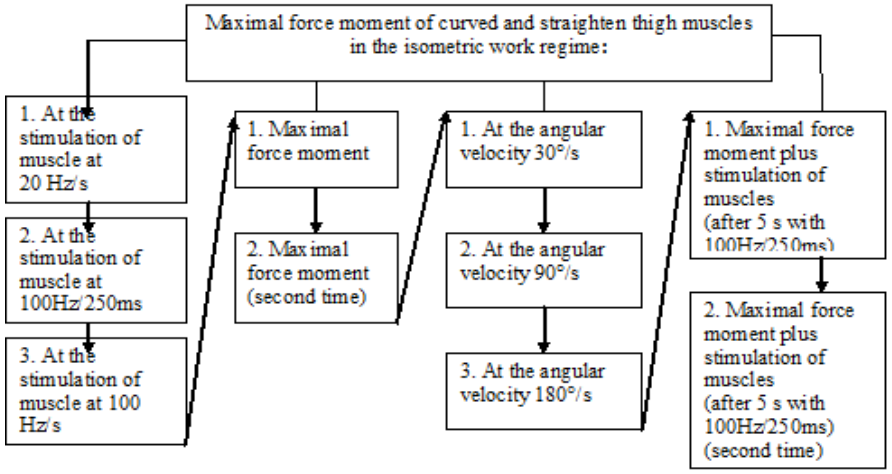

Fig. 3 Determination of thigh muscles force on land

and upper shank muscles (see Figure 4) in the isometric work regime, maximal force moment at stimulation of muscles (20 Hz/s, 100Hz/250ms, 100Hz/s), force moment at the angular velocity 30, 90, 180 degrees per second and carried out activation test of muscles in the determination of special force parameters of swimmers on land with the isometric device (System 3; Biodex Medical Systems, Shiley, New York).

In the producing of the results and calculating average results of group, there was determined their coherence with special force and parameters of endurance in the water.

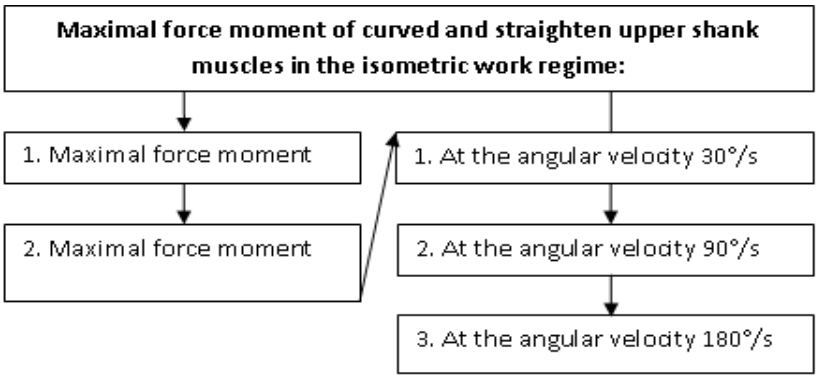

Fig. 4 Determination of upper shank muscles force on land

4. Special endurance parameters of swimmers in the water

We have obtained average results of group (see Figure 3) during following tests: 2x25 m in the test with interval 80 s- 26 s, 4x50 m in the test with interval 45 s- 31 s, 4x50 m in the test with interval 10 s- 34 s, 8x50 m in the test with interval 10 s- 35 s in the determining of swimmers' special endurance in the water (fixing time with the chronometer in the tests "CASIO").

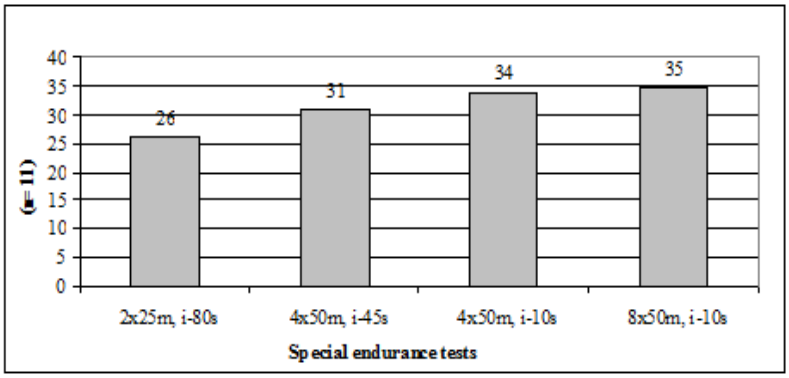

Fig. 3. Special endurance tests, mean results of group 50 m, s, (n=11)

5. Mutual coherence of shown parameters

In the determination of mutual coherence's group's shown average results we have obtained following results (see Table 3):

5.1. Negative, close correlation is found in the following results:

1) 4x50 m in crawl with the interval 45 s and maximal traction force, in swimming only with legs (r = - 0,728);

2) 4x50 m in crawl with the interval 10 s and maximal traction force, in swimming only with legs (r = - 0,770);

3) 4x50 m in crawl with the interval 45 s and maximal traction force 30 s (r = - 0,809);

4) 4x50 m in crawl with the interval 10 s and maximal traction force 30 s (r = - 0,795);

5) 8x50 m in crawl with the interval 10 s and maximal traction force 30 s (r = - 0,752);

6) 4x50 m in crawl with the interval 45 s and force endurance index (r = - 703);

7) 4x50 m in crawl with the interval 10 s and force endurance index (r = - 773);

8) 8x50 m in crawl with the interval 10 s and force endurance index (r = - 754).

Table 3

The correlation between the results of special tests in the water

Special tests in the water		2x25m, i-80s (s)	4x50m, i-45s (s)	4x50m, i-10s (s)	8x50m, i-10s (s)
Maximal pulling force, in swimming only with hands(kg)	r	-,315	**-,627**	**-,628**	**-,644(*)**
	α <>0,05	,375	,052	,052	,044
Maximal pulling force, in swimming only with legs (kg)	r	,000	**-,728(*)**	**-,770(**)**	**-,679(*)**
	α <>0,05	,999	,017	,009	,031
Maximal pulling force of swimming in full correlation(kg)	r	-,123	**-,605**	-,549	-,476
	α <>0,05	,736	,064	,101	,165
Maximal pulling force per 30 second (kg)	r	-,087	**-,809(**)**	**-,795(**)**	**-,752(*)**
	α <>0,05	,811	,005	,006	,012
Force endurance index	r	,057	**-,703(*)**	**-,773(**)**	**-,754(*)**
	α <>0,05	,875	,023	,009	,012

* - α < 0.05; ** - α < 0.01

5.2. Negative, average correlation is found in following results:

1) 4x50 m in crawl with the interval 45 s and maximal traction force, in swimming only with hands (r = - 0,627);

2) 4x50 m in crawl with the interval 10 s and maximal traction force, in swimming only with hands (r = - 0,628);

3) 8x50 m in crawl with the interval 10 s and maximal traction force, in swimming only with hands (r = - 0,644);

4) 8x50 m in crawl with the interval 10 s and maximal traction force, in swimming only with hands (r = - 0,679);

5) 4x50 m in crawl with the interval 45 s and maximal traction force, in swimming of full coordination (r = - 0,605);

5.3. At these observations the number of dependence between 2x25 m with the interval of 80 s and all force tests, as well as between 4x40m, 8x50 m in crawl with interval 10s and there are not accomplished to prove and signs should be considered as independent in the maximal traction force, in swimming of full coordination.

5.4. At these observations the number of dependence between special force and endurance results in the water and results of special force on land had not been proved and signs should be considered as independent.

Conclusions

In this observation dependency between endurance tests and force tests with isocinetic torque measurement tests was not found.

Between endurance tests and force tests in water are negative close correlations, what is a reason to believe that by raising the peak force in water can be improved the special endurance, as a result can be improved the time of the distance.

The use of specially designed swimming test sets allows swimmers to learn the necessary control of their training process, helps determine strengths and weaknesses of their preparation and prepares them to accept operative corrections.

References

1. Guzman, R. (2007). The swimming drill book. Champaign: *Human Kinetics.*
2. Ганчар, И. Л. (1998). Плавание: Теория и методика преподавания. Минск: *Четыре четверти.*
3. Петрович, Г. И. (2001). Этапная оценка специальной выносливости пловцов с целью коррекции тренировочного процесса. Минск: *методические рекомендации.*
4. Платонов, В. Н. (2000). Плавание. Киев: *Олимпийская литература*.
5. Платонов, В.Н. (1997). Общая теория подготовки спортсменов в олимпийском спорте. Киев: *Олимпийская литература.*
6. Фомиченко, Т. Г. (2001). Взаимосвязь между спринтерской скоростью плавания и силовыми способностями в возрастных группах пловцов. Москва: *СпортАкадемПресс.*

Submitted: August 16, 2010
Accepted: November 2, 2010

EDUCATION OF PEDAGOGICAL STAFF OF CHILDREN CAMPS

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Abstract

As the author has worked for more than ten years in children camps, she has developed a positive interaction and pedagogical activity model to be applied at work in children camps.

As we know from the experience very often not only people having pedagogical education are hired to work in children camps, but also people of different other professions without pedagogical education, research was carried out to see what the situation is in children camps concerning education of people working there.

A phone interview was carried out to state how many people are working in the camps without adequate pedagogical education. 14 camp leaders who had organized 16 different camps in Latvia in 2009 took part in the interview.

The results of the phone interview showed that 21% of the inquired camp leaders do not have pedagogical education and 71% of the camp leaders when hiring employees invite ones without pedagogical education.

Most of the inquired camp leaders when hiring the pedagogical team for work in a camp include employees without pedagogical education. This fact should be considered in further working out and approbation of the pedagogical activity model and when organizing seminars for the camp leaders and potential employees (without pedagogical education) where they could be introduced with pedagogical aspects of work in the camp and with the application of the worked-out pedagogical activity model for work in a camp.

Key words: *Children camp, pedagogue, education*

Introduction

Already in ancient Greece in the state of Athens the idea about many-sided and harmoniously developed personality as the aim of education was expressed. [4] This aim has been topical through many hundreds of years, and it has not lost its significance today. The head of the Department of Theory of the Latvian Academy of Sport Education Professor Rasma Jansone has said in her book that physical education today is a part of general education, and it facilitates many-sided development of a personality. [1] Nowadays a child spends 2/3 of an astronomical year at school. A task of a school is to apply physical education means to develop habits and stable interest in regular classes of lifelong physical exercises. But what about the time when a child is not learning? Children spend about 1/3 of the year in school holidays – summer, autumn, Christmas and spring. It is the time when different organized activities of spending free time are offered to children. One of the most popular is a camp.

A camp as children out-of-class education establishment with the purpose to develop their personalities has been more or less popular in Latvia at all times regardless of the state government, economical and political situation. A camp is an ideal place where a child can continue to develop, perfect his/her talents and strive to do physical activities every day, and develop the habit of daily exercising.

Having worked more than ten years in children camps and the last three years writing the Doctor dissertation and researching the questions about the role and work of a

pedagogue in a camp, as well as investigating the possibilities that a camp can give its participant as a member of society to develop his/her personality harmoniously, we have accumulated many cognitions, and we would like to share them, especially with the leaders and teachers of children camps, as well as children's parents.

In a camp there is a wonderful possibility to spend one's leisure time purposefully. Charles A.Bruches (1972) wrote: "Many objectives have been listed for camping and outdoor education programs. Some of the more important objectives that have been enumerated over the years as exist in our schools are as follows: students learn to live democratically with other children and adults, learn more about the physical environment…"[5] The possibility to motivate children to go in for physical activities systematically, to explain and give understanding about the role of physical activities in one's life, as well as camp pedagogues showing an example can encourage children to do different sports.

Taking into consideration children and teenagers' physiological need to move and the positive effect of physical activities on one's organism, physical activities have an important place both in physical and mental development of children [3] and facilitating a positive interaction between children, teenagers and pedagogues.

In the course of writing the Doctoral dissertation a positive interaction and pedagogical activity model is being developed. Taking several literature sources and practices as the basis, we can say that pedagogical work is more effective if a teacher in his/her pedagogical activity cooperates with children equally, despite the differences of age and experience. Then a relation system subject (teacher) ↔ subject (child) forms between them [2].

It is important to develop the habit of doing daily physical activities in children during their staying in camps, and camp pedagogues should actively participate in all camp activities.

There is an assumption that camp pedagogues using this model will be able to facilitate the development of the habit of doing daily physical activities in children.

The positive interaction model is being developed assuming that it will be applied in camps by people having pedagogical education.

People not only having pedagogical education, but also ones of other professions without pedagogical education work in camps. These are people who are motivated and interested to work with children, who are creative in their activity, and who, undoubtedly, are active in acquiring of new knowledge and skills. They are sport, pre-school, kindergarten teachers, geographers, historians, as well as organizers of different events, leisure time and tourism managers, festival directors.

Materials and methods

A phone interview was carried out to find out how many people work in camps without adequate pedagogical education. 14 camp leaders who had organized 16 different camps in Latvia in 2009 took part in the interview.

Results

The results of the inquiry showed that 79% of the camp leaders have pedagogical education, but 21% do not (Fig.1).

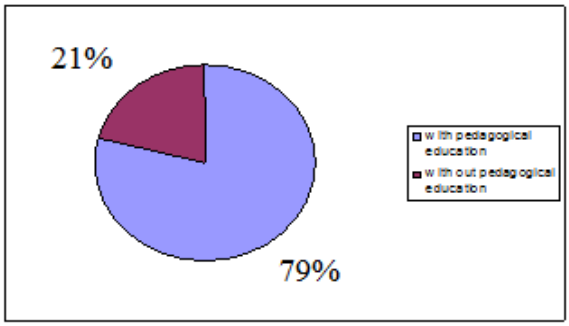

Fig. 1. Camp leaders' education

There have been quite many cases when camp leaders had to employ people without pedagogical education. The results of the interview show that 71% of camp leaders hire people without pedagogical education, but 29% choose to form their team of employees with pedagogical education (Fig.2). One of the camp leaders during the phone interview expressed the idea that people without pedagogical education should work in camps, as many pedagogues have authoritarian working style which is not favorable. The regulations by the Cabinet of Ministers, the Republic of Latvia, on "The order of children camp organization and activity" do not mention whether a camp leader should have pedagogical education, although knowledge about pedagogical and psychological aspects of children of different age and about the regularities of children's development is necessary in this work.

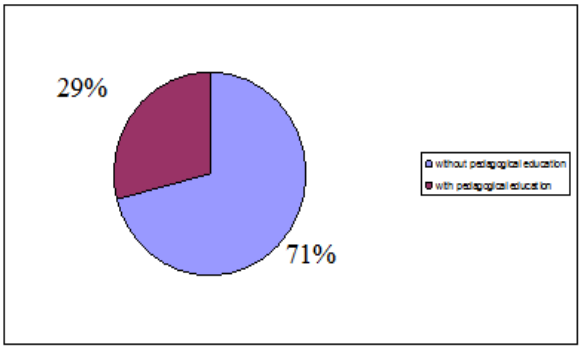

Fig. 2. Education of people working in camps

In the interview the camp leaders' opinion on the differences in pedagogical work in a camp and work at school was also clarified.

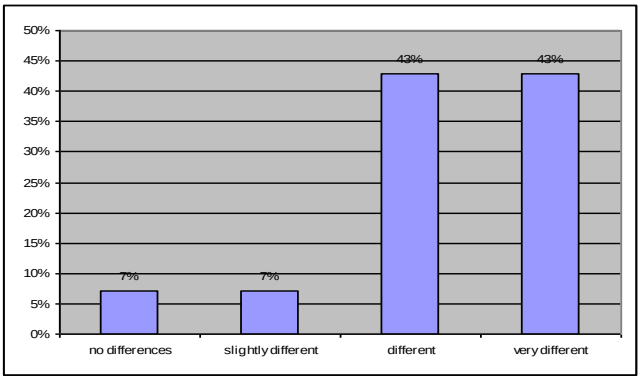

Fig. 3. Camp leaders' opinion about pedagogical work in camps and at school

From the inquired camp leaders 86% point out that work in a camp is different or very different from pedagogical work at school. However, 14% of the inquired camp leaders say that pedagogical work in camps is different or only a little different from pedagogical work at school (Fig. 3).

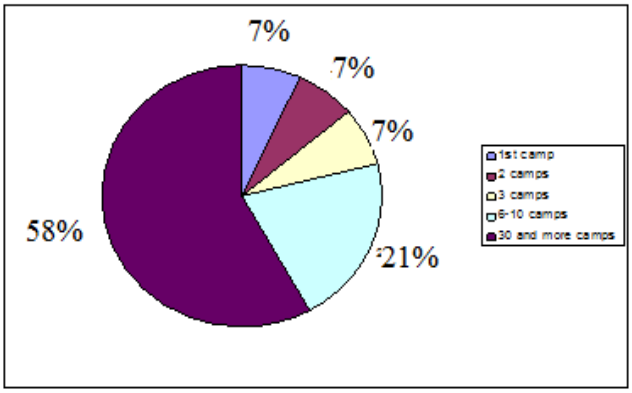

Fig. 4. Camp leaders' experience in running camps

We can agree with 86% of camp leaders who see differences in work with children at school and in a camp. We think that there are vital differences as there are other life conditions in a camp, and a pedagogue should be more flexible regarding the definite conditions of a camp, the requirements, the time table terms, children's personalities, their wishes and interests. A camp leader should be knowledgeable and should be able to apply different work methods and means when organizing classes and leisure time.

Pedagogues acquire knowledge about various methods and means, and their application both during the study process and practice. We wanted to find out camp leader's practical experience.

As we found out 58% of the interviewed camp leaders have run more than 30 camps, 21% of them – 6-10 camps, 14% – 2-3 camps, but 7% of the camp leaders ran the camp in 2009 for the first time.

Discussion: The mass media today reflect different opinions concerning the necessity for camp leaders to have pedagogical education. We think that the camp leader training programmes today contain adequate requirements and always include the questions on pedagogical and psychological aspects of children belonging to different social and age groups, about solving of conflicts and other important questions of camp organization and work.

Personal experience has shown that there are many excellent camp leaders and pedagogues who do not have pedagogical education, and there have been cases when the obtained pedagogical education does not help in work with children. Our opinion is that the main requirement in this work is one's desire and interest to work with children, and a creative approach.

Conclusions

1. 43% of the inquired camp leaders think that pedagogical work in a camp is different or very different from the work at school. Only 7% of them hold the opinion that it is not different or a little different.

2. 21% of the inquired camp leaders do not have pedagogical education, 79% – have pedagogical education. 71% of the inquired camp leaders hire pedagogical employees for work in the camp without pedagogical education.

3. Knowing that 71% of the inquired camp leaders when hiring the pedagogical team for work in a camp include employees without pedagogical education, it would be necessary to consider this fact in further development and approbation of the pedagogical activity model and to organize seminars for the camp leaders and potential employees (without pedagogical education) where they could be told about pedagogical aspects of work in the camp and with the application of the worked-out pedagogical activity model for work in a camp, thus coming a bit closer to the facilitating of a child's many-sided development and the habit to do physical activity.

References

1. Jansone R.(1999) *Sporta izglītība skolā*. Rīga: „RaKa".
2. Špona A. (2001) *Audzināšanas teorija un prakse*. Rīga: „RaKa".
3. Valtners A. (2001) *Bērnu un pusaudžu fizioloģija.* Rīga: Zvaigzne ABC.
4. Zelmenis.V. (2000). *Pedagoģijas pamati*. Rīga: „RaKa".
5. Charles A.Brucher (1972). (sixth edition) *Fundations of physical education*. Sant Louis the C.V. Mostby Company.

Submitted: July 25, 2010
Accepted: October 14, 2010

ESTIMATION OF AEROBIC CAPACITY AND HIGH INTENSITY LOADS TOLERANCE IN ENDURANCE AND TEAM SPORT ATHLETES

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Abstract

Sport training intensity, rest interval duration and training mode influences the accumulation of H^+ ions, which causes different changes in buffering systems capacity and high intensity loads tolerance. The aim of our investigation was to compare aerobic capacity and ability to maintain performance at high blood lactate concentration in endurance and team sport athletes.

Two groups of high qualification young (18 – 22 years old) male athletes participated in the investigation: 14 road cyclists and 11 handball players. They performed incremental load tests to exhaustion: the cyclists – a test on a bicycle ergometer, but the handball players – a running test on a treadmill. The cardiopulmonary diagnostic equipment is used for ventilatory characteristics measurement and registration of electrocardiography. The special lactate analyzers are used to determine the lactate concentration in the capillary blood every two minutes.

The mean body weight and body mass index are higher in handball players than in cyclists, $p < 0.007$. The aerobic capacity characteristics (absolute and relative oxygen uptake at the anaerobic threshold and the maximal oxygen uptake loads) are significantly greater in the road cyclists than in the handball players, $p < 0.03$. The handball players maintain better performance at higher concentration of lactate in the blood (10.16 ± 2.26 mmol/l) in comparison with the cyclists (8.14 ± 2.42 mmol/l), $p < 0.02$.

It indirectly proves that muscles and (or) blood buffering systems capacity is greater in handball players than in the road cyclists.

Key words: *aerobic capacity, anaerobic load tolerance, lactate, blood pH, load test, cyclists, handball players*

Introduction

High intensity exercises cause large changes in the concentration of metabolites and ions in skeletal muscles. The rapid rate of anaerobic glycolysis during maximal and submaximal intensity exercises results in the accumulation of hydrogen ions (H^+) (Robergs et al., 2004). Increase of the H^+ ions concentration in skeletal muscles and blood affects metabolic and contractile processes (Favero et al., 1995; Spriet et al., 1989), is one of the reasons in fatigue development (Weterblad et al., 1997) and causes decrease of high intensity exercises performance (Allen and Westerblad, 2001). Above mentioned allows us to conclude that ability of athletes' organism to regulate H^+ ions concentration in muscles and blood during intensive exercises determines their performance – the ability of muscles to perform strong contractions.

H^+ ions concentration regulate a great number of mechanisms, including ion transport and exchange mechanisms through a membrane of muscles' fibers, and both intra- and extra- cellular buffer systems (Juel, 1997; Parkhouse and McKenze, 1984). An elevated muscles buffer system's capacity in humans is associated with greater performance during a number of exercise tasks, including short (30 – 60 s) and longer (1-2 min) sprint running performance (Bell and Wenger, 1988; Nevil et al., 1989). Therefore

accumulation of H^+ ions is a reason of muscles' fatigue, the ability to buffer H^+ ions is an important determinant of high intensity exercises performance.

Sport training can improve muscles' buffer systems capacity and diminish H^+ ions concentration in muscles and blood (Bell and Wenger, 1988; Juel, 1998; Susuki et al., 2004). However, not all sport training studies have reported improved muscles buffer systems capacity (Harmer et al., 2000; Pilgaard et al., 1999). These finding may be the result of differences in the prior performance of the athletes and using of different training methods. Authors, who have reported improvement in muscles buffer systems capacity following training have also reported greater increase of single and repeated sprint running performance, as well as, improvements in short endurance (distances duration not longer than 10 min) performance (Bell and Wenger, 1988; Edge et al., 2002; Weston et al., 1997). High intensity training causes numerous adaptation reactions. Therefore it is difficult to estimate the contribution of improved muscles buffer systems capacity to greater sprint running performance (Sharp et al., 1986). Greater skeletal muscles buffer systems capacity improves athlete's performance in high intensity loads because it allows anaerobic glycolysis to continue longer time in submaximal intensity loads: the lactate concentration increases in muscles (and later in the periphery blood) without growth of the H^+ ions concentration in skeletal muscles and blood. The previous authors, who have reported a greater lactate accumulation in periphery blood, determined significantly unchanged the blood pH before and after training during sprint running (Bell and Wenger, 1989). It is very important for athletes, who need high anaerobic capacity to achieve good results in their sport specialization. Parkhouse et al. (1989) determined greater muscles buffer systems capacity and production significantly more lactate during short, high intensity exercise bout in 800 m track runners than in marathon runners and untrained persons. Team sport athletes after game had smaller change in plasma H^+ ions concentration in comparison with change in plasma lactate concentration, they had good repeated sprint running ability (Bishop et al., 2003).

Team sport athletes need many physical abilities and perform both: endurance and sprint training, suggesting that they both can cause muscles buffer systems capacity elevation. Nevertheless, Bangsbo et al. (1993) did not find any differences in muscles buffer systems capacity between elite male soccer players and middle-distance runners. Different authors findings concerning muscles buffer systems capacity and training protocol are conflicting: it is unclear whether the intermittent activities performed by team sport athletes during training and match-plays causes elevation of muscles buffer systems capacity better than endurance training or moderate physical activity. Edge et al. (2006) investigated and compared muscles buffer systems capacity and athletes' ability to perform repeated sprint distances in young female athletes trained in different sport specializations. These authors determined that team sport athletes (basketball, football, hockey and netball players) have better muscles buffer systems capacity and repeated sprint distances running results than endurance athletes (cyclists, rowers and athletes trained in triathlon) and untrained young females.

The aim of our investigation was to compare male team sport athletes (handball players) and endurance athletes (cyclists) aerobic capacity and ability to maintain high performance during high intensity loads, when the lactate concentration increases in the capillary blood.

Material and Methods

Two groups of high qualification male athletes voluntary participated in the investigation.

1. Athletes trained in endurance sport: 14 road cyclists from the Latvian Olympic Team. Their age varied from 18 to 21 years, the training experience of the cyclists

was seven to nine years. The aerobic performance tests of every cyclist were carried out once or twice a year at the initial and middle part of the preparation phase of training.

2. Athletes trained in sport games: 11 handball players from the team of Latvian Academy of Sports Education. Their age varied from 19 to 22 years, the training experience of handball players was seven to 12 years. They trained five times per week and regularly participated in sport games in weekends. Their aerobic performance was determined in the end of the first part of competition period.

The athletes performed incremental load tests to exhaustion: the cyclists – a test on a bicycle ergometer, but the handball players – a running test on a treadmill. A cardiopulmonary diagnostic equipment „Oxygen Mobile Via Sys" (Via Sys Healthcare GMBH, Germany) was used to register an electrocardiogram and respiratory characteristics. A mean duration of the test was 28 ± 2 minutes. A lactic acid concentration in the capillary blood was detected by a special lactate analyzers „Biosen 5030" (EKG – diagnostic, Germany) every two minutes (in the end of every load intensity step).

Every cyclist performed incremental load test on a mechanical bicycle ergometer (Monark, Sweden). Initial load intensity was 27 W, but then it was increased every two minutes step by step for 12 W.

The aerobic capacity of handball players is measured on a treadmill, the intensity of running increased step by step every two minutes for 0.15 m/s. The power (P) of every handball player performed during running test was calculated:

$$P = m \cdot D/ t = m \cdot v \text{ (kg} \cdot \text{m/ s)};$$

where: m – body weight of athlete, D – length of the performed distance, t – running time; v – running velocity. Then we determined the power performed by handball players in Watts (W):

$$P \text{ (W)} = P \text{ (kg} \cdot \text{m/ s)} \cdot 9.81.$$

Mean values and standard deviations for the aerobic capacity, performed power, maximal lactate concentration in the periphery blood were calculated. Student's *t* - test for unpaired data groups was used to determine differences between the characteristics of cyclists and handball players. The differences were considered to be statistically significant at $p<0.05$.

Results

The anthropometric characteristics of the cyclists [2] and handball players [3] are shown in the Table 1.

Table 1

Mean anthropometric characteristics of road cyclists and handball players

Characteristic / Sport	**Age** (years, mean ± SD)	**Height** (cm, mean ± SD)	**Body weight** (kg, mean ± SD)	**Body mass index** (kg/m^2, mean ± SD)
Cycling	19.3 ± 1.1	183.6±5.4	73.4 ± 3.8	21.7 ± 1.1
Handball	20 ± 1	186.7±8.1	84.7±11.1	24.2 ± 1.7
Significance of difference	*p > 0.05*	*p > 0.05*	*p<0.007*	*p<0.001*

The mean age and height of both groups of athletes do not differ significantly. The mean body weight and body mass index are higher in handball players than in cyclists due to greater muscles mass and fat content in sport games players body.

The aerobic capacity characteristics of the athletes (Pontaga and Konrads, 2009; Pontaga and Zidens, 2006) are compared in the Table 2. The aerobic capacity characteristics (absolute and relative oxygen uptake at the anaerobic threshold and the maximal oxygen uptake loads) are significantly greater in the road cyclists than in the handball players, $p < 0.03$.

Table 2

Mean characteristics of aerobic capacity in cyclists and handball players

Load intensity	**Anaerobic threshold load**			**Maximal oxygen uptake load**		
Charact. / Sport	**VO_2** (l/min, mean ± SD)	**Rel.VO_2** (ml/kg·min, mean ± SD)	**Heart rate** (beats/min, mean ± SD)	**$VO_{2\,max}$** (l/min, mean ± SD)	**Rel.VO_{2max}** (ml/kg·min, mean ± SD)	**Heart rate** (beats/min, mean ± SD)
Cyclists	3.85± 0.30	52.6± 3.7	167 ± 7	4.62± 0.40	63.2± 4.8	188 ± 9
Handball players	3.46± 0.51	41.1± 4,9	169 ± 7	3.96± 0.54	46.4± 4.4	187 ± 6
Significance of differ.	*p < 0.03*	*p < 0.001*	*p > 0.05*	*p < 0.002*	*p < 0.001*	*p > 0.05*

Both sports specializations athletes performed incremental tests to exhaustion (cyclists on the bicycle ergometer, but handball players on treadmill). The lactate concentration in the periphery blood is determined in end of load test. The relationship between the maximal power and the lactate concentration in the blood is shown in the Fig.1.

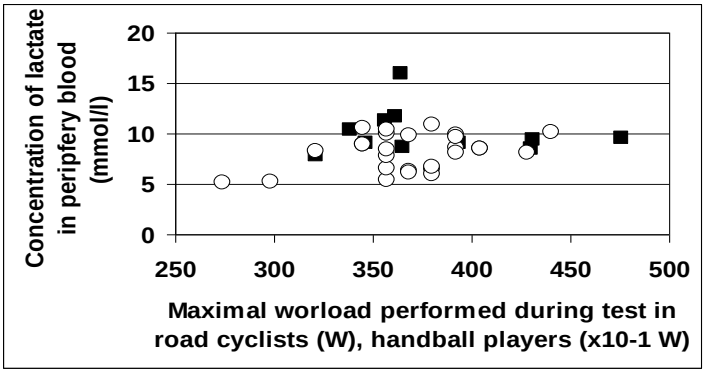

Fig.1. Relationship between maximal power production and lactate concentration in periphery blood at the end of the load test

■ – maximal power of handball players is determined from running test on the treadmill,

○ – maximal power of road cyclists is determined from load test on bicycle ergometer.

The mean concentration of lactate in the capillary blood of handball players (10.16 ± 2.26 mmol/l) is significantly greater than in the blood samples of the cyclists (8.14 ± 2.42 mmol/l), $p < 0.02$. It indirectly proves that muscles and (or) blood buffering systems capacity is greater in handball players in comparison with the road cyclists.

Discussion

The results of our investigation prove that the high intensity loads tolerance is greater in high qualification amateur male handball players than in Latvian elite cyclists. The handball players can maintain high performance at greater lactate concentration in periphery blood (10.16 ± 2.26 mmol/l) in comparison with the cyclists (8.14 ± 2.42 mmol/l), $p < 0.02$. It allows us to conclude that regular trainings and play – matches in team sports with different intensity and duration loads, including repeated high intensity anaerobic loads, can elevate the muscles and (or) blood buffer systems capacity. The endurance athletes regularly perform prolonged intensive aerobic loads (mostly anaerobic threshold intensity). It significantly improves their aerobic capacity, but the effect on muscles and (or) blood buffer systems capacity elevation is not so great. Our results are in a good agreement with the data of Edge et al. (2006), who revealed that young female team sport athletes (basketball, football, hockey and netball players) have better muscles buffer systems capacity and the results of repeated sprint distances running than endurance athletes (cyclists, rowers and athletes trained in triathlon) and untrained young females.

The opinion of Weston et al. (1996) is that the high H^+ ion concentration in skeletal muscles during high intensity physical training causes muscles buffer systems capacity increase. The concentration of H^+ ion depends of the intensity, load and rest intervals duration, training mode, which cause different changes in the capacity of buffer systems (Street et al, 2001; Yoshida and Waitari, 1993a; Yoshida and Waitari, 1993b). Many investigators observed growth of the lactate concentration in the periphery blood without chances of the blood pH in team sport athletes (Bagsbo et al., 1993; Bishop and Spencer, 2003). Ellis et al. (2009) performed the experimental investigation with intravenous infusion of lactate solution into the blood of high qualification cyclists before 20 km distance of cycling. The lactate concentration in the periphery blood before and after cycling of 20 km distance was significantly greater in the experimental group of cyclists in comparison with the control group. The great concentration of lactate in the blood had not effect on the result of 20 km cycling, the workload on bicycle and the respiratory characteristics of the athletes. It means that in the muscles and blood of athletes (especially team sports) buffer systems fast neutralize the lactic acid and it became the lactate, which does not influence their performance during high intensity sport loads.

Conclusions

1. The mean body weight and body mass index are higher in handball players than in cyclists, it is possible to explain by greater muscles mass and fat content in sport games players body.
2. The aerobic capacity characteristics (absolute and relative oxygen uptake at the anaerobic threshold and the maximal oxygen uptake loads) are significantly better in the road cyclists than in the handball players, $p < 0.03$.
3. The mean concentration of lactate in the capillary blood of handball players (10.16 ± 2.26 mmol/l) is significantly greater than in the blood samples of the cyclists (8.14 ± 2.42 mmol/l), $p < 0.02$. It indirectly proves that muscles and (or) blood buffering systems capacity is greater in handball players than in the road cyclists.

Acknowledgement

We are very grateful to Dr. Digna Jukmane and the staff of Latvian Olympic Team laboratory for the elite cyclist's and amateur handball players aerobic performance diagnostics.

References

1. Allen D.G. & Westerblad H. (2001). Role of phosphate and calcium stores in muscle fatigue. *Journal of Physiology, Volume 536*, Number 3 (pp.657 – 665). DOI 10.1111/j.1469-7793.2001.t01-1-00657.
2. Bagsbo J., Michalsik L. & Petersen A. (1993). Accumulated O_2 deficit during intense exercise muscle characteristics of elite athletes. *International Journal of Sports Medicine, Volume14* (pp.207 – 213).
3. Bell G.J. & Wenger H.A. (1988). The effect of one – legged sprint training on intramuscular pH and non – bicarbonate buffering capacity. *European Journal of Applied Physiology, Volume 58* (pp.158 – 164). DOI 10.1007/BF00636620.
4. Bishop D., Lawrence S. & Spencer M. (2003). Predictors of repeated – sprint ability in elite female hockey players. *Journal of Science in Medicine and Sport, Volume 6* (pp.199 – 209). DOI 10.1016/S1440-2440(03)80255-4.
5. Bishop D. & Spencer M. (2004). Determinants of repeated – sprint ability in well – trained team - sport athletes and endurance – trained athletes. *Journal of Sports Medicine and Physical Fitness, Volume 44* (pp.1 – 7). MedLine Citation: PMID: 15181383.
6. Edge J., Bishop D., Dawson B. & Goodman C. The effects of training intensity on muscle buffer capacity. The European Congress of Sports Science, 2002 (pp.622).
7. Edge J., Bishop D., Hill – Haas S., Dawson B. & Goodman C. (2006). Comparison of muscle buffer capacity and repeated – sprint ability of untrained, endurance – trained and team -sport athletes. *European Journal of Applied Physiology, Volume 96* (pp.225 – 234). DOI 10.1007/s00421-005-0056-x.
8. Ellis D., Simmons C. & Miller B.(2009). Sodium lactate infusion during cycling time – trial does not increase lactate concentration or decrease performance. *European Journal of Sport Science, Volume 9* (pp.367 – 374). DOI: 10.1080/17461390903009158.
9. Favero T.G., Zable A.C., Bowman M., Thompson A. & Abramson J.J. (1995). Metabolic end products inhibit sarcoplasmic reticulum Ca^{2+} release and H^{+} ion binding. *Journal of Applied Physiology, Volume 78* (pp.1665 – 1672). DOI 8750-7587/95.
10. Harmer A.R., McKenna M.J., Sutton J.R., Snow R.J., Ruell P.A., Booth J., Thompson M.W., Mackay N.A., Stathis C.G., Crameri R.M., Carey M.F. & Eager D.M. (2000). Skeletal muscle metabolic and ionic adaptations during intense exercise following sprint training in humans. *Journal of Applied Physiology, Volume 89* (pp.1793 – 1803). DOI 8750-7587/00.
11. Juel C. (1997) Lactate – proton cotransport in skeletal muscle. *Physiology Review, Volume 77* (pp.321 – 358). DOI 0031-9333/97.
12. Juel C. (1998). Muscle pH regulation: role of training. *Acta Physiologica Scandinavica, Volume 162* (pp.359 – 366). DOI 10.1111/j.1469-7793.1999.0633s.x.
13. Nevill M.E., Boobis L.S., Brooks S. & Williams C. (1989). Effect of training on muscle metabolism during treadmill sprinting. *Journal of Applied Physiology, Volume 67* (pp.2376 – 2382). DOI 8750-7587/89.
14. Parkhouse W.S. & McKenzie D.C. (1984). Possible contribution of skeletal muscle buffers to enhanced anaerobic performance; a brief review. *Medicine and Science in Sports and Exercise, Volume 16* (pp.328 – 338).
15. Parkhouse W.S., McKenzie D.C., Hochachka P.W. & Ovalle W.K. (1985). Buffering capacity of deproteinized human vastus lateralis muscle. *Journal of Applied Physiology, Volume 58* (pp.14 – 17).

16. Pilegaard H., Domino K., Noland K., Juel C., Hellsten Y., Halestrap A.P. & Bangsbo J. (1999). Effect of high - intensity exercise training on lactate/ hydrogen ion transport capacity in human skeletal muscle. *American Journal of Physiology, Volume 276* (E.255 – E.261). DOI 0193-1849/99.
17. Pontaga I. & Žīdens J. (2006). Handbolistu fizisko īpašību izvērtējums. *LSPA Zinātniskie raksti (periodisks izdevums)* (158 – 163 lpp.).
18. Pontaga I. & Konrads A. (2009). Evaluation of endurance physiological characteristics in road cyclists. *Journal: Education. Physical Training. Sport (Lithuania), Volume 72*, Number 1 (pp.85 – 91).
19. Robergs R.A., Ghiasv F. & Parker D. (2004). Biochemistry of exercise – induced metabolic acidosis. *American Journal of Physiology - Regulatory, Integrative and Comparative Physiology, Volume 287* (R.502 – R.516).
20. Sharp R.L., Costill D.L., Fink W.J. & King D.S. (1986). Effects of eights weeks of bicycle ergometer sprint training on human muscle buffer capacity. *International Journal of Sports Medicine, Volume 7* (pp.13 – 17). DOI 10.1055/s-2008-1025727.
21. Spriet L.L., Lindinger M.I., McKelvie R.S. Heigenhauser G.J.F. & Jones N.L. (1989). Muscle glycogenolysis and H^+ concentration during maximal intermittent cycling. *Journal of Applied Physiology,Volume 66* (pp.8 – 13). DOI 8750-7587/89.
22. Street D., Bangsbo J. & Juel C. (2001). Intersticial pH in human skeletal muscle during and after dynamic graded exercise. *Journal of Physiology, Volume 537* (pp.993 – 998). DOI 10.1113/jphysiol.2001.012954.
23. Susuki Y., Ito O., Takahashi H. & Takamatsu K. (2004). The effect of sprint training on skeletal muscle carnosine in humans. *International Journal of Sport and Health Sciences, Volume 2* (pp.105 – 110).
24. Westerblad H., Bruton J.D. & Lannergren J. (1997). The effect of intracellular pH on contractile function of intact, single fibres of mouse muscle declines with increasing temperature. *Journal of Physiology, Volume 500* (pp.193 – 204). PMCID: PMC1159369.
25. Weston A.R., Myburgh K.H., Lindsay F.H., Dennis S.C., Noakes T.D. & Hawley J.A. (1997). Skeletal muscle buffering capacity and endurance performance after high - intensity interval training by well – trained cyclists. *European Journal of Applied Physiology, Volume 75* (pp.7 – 13). DOI 10.1080/026404197367335.
26. Weston A.R., Wilson G.R., Noakes T.D. & Myburgh K.H. (1996). Skeletal muscle buffering capacity is higher in the superficial vastus than in the soleus of spontaneously running rats. *Acta Physiologica Scandinavica, Volume 157* (pp.211 – 216). DOI 35400004372174.0100.
27. Yoshida T. & Waitari H. (1993 a). ^{31}P – Nuclear magnetic resonance spectroscopy study of the time course of energy metabolism during exercise and recovery. *European Journal Applied Physiology, Volume 66* (pp.494 – 499).
28. Yoshida T. & Waitari H. (1993 b). Changes in intracellular pH during repeated exercise. *European Journal Applied Physiology, Volume 67* (pp.274 – 278).

Submitted: July 29, 2010
Accepted: October 14, 2010

GAIT PARAMETERS OF PERSONS WITH TOTAL HIP ARTHROPLASTY

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Abstract

Osteoarthritis is the most common form of arthritis in the hip. Osteoarthrosis is one of the most frequent diseases, which lead to locomotion defects. Endoprosthetics is one of the best methods for treating this condition. There are approximately 2300 hip arthroplasy surgeries per year in Latvia. The good outcome in total hip arthroplasty patients is the elimination of pain and recovery of a normal range of movement, which is essential to improve the gait and restore the quality of life. The aim of this study is to analyze changes of gait parameters in persons before and after unilateral total hip arthroplasty.

30 persons were included in the study (mean age 60±7). Patient group consisted of 15 persons with diagnosis of primar unilateral coxarthrosis and was examine 2-times. There was increased doublestance and stance phase in the healthy leg before surgery and these changes had positive correlation with pain intensity, after surgery stance phase has decreased, but doublestance had no changes ($p<0,005$). Asymmetric pelvic motion in the sagittal plane was detected in 93% participants before and after total hip arthroplasty. Before operation asymmetry of pelvic movement in frontal plane was observed in 53% participants, these changes were correlated with pain intensity, after total hip arthroplasty pelvic movement asymmetry was observed in 33% participants and correlation with pain was not observed.

Key words: *Gait analysis, total hip arthroplasty, coxarthrosis, orthopaedia, endoprosthetics*

Introduction

Degenerative joint disease is a structural and functional change in the synovial joint [1]. Osteoarthrosis is the most common joint illness and one of the major reasons for locomotion defects [1,12]. It can also be interpreted as arthropathy, which characteristic traits are erodation of the cartilage, subchondral bone damage, produce of osteophytes [12]. In the case of such illness the impact is left not only on the cartilage of a joint and subchondral bone, but also on ligaments, joint capsule, synovial tissue, tendons, and periarticular muscles are all eventually affected [1,7].

Osteoarthritis symptoms appear more often at the age of 40-50, yet such symptoms appear sooner among females then males. For men after 40 this illness can be encountered more often as a result of a trauma also frequently for high class athletes as a result of asymmetrical load or overload in the joints. After the age of 70 the regularity of appearance of the illness among genders evens up [1,12].

Joint cartilage structural and mechanical characteristics alter in the result of mechanical, cellular and biochemical process interaction. The subchondral bone slowly exposes, becomes sclerotic, cysts develop in it, osteophytes develop at the edges of joint surface. Synovium becomes inflamed and produces joint liquid with a lower viscosity, but

in a larger volume. Periarticular ligaments stretch and become inelastic, tendinitis is being created. With time the surrounding muscles atrophy and cannot fulfil its functions validly [1,7].

Main reason for treating osteoarthrosis is improvement of the functional condition and life quality. Reduced capability to participate in daily activities is commonly observed in patients [9].

Other objectives for treatment are educating the patient, pain control, improvement of functions, to delay the progress of illness and formation of complications (fig. 1) [7,8,9,10].

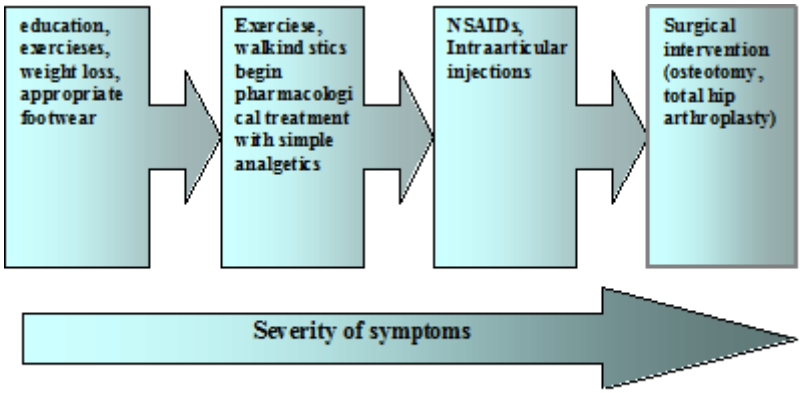

Fig 1. Stepwise algorithm for the management of patients with osteoarthritis [7]

Total hip arthroplasty is an operation during which the joint components affected by the illness are exchanged by an artificial prosthesis [2,9].

Result of the operation is effective in 68% - 95% of cases and allows to reach the goals of treatment [1,8]. Research results indicate that most rapid post operation recovery takes place during the first year [5,9]. However, this period of time might not be sufficient to reach optimal condition. Patients still complain about the daily activity disorders [7]. After two years only time and distance from the gait parameters may restore up to the norm, but kinetics data still remains altered [8, 10, 11]. After 8-10 years the functional condition has maximally improved however the parameters are bellow the control group level. Thereby initial post operation rehabilitation is important as well as repeated rehabilitation [5,6].

Methods and material

The research was made in Rehabilitation centre „Vaivari" in corporation with Hospital of Traumatology and Orthopaedics, during the term of October 2008 until December 2009, the work has been approved by the ethical committee.

During the research two participant groups were formed: a study (patient) group and a control group. 30 persons were included in the study (mean age 60±7). Before examination all of participants were informed about the work and signed agreement letter.

Study group consisted of 15 patients (7 male and 8 female) who during the mentioned time period had had first unilateral total hip arthroplasty in Hospital of Traumatology and Orthopaedics in Riga. Control group was made from 15 persons without any muscle-sceletal system disoders.

Patients were evaluated two times: few days (1-2) before the operation and 2 months after the operation. During examination the patients were mediatised, clinically examined and their gait was instrumentally recorded. Until the second examination none of them had received rehabilitation treatment. Following parameters were measured out: leg

length asymmetry (absolute and relative leg length in cm), range of motion (in degrees), Harris hip score, pain localization and intensity (using visual analog scale in points). The gait analysis was performed also 2-times, following parameters were observed: spatial-temporal changes, kinematic changes of the pelvic, both hips and knees, kinetic changes (force moments) of both hips and knees, vertical ground reaction force and centre of gravity movement amplitude. Patient data was compared with the control group data.

For gait analysis we used 6 Qualisys infrared cameras, AMTI force plate and 24 passive reflected surface markers. Before recording the gait 29 special spherical markers from light reflecting material were placed with adhesive tape on patient's skin at certain anatomical points (Helen Hayes model). With them the participants had to walk 6 up to 10 times a 7-8 meter distance.

Results

Before operation all of patients had pain in the affected hip joint for a long period, 13 persons (86,7%) had pain more than 2 years and only 2 persons had pain only 1 year. Mean pain intensity was 5,8 ±2,3 points before operation, after operation pain mean intensity was decreased till 1,0±1,5 ($p=0,023$), 9 of participants didn't check pain in the affected hip joint at all. Before operation 11 (73%) persons had pain in the lumbal spine and at the knee joints. After operation pain in the lumbal region of spine checked out 9 patients, 7 from them had diagnosis of spondilosis in the lumbal region of spine, pain in the knee joint checked out 5 persons and gonarthrosis was detected 3 patients. Before operation 5 patients checked out pain in the opposite hip joint, after operation only 1 person.

Before operation absolute leg length asymmetry (affected leg was shorter) was observed in 12 persons, mean asymmetry was 1,1±0,7 cm, after operation asymmetry was observed in 5 persons. Relative leg lengths asymmetry was observed 11 patients (mean 0,7±0,6 cm) before surgical intervention, after operation that was detected in 8 participants (mean 0,5±0,4). Control group had no leg length asymmetry.

There was increased doublestance (28,67±5,92%) and stance phase in the healthy leg before surgery (66,9±4,4%) and these changes had positive correlation with pain intensity ($r=0,818$). After surgery the stance phase decreased, but double stance did not changed ($p<0,05$). There was a statistically significant increase in hip range of motion during gait in the sagittal plane after surgery (24,2±6°; $p<0,001$) but however significant difference between the postoperative data and control group. There was limited hip extension in terminal stance phase before operation in all cases (fig. 2).

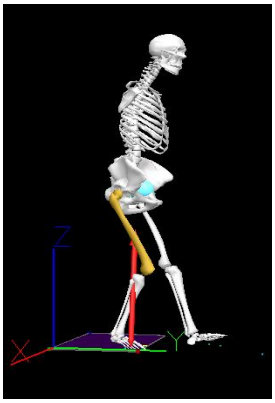

Fig. 2. Decreased hip extension in terminal stance

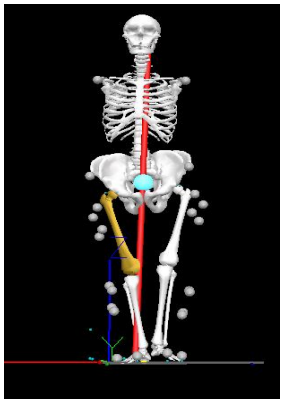

Fig. 3. Contralateral pelvic hike in stance phase

Before surgery contralateral pelvic hike was observed in 8 (53%) patients, and after surgery this limping was observed in 5 (33%) patients (fig. 3, fig. 4).

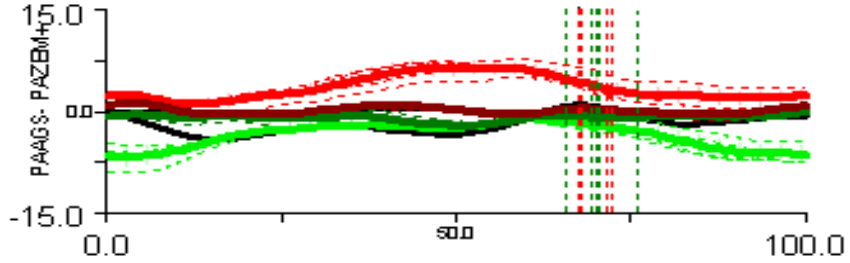

Fig. 4. Pelvic movement asymmetry in frontal plane (red line – affected side, green line – not-affected line. Light lines – before operation, dark line – after operation

Before and after surgical intervention it was increased pelvic tilt and knee flexion during stance phase, as a compensation of decreased hip extension in the terminal stance ($p<0,05$) (tab. 1).

Before operation this deviation had statistically significant correlation with pain intensity, but after surgical treatment that was disappeared. Asymmetric pelvic motion in the sagittal plane was detected in 14 (93%) participants before and after total hip arthroplasty ($p<0,01$).

Table 1

Kinematic parameters

Parameters	**Side**	**Control group**	**Before surgery**	**After surgery**
Hip movements				
Active ROM in the sagittal plane	A	118,2±3°	80,47±10°*	86,0±6°
	B	116,0±4°	104,67±13,5°*	110,67±11°**I**
ROM in sagittal plane during gait	A	39,8±4°	17,67±6°*	24,2±6°* **I**
	B	39,27±4°	35,33±8°	33,13±7***I**
Extension (minimal flexion) in terminal stance phase	A	10±9°	18,2±13°*	13,6±10°***I**
	B	-9±11°	10,5±4°*	9±6°*
Maximal flexion in swing phase	A	29,9±9°	35,9±10°	36,4±9°
	B	29,3±10°	43,9±8°*	35,9±9°**I**
Knee joint movements				
Flexion in mid-stance phase	A	4±3°	11,8±8°*	13±7°*
	B	3±2°	10,9±6°*	8,0±7° **I**
Flexion in loading response	A	16,9±6°	8±7°*	11±9° **I**
	B	16,6±5°	16,1±6°	12,3±6°
Pelvic and trunk movements				
Pelvic tilt		-5±8° "-"rotated backward	16°±7°*	11,4±5°*
Trunk lateroflexion in stance phase to the stance leg`s side	A	3±1°	4±1°	3±1°
	B	1,4±1°	3±3°	0,9±0,5° **I**
	B	1,4±1°	3±3°	0,9±0,5° **I**

A- affected side (patient group), right side (control group) B – non-affected side (patient group), left side (control group)

"*" there is statistically significant difference between patient group and controls ($p<0,05$)

"I" is statistically significant difference between before and after surgery data

After operation there is increased extension moment of not-affected hip joint corresponding to norm and control group (0,83±0,25 Nm/kg (p=0,04), that has statistically significant positive correlation with ipsilateral knee joint flexion during loading response (r=0,580; p=0,026) (tab.2).

Table 2

Vertical ground reaction force and kinetic parameters of hip joint

Parameter	Side	Control group	Before surgery	After surgery
Abduction moments in loading response (Nm/kg)	A	0,92±0.06	0,719±1,9*	0,794±0,19*
	B	0,92±0.06	0,790±0,19*	0,92±1,5 **I**
Extension moment in loading response (Nm/kg)	A	0,71±9,14	0,70±0,21	0,68±0,28
	B	0,67±0,13	81±27*	83±25*
GRF first maximum peak (% of body weight)	A	104±46	95±10*	97±10*
	B	105±55	97±14	102±6
GRF second maximum peak (% of body weight)	A	110±7	100±9*	95±20*
	B	111±8	105±6	111±8
CG vertical movement amplitude (cm)		2,0±0,4	3,0±0,9*	2,9±0,9*
CG horizontal movement amplitude (cm)		3,9 ±0,4	5,3±2,0*	5,5±1,8*

A- affected side (patient group), right side (control group) B – non-affected side (patient group), left side (control group)

"*" there is statistically significant difference between patient group and controls (p<0,05)

"I" is statistically significant difference between before and after surgery data

GRF - ground reaction force

CG – centre of gravity

Discussion and conclusions

Two months after surgery there is an increase in the range of motion during gait in affected hip, decrease in pain intensity, improvement in affected leg muscle strength, but it remains a decreased vertical ground reaction force, increased double stance and compensation movements of pelvis and ipsilateral knee joint.

Reduced motion of the hip joint leads to an increased pelvic motion, which should affect the natural mobility of the lumbar spine and cause pain in the lumbar region of the spine because of their kinematic interaction (*Z.Bejek, R.Paroczai, 2006*).

The first symptoms of displastic coxarthrosis of teenagers may be revealed from plantar pressure measurements by analysis the character of time dependence the velocity of the centre of pressure and loading of different areas of the foot (force and contact time) (*T.Tsvetkova, V.Lebedev, 1997*).

The stage of osteoarthritis and the changes in the leg-length discrepancies were the factors that most influenced gait improvement after total hip arthroplasty throughout the follow-up period. (*R.Tanaka, M.Shigematsu, 2009*).

Therefore it is very important, in long term, to know about progression of gait abnormalities, because they can affect other joints. Thus, for future work it is necessary to be able determining the urgency of indication for hip arthroplasty by gait analysis (by monitoring gait one time in a year).

References

1. Bhargava P., Shivastava P. Assessment of changes in gait parameters and vertical ground reaction forces after total hip arthroplasty// IJO (Indian Journal of Orthopaedics), 2007; 41 (2), 158-162
2. Dieppe P. Management of hip osteoarthritis// BMJ (British Medical Journal) 1995; 311:853-857
3. Dujardin F., Aucouturier T., Bocquet G., Kinematics of the healthy and arthritic hip joint during walking. A study of 136 subjects// Revue de chirurgie orthopédique et réparatrice de l'appareil moteur.(Rev Chir Orthop Reparatrice Appar Mot.) 1998 Nov;84(8):689-99.
4. Flugsrug G.B., Nordsletten L., Espehang B. The impact of body mass index on later total hip arthroplasty for primary osteoarthritis: a cohort study in 1,2 million persons// Arthritis & Rheumatism; 2006, 54 (3): 802. DOI. 10.1002/art.21659
5. Hinton R., Sean F.T. Osteoarthritis: Diagnosis and Therapeutic Considerations// Practical Therapeutics, 2001
6. Hulet C., Hurwitz D.E., Andriacchi T.P. Functional gait adaptations in patients with painful hip// Revue de chirurgie orthopédique et réparatrice de l'appareil moteur.(Rev Chir Orthop Reparatrice Appar Mot.), 2000 Oct;86(6):581-9
7. Hunter D.J., Felson D.T. Clinical review of osteoarthritis// BMJ (British Medical Journal) 2006; 332:639-642. DOI: 10.1002/acr.20278
8. Hunter D.J., McDougall J.J. The symptoms of osteoarthritis and the genesis of pain// Rheumatic Disease clinics of North America, 2008, 34(3); 623-643. DOI:10.1016/j.rdc.2008.05.004
9. Illyés Á., Bejek Z., Szlávik I. Three – dimensional gait analysis after unilateral cemented total hip arthroplasty.// Physical Education and Sport 2006; 4 (1), 27 – 34.
10. Jones A., Doherty M., ABC of Rheumatology: osteoarthritis// BMJ (British Medical Journal) 1995; 310:457-460
11. Kyriazis V., Rigas C. Temporal gait analysis of hip osteoarthritic patients operated with cementless hip replacement // Clinical Biomechanics, 2002; 17 (4), 318-321
12. Miller M.L. The Little Black Book of Rheumatology; 2008, Jones and Bartlett publisher (262)

Submitted: July 5, 2010
Accepted: November 2, 2010

HEART RATE AND ENERGY CONSUMPTION DURING STANDARD SPORT DANCING

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Abstract

Dancers appear to be performing at very high levels of energy expenditure throughout their competitive dance routines. A more thorough understanding of the energy demands of competition would enable the prescribing of more specific training programs. The main aim of our research was to determine heart rate and energy consumption differences between dancing in close partners' contact and without it. For this purpose we have measured and analyzed heart rate and energy consumption of sport dancers during competitive standard dance sequences and compared measured data of dancing with and without a close body contact of partners. Results show that contact condition significantly influences on physical load of dancers during competitions. Nevertheless, continuous contact keeping in couple enables more effective and dynamic movements in composition, which obviously decreases heart rate while performing competitive dance routines. Such information can be useful for developing sport dancing training techniques and methodologies.

Key words *Standard dance sport, IDSF, HR, energy consumption, body contact*

Introduction

Following the success of information technologies and development of smart electronic devices, usage of small portable physiological measurement systems are expected to be widely used for dance sport in the near future. Dance sport currently is enjoying a growth of public interest in Europe. Dancers appear to be performing at very high levels of energy expenditure throughout their competitive dance routines. A more thorough understanding of the energy demands of competition would enable the prescribing of more specific training programs. Standard sport dances can consist of fast movements, continuous turns, sways, and swings; therefore cumbersome measuring equipment is not acceptable due to safety issues.

In Standard sport dances correct movements should be made in close partners' contact. Depending on couples' dancing professional skills ability to continuously keep contact changes. The main aim of our research is to estimate importance of keeping contact for dancers' energy conservation. For this purpose we have measured physiological parameters of sport dancers with and without partners' close contact using *Suunto T6c Heart Rate Monitoring System*. Being able to establish that there is a difference between physiological parameters (HR, oxygen and energy consumption, respiration rate) measured during Standard sport dancing performance simulation with and without contact would therefore be of benefit in determining contact condition influence on physical load of dancers during competition.

In recent years sports science has shown the importance of fitness testing that is activity specific. To date, no valid dance-specific fitness tests for sport dancing exist. Such

information can be useful for developing sport dancing training techniques and methodologies.

Material and methods

The investigation consisted of four main sessions:

1. Adjusting *Suunto* equipment to the subjects;
2. Recording initial parameters of subjects;
3. Measuring physiological parameters during Standard dance sequences;
4. Recorded data processing and analysis.

Equipment

Before adjusting the equipment to the subjects, *Suunto* devices (*Suunto T6c Heart Rate Monitor* and *Suunto Memory Belt)* [1], [2], [8] were appropriately configured to the dancers' parameters and then paired between each other. Pairing of devices is very important step in adjusting equipment, which is necessary to avoid correlation of signals from devices of other dancers. Then *Suunto Memory Belts* were adjusted to each dancer.

The *Suunto Memory Belt* is a sophisticated heart rate recorder and wireless transmitter, which transmits on-line data to a *Suunto PC POD* and *T6c Heart Rate Monitor*, operating on a secure, 2.4 GHz frequency. It also records data on an integrated memory chip for downloading and analyzing at a later time. Designed for athletic, educational and wellness environments, this equipment perfectly fits on dancers.

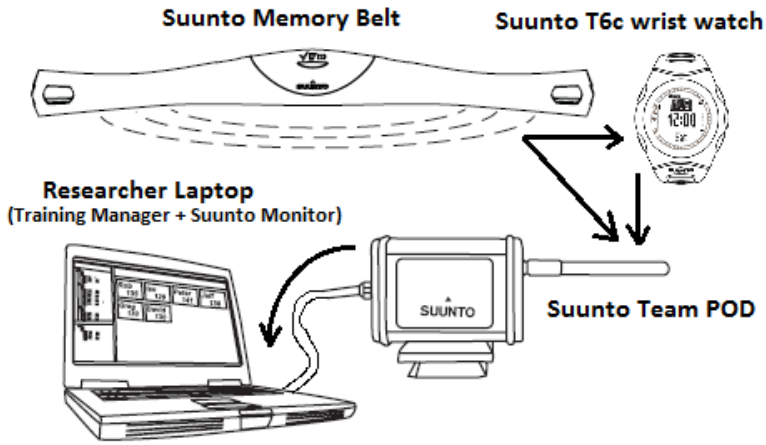

Fig. 1 Physiological monitoring system overview

Subjects

Twelve competitive A class couples took part in the investigation. After having been made familiar with test procedures, dancers were asked to rest for 25 minutes in supine position. Resting metabolism was measured in the sitting position after the rest using *Suunto Memory Belt*. Maximal heart rate was measured by a method presented in [5]. Before testing part we also recorded height and weight of each dancer. The mean physical characteristics of the subjects are listed in Table 1.

Table 1

Physical characteristics of the dancers

	Males (n = 12)		Females (n = 12)	
	Mean	S.D.	Mean	S.D.
Age (yrs)	*20.5*	*2.11*	*20.3*	*3.33*
Height (cm)	*182.2*	*4.67*	*169.4*	*5.35*
Weight (kg)	*71.0*	*6.32*	*54.3*	*5.70*
Resting HR (beats.min^{-1})	*56.0*	*4.72*	*62.0*	*4.22*
Maximal HR (beats.min^{-1})	*197.0*	*4.20*	*195.0*	*4.50*

Testing

Subjects attended two formal testing sessions. The ambient temperature of venue was in range of 19°C to 21°C and relative humidity less than 55%. The tempi, timing, and dance sequences are shown in Table 2. Breaks between each dance were 15 to 20 seconds. Dances were completed in accordance with the IDSF Competition rules [3] and all couples danced to the same music.

Table 2

Tempi, timing, and sequence of Standard dances

Sequence	Name	Tempi (bars/min)	Duration (sec)
1	Slow Waltz	*28-30*	*90-105*
2	Tango	*31-33*	*90-105*
3	Viennese Waltz	*58-60*	*75 - 90*
4	Slow Foxtrot	*28-30*	*90-105*
5	Quickstep	*50-52*	*90-105*

The first session involved the recording of heart rate data during simulated competitive Standard dance sequences when couples remain in close partners' contact. On completion of the first dance sequence, subjects rested for further thirty minutes. When the physiological data values displayed on *Suunto T6c* wrist were identical to those values, which were obtained exactly before starting first performance, sport dancing couples were managed to start second session – this time without partner's close body contact. The same performance compositions and time intervals of each dance were used to obtain maximum precision of the experiment.

Results

The mean HR data observed for males and females for each individual dance and the overall dance sequences of Standard dance are presented in Table 3. Exercise which results in a HR range in excess of 150 beats.min^{-1} has been classified as heavy [6] or extremely heavy [7]. In this study, males elicited an overall mean HR of 167 beats.min^{-1} (range 154-179 beats.min^{-1}) for Standard dance sequences with partners' close body contact and 170 beats.min^{-1} (range 157-183 beats.min-1) without partners' close body contact. The female overall mean HR for Standard dance sequences with partners' close body contact was 171 beats.min^{-1} (range 156-187 beats.min^{-1}) and 175 beats.min^{-1} (range 159-190 beats.min-1) without partners' close body contact. According to the above definitions, therefore, competitive Standard Sport dancing is a vigorous activity requiring the cardiovascular system to work at levels which require high energy expenditures to match this physiological strain. Obviously partner's contact significantly influence on heart rate during competitive dance routines.

Table 3

Mean values of HR per dance and overall mean heart rate per 5-dance sequence

	Males (n = 12)		Females (n = 12)	
	Mean HR	S.D.	Mean HR	S.D.
With partners' close body contact:				
Slow Waltz	*150.2*	*3.27*	*153.6*	*4.48*
Tango	*164.4*	*4.56*	*169.8*	*5.72*
Viennese Waltz	*170.5*	*5.12*	*172.3*	*6.12*
Slow Foxtrot	*172.1*	*5.43*	*176.2*	*5.09*
Quickstep	*179.0*	*6.21*	*184.7*	*6.33*
Overall dance sequence	*167.2*	*4.68*	*171.3*	*5.22*
Without partners' close body contact:				
Slow Waltz	*152.3*	*5.12*	*155.7*	*5.88*
Tango	*166.2*	*5.76*	*174.9*	*5.12*
Viennese Waltz	*175.2*	*6.10*	*178.6*	*6.42*
Slow Foxtrot	*177.1*	*6.03*	*178.9*	*7.10*
Quickstep	*181.4*	*5.72*	*185.7*	*5.01*
Overall dance sequence	*170.4*	*5.32*	*174.8*	*5.54*

A mean values of HR and energy consumption data differences between 2 testing sessions (with and without partners' contact) of Standard sport dancers are shown in Figure 2 and 3.

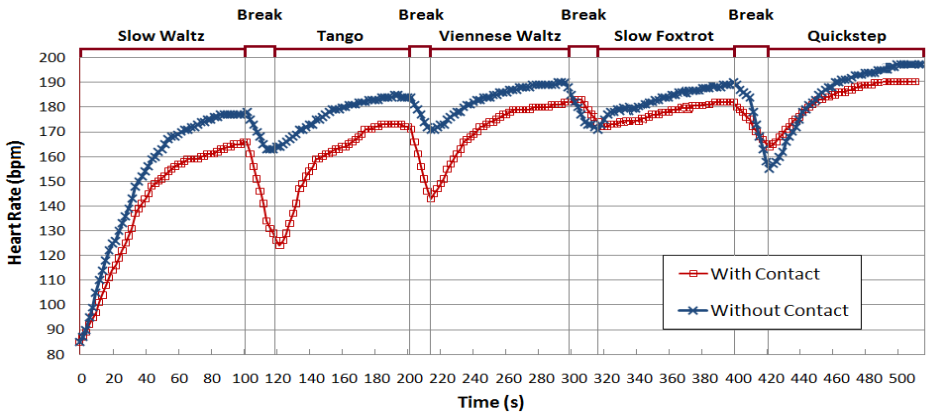

Fig. 2 HR (bpm) during competitive Standard dance sequences with and without partners' close contact.

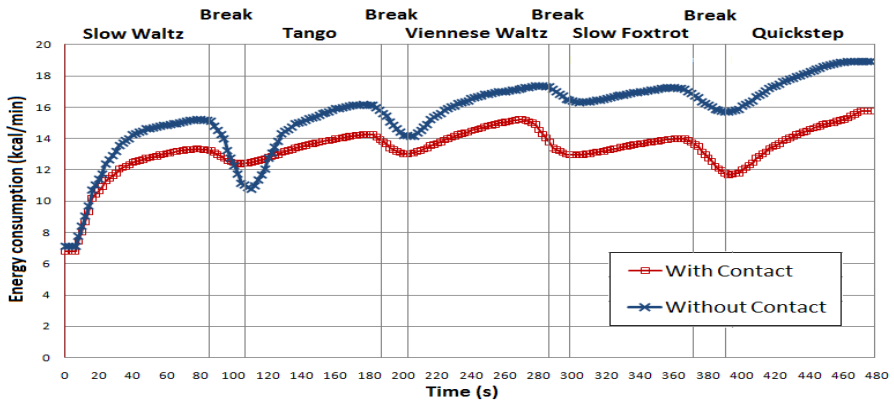

Fig. 3 Energy consumption (kcal/min) during competitive Standard dance sequences with and without partners' close contact.

We observed that during dancing performance it was more difficult to perform turns and sways while couple was dancing without close contact, so the dynamics and speed of composition were lost.

Conclusions

Physiological monitoring systems have a place as part of any physical training program, and can be especially beneficial for Standard sport dancers. Obtaining and analyzing physiological data of dancers enable the prescribing of more specific training programs. Performing simulated competitive sequences of Standard dance is a valuable training procedure which lead-up dancers to be well-prepared physiologically for the competition. Above results show that continuous contact keeping in couple enables more effective and dynamic movements in composition, furthermore it obviously decreases heart rate while performing competitive dance routines. Therefore paying more attention to partners' contact will help to conserve energy and to gain more speed for Standard dance patterns.

References

1. Suunto Oy (2009). SUUNTO ON How Not to Rely on Luck WHEN OPTIMIZING YOUR TRAINING EFFECT, Training Guidebook, *www.suunto.com.*
2. Suunto Oy (2009). Suunto t6c User's Guide, *www.suunto.com.*
3. IDSF Competition Rules (June, 2009). *AGM Macau*, Rule 14, 8-9.
4. Krasnow D., Chatfield S.J. (1996). Dance Science and the Dance Technique Class. *Impulse*, 4, 162-172.
5. Miller et al (1993). Predicting max HR. *Medicine & Science in Sports & Exercise*, 25(9), 1077-1081.
6. Suggs, C. W. (1967). An analysis of heart rate responses to exercise. *Research Quarterly*, 39 (1): 195-205.
7. Astrand, P.-O., Rodahl, K., (1977). Textbook of Work Physiology. *McGraw-Hill Book Co.*, Sydney.
8. Wisbey B. (October, 2005). Suunto t6 Heart Rate Monitor Review, *FitSense Australia*., Sydney.

Submitted: July 30, 2010
Accepted: November 11, 2010

LOCAL VIBRATION IN STRENGTH DEVELOPMENT

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Abstract

Local vibrostimulation is a local vibration method which can increase the expressions of maximal strength and muscle endurance without conducting traditional strength trainings. In our research we have tested the influence of local vibration on maximal strength by corresponding experiment. In all cases the dynamics were positive and increase of strength was significant. Investigating strength abilities of m.quadriceps femoris, we observed result increasement for experimental subjects' right leg (15kg), and second major significant increasement was for experimental subjects left leg, which was not involved in vibration training, increasement was 5kg. We concluded that vibrostimulation has positive influence on different muscle physiological systems, and it can be applied before or after the training, and in some cases during the training.

Key words: *strength expressions, thigh quadriceps*

Introduction

The world has known that prolonged vibration has negative effects on the human body, it is the occupational disease in many professions. However, some time ago – in last century, the 1960th some scientists have found that short-term and regulated amplitude and intensity of the vibrations have a positive impact on athletes work capacity and conditioning. Vibrostimulation can also be called biomechanical stimulation [Назаров, 1987]. In last century, the late seventies and eighties, the scientists of Russian naval scientific research institute A.Ņemčeno and V. Krauksts for the first time found that each individual has its own optimal muscle vibration frequency, which gives the greatest training or therapeutic effect (EN 12937 B patent and patent EN 12714 B). It was confirmed by Italian research group of dr. C. Bosco led the 1999th by studies on athletes [Bosco, Cardinale and Tsarpela, 1999]. They found that each individual has their own optimal muscle vibration frequency, which gives the greatest training effect. Italian scientists have proved that the greatest effect gives the vibration, which is absorbed in the vertical direction, contrary to gravitational forces. In sports there is practice to use a vibroplates who are able to move in all three planes simultaneously. Of course, the greatest training affect occurred, when vibration has been realized in vertical (x) axis in the plane.

Literature is a broad outline of the positive impact of the whole-body vibration in this area [Bosco, Cardinale and Tsarpela, 1999; Issurin, Tenenbaum, 1999]. Vibration forces cause muscle elongation and shortening, resulting in changes of each muscle fiber length. From each muscle fiber elongation pulses are transmitted to the central nervous system (CNS). Vibration results to a significantly higher number of muscle fibres participating in a contraction than normal during exercises [Issurin, Tenenbaum 1999]. Vibration results in markedly high electromyographical (EMG) activity [Bosco, Cardinale and Tsarpela, 1999; Delecluse, Roelants and Verschueren, 2003].

Vibration load results in more muscle fibres (motor units) activated count than normal muscle loading version. As a result, the muscle is loaded much more efficiently [Cormie, Deane, Triplett and McBride, 2006; Bosco, Cardinale and Tsarpela, 1999; Bosco

et.al, 2000; Rittweger 2001 Rittweger, Felsenberg, 2004]. The acute effect of muscle load is considerably faster and more efficiently, as a result muscle can produce more power. Of course, these efficiencies will not be effective enough if the vibration caused by the stimulus will be too strong and too long, because then it might cause fatigue and the work capacity will be reduced.

Acute vibration loads leads to increased blood circulation intensity. Rapid muscle contraction and relaxation (20 to 50 times per second) mainly work as a pump in blood vessels and lymph nodes, resulting in increased blood flow velocity and thereby increasing oxygen transport, energy supply, and faster transport of metabolism substances from the loaded muscles [Kerschan-Schindl et al, 2001]. Individuals usually feel as if the temperature increase in vibrated body parts, other authors also indicate that blood wires expands (vasodilation) [Oliveri, and Kenneth Chang-Zern, 1989; Stewart, Karmanos, Montgomery and McLeod, 2004].

When the organism is regularly and periodically loaded and overloaded, it is experiencing effect of super-compensation. As a result, has been observed the body's adaptation to the vibration caused by the loads, increasing the athletes the physical work capacity, because the vibration loads has training effect. This effect has been observed several times in repeated research on young and elder subjects [Roelants, Delecluse and Verschueren, 2004; Delecluse et al, 2005; Verschueren et al, 2004].

Studies have determined the structural vibration training effect; it is found that strength expressions increased by vibration training can be comparable with other strength development methods. However, the best performance of the vibration training is in field of explosive power [Delecluse, Roelants and Verschueren, 2003], when the effect of vibration training is significantly greater the generally accepted training.

Another significant difference that has been observed between the standard training methods and vibration training method is that vibration training method gives an identical result with minimal in loads, as well as the intensity and amount of training. So the load does not produce negative effects on bones, tendons and joints. As a result, vibration training approach is very effective for elder athletes, and for women, children and adolescents with injuries in cases of various diseases and injury. This, of course, is very effective for Professional well trained athletes (professionals) who seek to maintain and even increase the muscle strength expressions without overloading the joints and simultaneously relaxing the CNS [Cochrane, Stannard, 2005; Mahieu et al, 2006].

Aim of our study was to examine the effectiveness of the local vibration of the maximum force expressions in the development of the thigh musculature. In the research we set the following tasks: to carry out local vibration training process only to the right leg quadriceps muscle (quadriceps femoris) and at the end of the study to determine the local vibration training method effectiveness, determining the maximum force dynamics. The object of research is the maximum force expressions. We have tested twenty athletes, 24±3 year old males, with strength training experience but who are not trained in the field strength increasement of at least three years.

Materials and methods

Before the experiment we studied the literature and obtained other authors experience in vibration training methods and its efficiency. In experiment organization was taken into account companies' Vibromed (Dr.A.Ņemčenko) approximately 30 years of great experience. The experiment was organized in Latvian Academy of Sport Education biomotoric ability diagnostic laboratory using the company "Vibromed" technical apparatus of vibration (Patent Office of the Latvian Republic issued patents LV12937B and LV12714B, inventor Alexey Ņemčenko), for the maximum power testing we used

seated leg extension trainer, which had been set at a maximum weight (kg), with which an athlete can perform a single repetition.

In testing we used the movement – leg extension in knee joint when seated in a special trainer (Fig.1).

Fig. 1. Seated leg extension

The movement is an isolated form; the motion requires the involvement of only the thigh muscle, which allows us to judge about the strength expressions of muscle, irrespective of exercise performance technique, musculoskeletal individual features and other adjacent conditions. Movement of the knee joint was performed for about 0-80 degree range. Were tested in one leg, the other was in a fixed position at an angle of 90 degree, and then the procedure was repeated with the other leg. Athletes warmed up gradually, until the trainer was loaded with resistance with which the athlete can perform leg extension once. Resistance load was increased by 2.5kg steps till athlete could no longer perform the movement in prescribed range.

For the experiment were selected in 20 practically healthy subjects aged 24±5 years old, personal bodyweight 83± 11kg. Subjects were divided into two groups of 10 people each, one group was named experimental, who in his training process used only local vibrostimulation, the other group was called the control group and it did not used procedures of vibrostimulation.

Experimental group used the local vibration training method for increasing the strength expression forms by acting on the thigh quadriceps muscle (m. quadriceps femoris). Subjects were seated, the knee joint flexed in about a 90^0 angle, so the thigh muscle was slightly stretched. Vibration was linear from the distal to the proximal part of the muscle, performing "soothing" and the pulsating movement all over the thigh quadriceps muscle (m.quadriceps femoris) surface, which also included the transition to muscle tendons. Vibration was held following to methodology, which can be seen in table1.

Table 1

Plan of vibrostimulation procedures during the experiment (L-linear, P – pulsating vibration)

	Sets and time for rest, min		
Week/set	**1**	**2**	**3**
1	L		
2	L, 2	L	
3	L, 2	L, 2	L
4	L, 2	L, 1	L
5	L, 2	P, 1	P
6	L, 2	P, 1	P
7	L, 1	P, 1	P

Local vibration was used at 120-200Hz frequency with amplitude of 2-6mm. Each time was experimentally determined frequency range for each individual, which resulted in the best state of health. Acceleration of vibration motion was from 1 to 200g.

The experiment lasted for seven weeks. Both groups were tested in the beginning of the experiment and at the end. During the experiment, both experimental and control group carried out activities for increasing the general physical condition, including different aerobic and anaerobic exercises, the load was similar for both groups. During the experiment, the results were processed by methods of mathematical statistic.

Results

Solving tasks of the experiment, we obtained following results of maximal strength in quadriceps muscle.

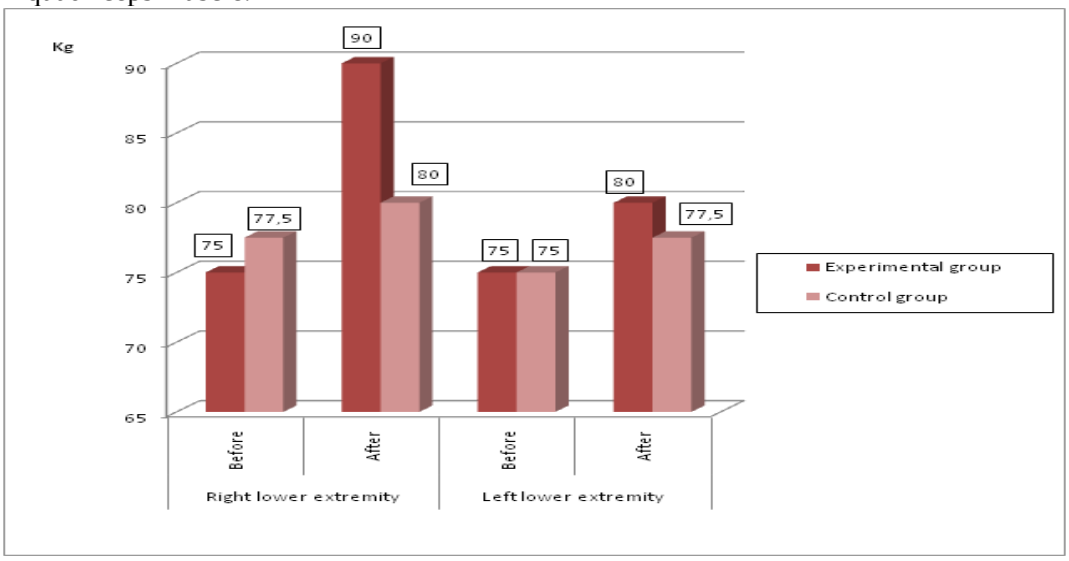

Fig.2. Dynamics of maximal strength of thigh quadriceps

Processing the experimental results we found, that the largest increase was in the experimental group, the right leg: before the experiment the result was 75kg, 90kg after the experiment, the difference amounted to 15kg ($p<0.05$, significant difference). Experimental group, the left leg maximal strength increasement was lower, before the experiment the result was 75kg, after 80kg, the increase amounted to 5kg ($p>0,05$, difference insignificant). The control group increasement for both legs was similar; it amounted to 2.5 kg and was not statistically significant. Mathematical statistic methods were used in processing of results.

Discussion and conclusions

During the procedure of vibrostimulation subjects were placed in a sitting position, as it is known that the stretched muscles are much more sensitive to vibrostimulation, which was important in our experiment, and the contraction of muscle is stronger [Eklund, Hagbarth, 1966; Rohmert, Wos, Norlander and Helbig, 1989].

Looking at the changes of maximum strength test results during the experiment, we can conclude that the most impressive change was in the experimental group. We can conclude that vibrostimulation have local effects on the target muscle, because the subjects of experimental group showed a better result for the right leg (with vibrostimulation) than for left leg (without vibrostimulation), (the difference was 10kg ($p<0.05$), the difference was significant), indicating that the vibrostimulation can be used for local stimulation for

isolated muscle or passive stimulation of the muscle groups that may need in rehabilitation after injuries, as well as into the stance disorder and the prevention of muscle disproportion [Eklund, Hagbarth, 1966]. The subjects of experimental group was observed even increasement of the left legs results of strength abilities, which were higher than to the control group subjects reported results of strength increasement (difference between results of both legs for control group was 2.5kg ($p>0.05$, difference not significant), which had to be explained by the fact that the vibration effect transfers associated with CNS stimulation, the stimulation of muscle tendon causes muscle sensory irritability [Brown, 1967]. The control group results increasement for both legs was 2.5kg ($p>0.05$) and was not statistically significant.

References

1. Abercromby A, Amonette W, Layne C, McFarlin B, Hinman M, Paloski W, 2007. Vibration Exposure and Biodynamic Responses during Whole-Body Vibration Training. *Medicine & Science in Sports & Exercise. Oct, 39 (10),* 1794-1800.
2. Bosco C, Cardinale M, Tsarpela O, 1999. Influence of vibration on mechanical power and electromyogram activity in human arm flexor muscles. *European Journal Of Applied Physiology And Occupational Physiology, Mar, 79(4),* 306-11.
3. Bosco C, Iacovelli M, Tsarpela O, Cardinale M, Bonifazi M, Tihanyi J, Viru M, De Lorenzo A, Viru A, 2000. Hormonal responses to whole-body vibration in men. *European Journal Of Applied Physiology, Apr, 81(6),* 449-454.
4. Brown M, Enberg I, Matthews P, 1967. The relative sensitivity to vibration of muscle receptors of the cat. *Journal of Physiology, 192,* 773-800.
5. Burkhardt A, 2006. Vibrationstraining in der Physiotherapie - Wippen mit Wirkung. *Physiopraxis 9/06,* 22-25.
6. Cochrane D, Stannard S, 2005. Acute whole body vibration training increases vertical jump and flexibility performance in elite female field hockey players. *British Journal of Sports Medicine, 39,* 860-865.
7. Cormie P, Deane R, Triplett N, McBride J, 2006. Acute effects of whole-body vibration on muscle activity, strength, and power. *Journal of Strength and Conditioning Research, 20(2),* 257-61.
8. Delecluse C, Roelants M, Diels R, Koninckx E, Verschueren S, 2005. Effects of whole body vibration training on muscle strength and sprint performance in sprint-trained athletes, *Interantional Journal Of Sports Medicine, Oct, 26(8),* 662-8.
9. Delecluse C, Roelants M, Verschueren S, 2003. Strength increase after whole-body vibration compared with resistance training. *Medicine & Science in Sports & Exercise, Jun, 35(6),*1033-41.
10. Eklund G, Hagbart K, 1966. Normal variability of tonic vibration reflexes in man. *Experimental Neurology, 16,* 80-92.
11. Hagbarth K, Eklund G, 1966. Tonic vibration reflex (TVR) in spasticity. *Brain Research, 2,* 201-203.
12. Issurin V, Tenenbaum G, 1999. Acute and residual effects of vibratory stimulation on explosive strength in elite and amateur athletes, Journal Of Sports Sciences, Mar,17(3),177-182.
13. Issurin V, Liebermann D, Tenenbaum G, 1994. Effect of vibratory stimulation training on maximal force and flexibility. *Journal of Sports Sciences, 12,* 562-566.
14. Kerschan-Schindl K, Grampp S, Henk C, Resch H, Preisinger E, Fialka-Moser V, Imhof H, 2001. Whole-body vibration exercise leads to alterations in muscle blood volume. *Clinical Physiology, May, 21(3),* 377-382.
15. Mahieu N, Witvrouw E, Van de Voorde D, Michilsens D, Arbyn V, Van den Broecke W, 2006. Improving strength and postural control in young skiers: whole-

body vibration versus equivalent resistance training. *Journal Of Athletic Training, Jul-Sep, 41(3),* 286-293.
16. Oliveri D, Kenneth L, Chang-Zern H, 1989. Increased skin temperature after vibratory stimulation. *American Journal of Physical Medicine and Rehabilitation, 68,* 81-85.
17. Rittweger J, Schiessl H, Felsenberg D, 2001. Oxygen uptake during whole-body vibration exercise: comparison with squatting as a slow voluntary movement. European Journal Of Applied Physiology, Dec, 86(2),169-7.
18. Rittweger J, Felsenberg D, 2004. Resistive vibration exercise prevents bone loss during 8 weeks of strict bed rest in healthy male subjects: results from the Berlin Bed Rest (BBR) study. *26th Annual Meeting of the American Society for Bone and Mineral Research; October; Seattle*
19. Roelants M, Delecluse C, Verschueren S, 2004. Whole-body-vibration training increases knee-extension strength and speed of movement in older women. *Journal of the American Geriatrics Society. Jun, 52(6),* 901-908.
20. Rohmert W, Wos H, Norlander S, Helbig R, 1989. Effects of vibration on arm and shoulder muscles in tree body postures. *European Journal of Applied Physiology, 59,* 243-248.
21. Stewart J, Karman C, Montgomery L, McLeod K, 2004. Plantar vibration improves leg fluid flow in perimenopausal women. *American Journal of Physiology - Regulatory, Integrative and Comparative Physiology Mar*, 288(3), 623-9.
22. Verschueren S, Roelants M, Delecluse C, Swinnen S, Vanderschueren D, Boonen S, 2004. Effect of 6-month whole body vibration training on hip density, muscle strength, and postural control in postmenopausal women: a randomized controlled pilot study. Journal of Bone and Mineral Research, Mar, 19(3), 352-359.
23. Wakim K, 1985. Physiologic effect of massage. In Manipulation, Traction and Massage (edited by J.V. Basmajian). *Baltimore, MD: Williams&Wilkins,* 132-158.
24. Назаров В, Спивак Г, 1987. Развитие атлетических способностей посредством метода биомеханической стимуляции. *Теория и практика физической культуры, Москва, 12,* 37-39.

Submitted: July 6, 2010
Accepted: October 14, 2010

NUTRITION OF YOUNG BASKETBALL PLAYERS IN TRAINING CAMP

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Abstract

The objective of the current study was to investigate the nutritional intake of young basketball players over a ten day period during training camp. For this purpose we have analyzed trainings to estimate daily energy expenditure. Questionnaire and interview were necessary for the evaluation of the daily menu. We proceeded with anthropometry and statistical analysis to obtain the results. The results showed that average daily amount of energy intake (kcal) for athletes was sufficient ranging from minimum to medium weight, but insufficient for the athlete with the largest weight. Average daily intake of protein 2.6g/kg (16.7%E) was consistent with the requirements for the young athletes, taking into account the age and increased physical load. Average daily intake of fat (30.02%) was slightly higher as desired at the expense of the high proportion of increased saturated fat. Average daily intake of carbohydrate was not enough: 7.2g/kg (52.9%E). The young athletes' diet during the training camp did not include sufficient amounts of fruit and vegetables, as well as a variety of products. In conclusion, average energy intake of young athletes during the training camp was sufficient for the athletes with minimum and medium weight, but insufficient for the athlete with the largest weight, therefore resulting in an energy deficit. Average protein intake was sufficient and corresponded to the upper limit of the daily requirement: 2.6 g/kg daily. The percentage of proteins provided on average 16.7% of the energy intake. Average daily fat intake (30.0% from the energy intake) was slightly increased at the expense of animal origin saturated fat. Taking into account the increased amount of physical work, the carbohydrate intake was insufficient (7.0 g/kg). Average daily carbohydrate consumption provided 52% of the energy intake which should be increased at the expense of fat. The menu provided for the young basketball players during the training camp only partially corresponded to the principle of variety.

Keywords: *Young athletes, basketball, nutrition, energy, food, principles of healthy nutrition.*

Introduction

In general there is little information on the nutritional status and food habits of adolescent basketball players as well as male adolescent athletes. According to A. Litt (2004) proper nutrition during adolescence is crucial for optimal physical condition and good health in the short and long term. Energy and nutrient needs increase during adolescence and are higher than at any other time in life. Adolescent athletes have special nutrient needs due to the additional demands of training and competition. Potential consequences of inadequate energy and nutrient intakes in young athletes include poor bone health, fatigue, limited recovery from injuries, and poor performance (Caccialanza et al, 2007). Further studies of energy balance and nutrient status in young athletes are needed for a better understanding of the nutritional needs of this particular group.

Nutrition in sport camps serves to renew high-intensity work capacity, and as a standard, helping to choose the appropriate diet during the entire training cycle. Currently

in Latvia, systematic investigations concerning the composition of young athletes' nutrition are not being carried out qualitatively or quantitatively. At this time there are no examples of menus being offered which take into account the nutrition of athletes of varying ages in sport camps.

Material and Methods

The investigation was carried out using quantitative cross-section research. 21 male athletes, 15-17 years old, were recruited from the B1 boy basketball team, from the children and youth sport school "Daugava," during a training camp in Kandava in 2009. At the time of the study athletes were in regular training in the second half of the season. They trained six hours a day (seven days per week). Every training session involved physical, technical, and tactical exercises.

Methods of research:

1. *Dietary intake* was assessed using seven-day food records (Gibson, 2004). Serving amounts and food composition were estimated with the help of appropriate tables (Kozule, 2002). Data processing was carried out by the micro-computer program „Uzturs" and worked out in the LASE.
2. *Anthropometry.* BMI was calculated, using body height and mass indices. The estimation of BMI was carried out according to Cole's method (Cole et al, 2000).
3. *Calculation of energy consumption*. Daily energy expenditure was calculated with the help of two variations of the diary method. Accordingly, one variation of the daily activities carried out was the athletes were timed and energy expenditure calculated, using available tables of energy cost (Montoye et al, 1996). Accordingly, the second variation of daily energy expenditure was calculated by multiplying resting metabolic rate (RMR) by an estimated activity factor (PAL) for training days: BEE x PAL = DEE. Resting metabolic rate was calculated with the Harris/Benedict formula (Caccilanza et al, 2007).
4. *Statistical analysis*. MS SPSS 14 and MS Excel software were used for data processing, performing calculations, forming tables and diagrams.

Results

Anthropometric parameters

General characteristics of the participants in the research included their age, height, weight, and body/mass index which are reflected in Table 1. None of the young basketball players had a lowered body mass index-BMI (<18.5 kg/m²). It was found that BMI exceeded 25.0 for four athletes. According to De Garray et al, (1974) in many sports, including basketball, body weight does not essentially influence the results, if only the values of BMI are within norms.

Table 1

Anthropometric characteristics of the young basketball players

Indicator	n	Min	Max	Mean(μ)	SEM (S_μ)	SD (σ)
Age, years	21	15	17	16.6	0.14	0.66
Weight, kg	21	62	102	77.6	2.05	9.39
Height, cm	21	177	200	187	1.35	6.22
BMI	21	19.14	25.5	22.16	0.42	1.93

Nevertheless, in accordance with the data, the mass of adipose tissues negatively correlates with the height of jump and explosive force (Rusko, Pontaga, 2009) therefore in the case when an athlete's body/mass index exceeds 25, the body composition should be estimated and the type of body constitution should be determined.

Energy expenditure

To determine the young athletes' 24-hour energy expenditures, the minutes of every activity were recorded. Altogether, athletes had three training sessions daily; the length of the training sessions were six hours long. For greater accuracy daily energy consumption was calculated using two variations of the diary method.

The obtained results validate that the least difference in energy expenditure estimated with two different variations of the diary method was demonstrated by the athlete with medium body weight. For the athlete with the smallest weight the difference of consumed energy turned out to be considerably higher: 199.8 kcal, but the largest difference in the calculated consumed energy was exhibited by the athlete with the greatest weight: 388.2 kcal.

Daily requirements

The daily requirement of nutrients for every athlete was calculated from energy expenditure, using the formulas of nutrient balance advised by Benardot (2000). Athletes ranging from fifteen to seventeen year old with different body weights require different amounts of energy and nutrients (Table 2).

Table 2

Energy and macronutrient requirements of the young basketball players

Body weight (kg)	Energy,(kcal)	Proteins, g 10-15%E	Fat, g 25-30%E	Carbohydrates, g 55-60%E
77.7 (medium)	4599.3	114.9-172.4	127.7-153.3	632.4-689.9
62.0 (smallest)	4019.2	100.4-150.7	111.6-133.9	552.6-602.8
102.1 (largest)	5630.7	138.2-207.4	153.6-184.3	760.4-829.6

Supply of energy and nutrients

During the training camp young basketball players were provided three meals daily which included breakfast, lunch and dinner with the opportunity to receive additional portions from the menu offered. For breakfast young athletes had a choice of cereal, porridge, bread, tea or cacao with milk. Lunch consisted of soup and a choice between meat and a fish dish which were usually prepared by frying. Additionally, stewed vegetables, a choice of boiled or fried potatoes, rice or pasta were offered as well as a vegetable salad which was usually prepared with plant oil. For dinner the athletes were usually given a choice of cereal porridges or pasta, milk or dairy products. The amount of nutrients, balance of energy, macronutrients and variety of foods were estimated for the entire length of the training camp.

The analysis of the menu offered validated that calorie content of the meals was not equal per day (Figure 1).

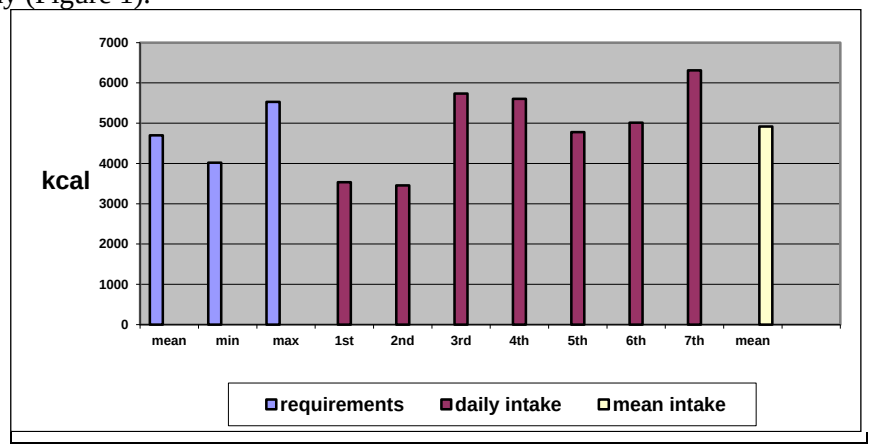

Fig. 1. Energy requirement (expenditure) and energy intake during the training camp

None of the young athletes had sufficient amounts of energy intake during the first two days. During days 3 and 4, as shown in figure 1, the energy intake corresponds to the expended energy even for the athlete with the largest weight. During days 5 and 6 the amount of energy taken in is sufficient for the athlete with medium body weight, but on day 7 the amount of energy intake exceeds the amount of energy consumed even for the player with the highest body mass.

The amount of average daily protein intake reached the necessary daily requirement for the heaviest athlete. The amount of daily protein intake for the athlete with a medium weight was 2.6 g/kg daily, for the athlete with the least weight: 3.3 g/kg daily, but for the heaviest athlete: 2.0 g/kg daily (Table 3).

Table 3

Daily intake of energy and nutrients during the 7 day training camp

Day	Energy, kcal	Protein		Fat		Carbohydrate	
		g/day	g/kg	g/day	g/kg	g/day	g/kg
1.	3536.9	153.6	1.9	111.9	1.4	478.2	6.1
2.	3456.1	112.2	1.4	123.0	1.6	450.3	5.8
3.	5734.5	241.4	3.1	148.5	1.9	853.1	10.9
4.	5603.1	215.9	2.7	213.8	2.7	697.1	8.9
5.	4776.9	210.3	2.7	149.9	1.9	633.9	8.2
6.	5011.9	210.0	2.7	180.3	2.1	630.1	8.1
7.	6312.5	296.6	3.8	220.9	2.8	814.9	10.5
Mean	4918.9 ±412.7	205.7± 35.3	2.6±1.2	164.07±28.4	2.1± 0.9	651.1±152.7	8.4± 2.1

The percentage of proteins provided on average 16.7% of the energy intake (Figure 2), which corresponds to the recommended daily intake, taking into account that the basketball players worked in a very intensive training regimen.

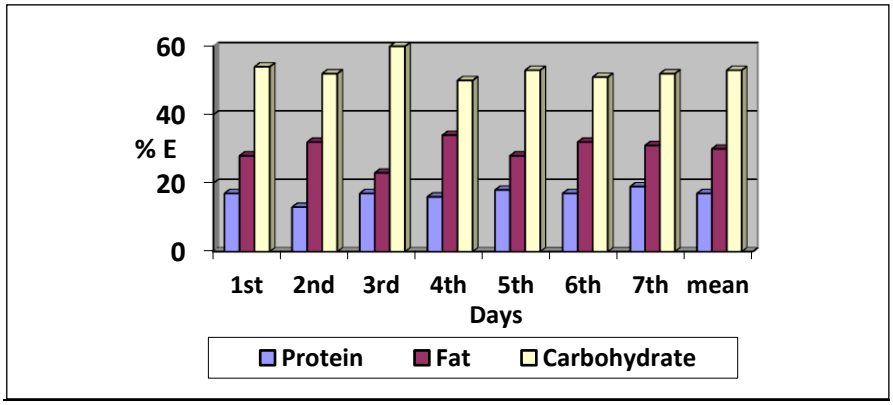

Fig. 2. Nutrient balance of the menus provided in the training camp

The amount of fat intake during the first two days of training camp corresponded to the athletes with a medium body mass of (1.4-1.6 g/kg). During day 3, day 5 and day 6 fat intake was increased for athletes with a medium body mass of (1.9-2.3 g/kg) and the least body mass of (2.4-2.9 g/kg), but respective for the heaviest participant of the training camp (1.5-1.8 g/kg). During day 4 and day 7 the amount of fat intake nutritionally was increased for all athletes (2.1-2.2 g/kg). On average during this time span of the training camp the amount of fat intake was appropriate only for the heaviest of all the basketball players (164.1 g or 1.6 g/kg).

Carbohydrates are the primary fuel used by muscles during practices and games. Taking into account the conditions of increased physical load, the amount of carbohydrate intake during the training camp was not sufficient for any of the athletes, disregarding their body mass (Figure 3). The amount of carbohydrate intake during day 1 and day 2 did not reach the desirable level, even for the lightest athlete: 7.2 and 7.7 g/kg or 52.1% and 54.0% from the energy intake. During day 3 and day 7 the amount of carbohydrates offered were sufficient in all weight groups.

It is necessary to add that on day 7 the amount of energy provided by carbohydrates was diminished because of the considerable increased amount of fat intake. During day 4, day 5 and day 6 the amount of carbohydrates was sufficient for the lightest athlete, but in percentages carbohydrates did not even reach the lowest limit from the amount of energy. It is reasonable to conclude from the results when planning a menu for athletes to reduce the amount of energy intake with fat and increase the amount of carbohydrate intake.

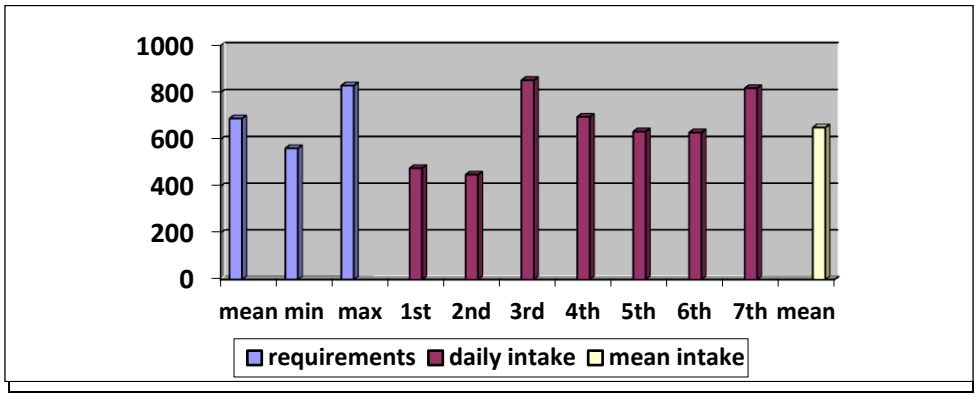

Fig. 3. The correlation of carbohydrate supply to carbohydrate requirement

For the evaluation, the principle of variety was used recording the daily number of servings in each level of the diet pyramid. The majority of the authors recommend the following serving amounts per day for athletes: 6-11 servings of cereals, 5-9 servings of vegetables and fruit, 2-3 servings of dairy products and 2–3 servings of meat and fish (Burke, 1992; Litt, 2000; Benardot, 2000; Petrie et al, 2004).

Evaluating the correlation of the basketball players' diet to the principle of variety, it can be concluded that during both days the intake of cereal servings and the amount of vegetables were sufficient, but fruit was not included in the menu on both days as it was not taken into consideration. (Figure 4).

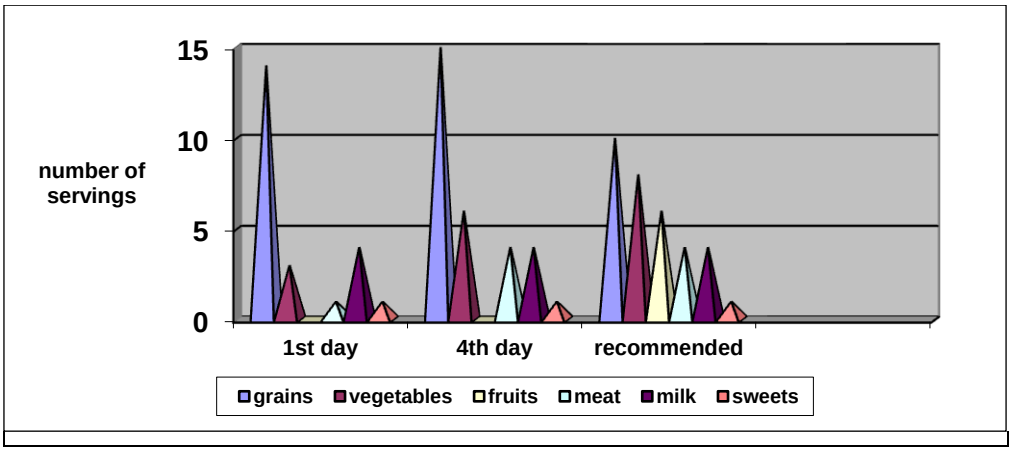

Fig. 4. The correlation of young athletes' nutrition to the principle of variety

During the first day of training camp the menu created a deficit of meat and fish products, but on day 4 the intake of servings with animal protein was increased.

Discussion

Similar results were obtained in research carried out in Russia which focused on the energy needs of young basketball players from the Russian Olympic reserves (Мартинчик и др., 2003). It was determined that when the mean daily 24-hours energy expenditure reaches 5000 kcal, it should be compensated with diet. In the research it had been found that, similarly with our investigation, taller boys had a considerable energy deficit of about 200 kcal, but shorter boys had energy excesses of about 500 kcal. At the end of the Russian basketball training camp it was observed that there was a decrease in body mass in all weight groups, especially for taller boys. The data concerning the supply of nutrients was very similar to the results of the current research. Protein intake both in grams and kilograms per weight and in percentages of energy intake were estimated as being sufficient. Fat percentage was increased (34% E), but carbohydrate intake provided less than 55% of total energy intake. In the mentioned investigation carried out in Russia, it was also stated that the nutrition of young athletes was excessive in the amount of meat products, but insufficient in the variety of vegetables and fruit.

The research carried out by Fleming and Costarelli (2007) confirms the deficit in energy intake for 16 to 18 year old athletes involved in wrestling. Similarly with our investigation, the athletes' diet was rich in fat (40.2% E), and the amount of carbohydrates in it were considerably less than the necessary (44.3% E), but protein intake was appropriate both in grams per weight kilogram (1.7) and in percentage of energy (15.4%). As Petrie et al, (2004) have noted participants in weight-control sports may be at greater risk of failing to meet requirements for energy, protein, and some micronutrients as athletes in team sports. The mentioned authors also stress that acute issues such as heat illness and chronic concerns, including impaired growth and development, and the risk of injuries may be the outcome of inadequate nutrition of young athletes. According to Iglesias-Gutierrez et al, (2005) potential consequences of inadequate energy and nutrient intake in young athletes include poor bone health, fatigue, limited recovery from injuries, and poor performance.

Comparing the results of available studies, it can be concluded that mistakes in young athletes' nutrition are similar: insufficient amount of energy intake, adequate protein intake, increased amount of saturated fat and essential carbohydrate deficit. It confirms that balancing and using variety principles in working out an adequate menu is a complicated task. Nutrition specialists should be involved in menu planning, but coaches and athletes should be educated in the issues of nutrition in order to be competent judges of nutrition.

Having evaluated the young basketball player diet an alternative menu was offered which provides the athletes with 5035.02 kcal daily. From the amount of energy intake, the protein percentage is 15.7%, fat percentage 24.9%, but carbohydrate percentage 57.65%.

The characteristics of a suggested menu are as follows: amount of calories: 4905.17 kcal, proteins to provide for 16.8% of the energy intake, fat: 26.15%, but carbohydrates: 56% of the energy intake. The choice of products offered provide energy balance, carbohydrates which are necessary to provide the renewal of the reserves of glycogen under conditions of increased physical load, and secure optimal realization of the functions of proteins.

Conclusions

1. Average energy intake of young athletes during the training camp (4918.8 kcal), was sufficient for the athletes with minimum and medium weight (+319.5 kcal), but insufficient for the athlete with the largest weight, therefore resulting in a deficit of energy (-711.8 kcal).
2. Average protein intake was sufficient and corresponded to the upper limit of daily requirement: 2.6 g/kg daily. The percentage of proteins provided on average 16.7% of the energy intake corresponded to the needs of the athletes, taking into account their age and the conditions of intensive training.
3. Average daily fat intake (30.0% from the energy intake) was slightly increased at the expense of animal origin saturated fat. Average fat intake corresponded to the requirements of the athlete with largest body mass (164.1 g or 1.6 g/kg).
4. Taking into account the increased amount of physical work, the carbohydrate intake was insufficient (7.0 g/kg). Average daily carbohydrate consumption provided for 52% of the energy intake which was insufficient during the training camp and should be increased at the expense of fat.
5. The menu provided for the young basketball players during the training camp only partially corresponded to the principle of variety. Sufficient amounts of cereals and vegetables were included in the menu, but fruits were not.

References

1. Benardot, D. (2000). *Nutrition for serious athletes*. USA: Human Kinetics.
2. Burke, L. (1992). *The complete guide to food for sports performance*. Australia: Allen&Unwin Pty Ltd.
3. Caccialanza, R., Cameletti, B., Cavallaro, G. (2007). Nutritional intake of young high level soccer players: under reporting is the essential outcome. *J.Sports Sci.Med.6*, 538-542.
4. Cole, T.J.M., Belizzi, M.C., Flegal, K.M., Dietz, WH. (2000). Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ 2000**;** 320(7244),*1240-1243***.**
5. De Garray et al. (1974). *Genetics and anthropometrical studies of Olympic athletes.* Academic Press.
6. Fleming, S., Costarelli, V. (2007). Nutrient intake and body composition in relation to making weight in young male Taekwondo players. *Nutrition and Food Science*, 37(5), 358- 366.
7. Gibson, R.S. (2004). *Principles of Nutritional Assessment*. New York Oxford: Oxford University Press.
8. Iglesias-Gutierrez, E., Garcia-Roves, P.M., Rodriguez, C. et al. (2005). Food habits and nutritional status assessment of adolescent soccer players. A necessary and accurate approach. *Canadian Journal of Applied Physiology, 30, 18-32*.
9. Kozule,V. (2002). *Uzturs. IV daļa Kompleksās ēdienkartes*. Ozolnieki: Latvijas Lauksaimniecības konsultāciju un izglītības atbalsts centrs.
10. Litt, A. (2004). *Fuel for young athletes*. Human Kinetics, 2004.
11. Montoye, H.J., Kemper H.C.G., Saris, W.H.M., Washburn R.A. (1996). *Measuring physical activity and energy expenditure*. Human Kinetics.
12. Petrie, H.J., Stover, E.A., Horswill, C.A. (2004). Nutritional concerns for the child and adolescent competitor. *Nutrition,* 2004, 20 (7-8),620-631.
13. Ruško, D., Pontaga, I. (2009). Jauno handbolistu ātrspēka spēju izvērtējums atkarībā no ķermeņa masas sastāva. LSPA zinātniskie raksti. Rīga, 443.-448.

14. Мартинчик, А.Н. Батурин, А.К. Петухов, А.Б. Баева, В.С. Потребность в энергии баскетболистов-подростков из команды олимпийского резерва России. *Вопросы питания,* 2003, № 2, 35-40.

Submitted: July 1, 2010
Accepted: October 14, 2010

THE DEVELOPMENT TO SUCCESS IN SWEDISH BIATHLON

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Abstract

The purpose of this study was to contribute to an explanation why Swedes of both sexes achieved great international success simultaneously in a small national sport such as biathlon. The elite group consisted of the male and female national team. A control group matched in pairs was identified in variables age, sex and athletic performance. All investigated athletes were products of the Swedish sport academy system (RIG, upper secondary education). Data were collected via interviews with athletes, national coaches and managers. Compared to the controls, elite athletes were more often born early in a year, less injured and less sick during RIG years and experienced coaches more favourable in terms of acting and individualisation.

Keywords: *Biathlon, competition, performance analysis, coaching, interviews*

Introduction

Biathlon is of Scandinavian descent originating from skirmishes between Swedish and Norwegian border patrol units in mountainous areas as far back as the 1700s (Hanstad, 2005). Even if the first competition between the two countries was held in 1767, the first biathlon sport club was founded some 100 years later in 1861, The Trysil Rifle and Ski Club in Norway. Military patrol conducted an exhibition at the 1924 Chamonix Olympic Games as well as in Garmich 1936 and S:t Moritz 1948. The concept of modern winter biathlon was established in 1955 allowing participation in the 1960 Squaw Valley Games represented by one discipline – 20 km men. Involving the two very different activities, shooting and cross-country skiing, biathlon developed during the years to come to a worldwide recognised winter sport.

The Olympic biathlon program gradually expanded and consists at present of 5 disciplines. The transition in 1978 from large bore 5,6 mm rifles and a shooting distance of 150 m to small bore 5,6 mm specially designed rifles and a 50 m shooting distance along with mechanical falling plate targets revolutionised the sport. It opened up for women and youth thereby gaining wide and international recognition. Biathlon of today is to be regarded an arena sport appealing to media, spectators and sponsors. According to a newly conducted survey biathlon attracted more viewers at nationally televised international championships and world cup events than did traditionally dominating winter sports such as alpine and cross-country skiing (Norstat Sponsor Insight 2009).[1]

The Swedish Sport Confederation (RF) consists of 70 different sports of which biathlon is one of the smallest. Some 500 members are spread out in 32 clubs. In spite of this a number of Swedes achieved great international success over the years starting with winnings in the first world championships in 1958 as well as in the first winter Olympics in 1960. All together, representatives of both sexes achieved some 60 World Cup victories, 12 World Championships, 3 Olympic gold medals and 6 total World Cup triumphs.

[1] The survey was conducted with a representative sample of 1 000 individuals in variables age, sex and geographic location.

Purpose

Why is it that a small sport in a small country achieved international success and recognition to the extent that the national team per se along with men and women on an individual basis are ranked among the very top in the world? The main purpose of this study was to contribute to an explanation to the success Swedish biathlon achieved in later years. The following areas were considered to be of particular interest;

- Athletes` background, early experiences and personal characteristics
- Environmental structures and its function in the development to elite
- Interactive processes between the athlete and the surrounding environment

A Theoretical Frame for Human Development

Based on an ecological model for human development the study analyses roles, activities and perceptions during adolescent and adult years (Bronfenbrenner 2000). This approach (fig. 1) focuses aspects in the immediate environment where the developing person is an important influent in the developing process (*micro* and *meso* levels) as well as more external structures mainly beyond influence and control (*exo* and *macro* levels). The ecological aspect is based on the continual interaction taking place and involving all four levels.

The *micro* level consists of systems in the immediate environment where the developing person is an active participant. Interactive processes involving these structures and the developing person form the *meso* level. The *exo* level includes different influents in the local environment such as neighbourhood facilities and community standards. General societal foundations like economy, democracy and health promotion form the *macro* level thus dictating conditions and terms for sport practice in a wider perspective. The model also holds a phenomenological approach emphasising subjectivity and the impact of personal thoughts and experiences during the developmental process. The horizontal arrow through the model symbolises possible changes in the different levels over time.

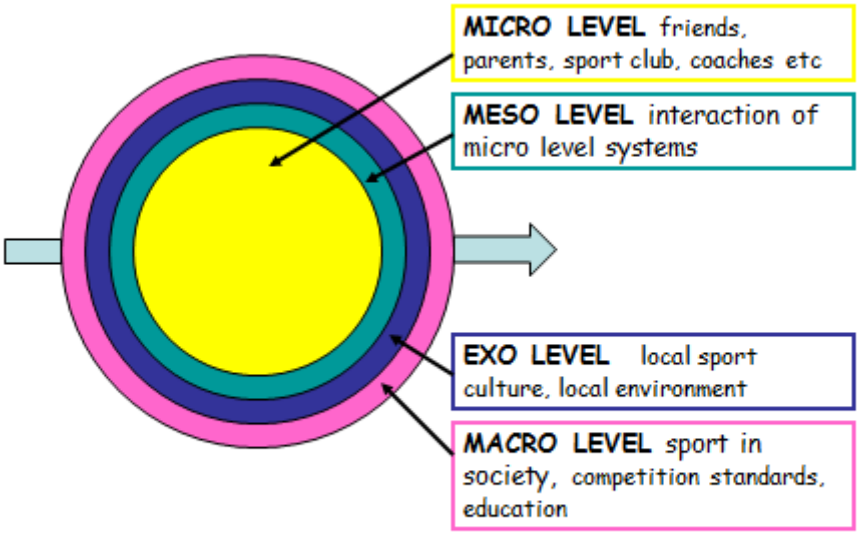

Fig.1 An ecological model for human development (after Bronfenbrenner)

Material and methods

In order to describe the athletes, the environment and the interaction in between the two, data were collected via interviews and on-site observations during training and competition. Along with coaches and the team manager from the Swedish Biathlon

Federation (SSSF) the investigated group consisted of an elite group with controls. Additional information concerning national sport academies (RIG) on the upper secondary education level was collected from coaches and teachers from the two national biathlon sport academies.

The elite group was the national team consisting of 13 individuals, 7 men and 6 women. All members of the team were products of the national sport academies in biathlon or cross-countrycross-country skiing. The controls were identified and selected among students accepted to and having graduated from RIG but who did not qualify for the national team as adults. The controls were matched in pairs in variables age, sex and sport specific performance. This means that each individual on the national team had an equivalent in the control group of the same age, same sex and equal in sport specific performance during RIG years. The team manager is responsible for all training and competition activities. The two coaches to his disposition are specialised in physical training and shooting respectively. Data were collected during a 4-day pre season training camp and the opening World Cup event in Östersund, Sweden, late November 2009. All interviews were taped and transcribed. Analyses took place in the spring of 2010.

Research on biathlon

A result from later years` increasing popularity is a more intense and varied program in international championships and world cup competitions. Stadiums and arenas do more apply to the interest from media, sponsors and audiences. An analysis from 7 world cup seasons revealed an increased number of travel days, competition days and kilometres raced (Manfredini, et al., 2002). This retrospective study also found biathlon as more demanding based on self-reported stress scores among both sexes. The increase between the easiest season and the most demanding season was more than 100 %.

The combination of physiological endurance and target fixation during competition put high demands on athletes in such events. Ten members of the Canadian biathlon team participated in a study analysing the effects of physiological arousal, cognitive anxiety and gaze control in biathlon (Vickers & Williams, 2007). The prime goal was to determine why some individuals overcome effects of extreme exercise, performance pressure and anxiety whereas others choke under the combined weight of those pressures. In laboratory conditions the biathlon shooters took standing shots to a target after exercising on a bike ergometer at individually prescribed power output levels of their maximum oxygen uptake. Performance pressure was manipulated in counterbalanced conditions such as general testing of target fixation or presence of the national coach telling the athletes that the results would affect team selection. The results indicated that 3 participants were able to perform on a high level in high performance conditions without choking while the remaining 7 athletes performed at a low level and choked. The results showed that those who did not choke changed their target eye fixation from a shorter duration during low pressure conditions to a longer duration during high pressure conditions. The findings support the role of automaticity in performance emphasising external focus rather than internal (Wulf et al., 2002).

With reference to exercise intensity and shooting performance a study involving 13 members of the United States biathlon team indicated minimal effect on shooting accuracy and precision for prone shooting but did affect measures for shooting in the standing position (Hoffman et al., 1992). Bicycle ergometry was chosen as the exercise modality. A similar Soviet study elevating heart rate to comparable levels by ergometry or treadmill did however not demonstrate significant effects on shooting performance in either position (Soldatov, 1983). Shooting performance was only assessed by the number of targets hit. Similar conclusions would have been drawn by Hoffman if the same evaluation measurements would have been used.

An interesting aspect is the influence of shooting result and skiing time on the final result. A study including results from the World Cup and Olympic Games during the 2001/2002 season involved athletes from 65 nations (Cholewa et al., 2005). The results conclude that depending on sports level, the influence of shooting efficiency and the time of the run is varied. Overall results of the run influence the final result to a higher degree than does shooting. Among higher ranked elite biathletes, however, the influence of the time of the run on the final result is smaller than among athletes of lower ranking. Furthermore, shooting efficiency has a significant influence on the end result during individual competition, where shooting occurs 4 times and the possibility of committing mistakes is greater.

Burnout has been characterised by progressive disillusionment and by physical and psychological symptoms that diminish one`s self-esteem (Freudenberger 1980, Coakley 1992, Gold & Roth 1993, Henschen 1998, Wiersma 2000, Raedeke& Smith 2004). In a study involving elite winter sports like alpine skiing and biathlon with the purpose to investigate athletic burnout from a social cognitive perspective it was found that maladaptive motivational profile may be a critical factor to underpin athlete burnout (Lemure et al., 2008). This infers that when demonstrating perfectionist qualities where they fear making mistakes and doubt their ability, the risk of experiencing burnout is greatly increased. Reasons behind this could be overtraining or risk of recovery following previous competitions (Kellmann 2002).

The concept of competition

Institutionalised modern competitive sport attracts enormous interest in most cultures and most ages. For children and youth it is a dominant leisure time activity and regarded as an important influent in the socialising process to well functioning members in society (Dunning 1999, Jarvie 2006, Blomdahl&Elofsson 2006, Bergsgard et al., 2007). The core of competition is the uncertainness of the outcome. The more attractive the winning is and the better the chances for success, the higher motivation and mobilisation of resources and efforts. In order to optimise the attractiveness of the competition, constructed norms and systems vary between sports. (Heinilä 1982, Vuolle 1998, Breivik 2000, Engström 2000, Halberstam 2000, Hertting 2007, Greenwood &Kanters 2009, Johnson et al., 2009, Light Shields & Light Bredemeier 2009). Due to variations in the speed of growth during the adolescent period a division in competition classes is necessary to maintain the attraction to competitive sport. (Lindgren 1989,Carlson 1993, Malina 1996, Musch&Grondin 2001, Cote & Hay 2002, Twist & Anderson 2005, Baker et al 2005).Age is the predominant criteria, in power sports often combined with weight.

In the early 1980s Heinilä (1982) introduced a model for the totalisation process in competitive sport (fig. 2) with reference to an increased level of demands on the athlete in order to succeed. According to this perspective Heinilä identified three interacting components.

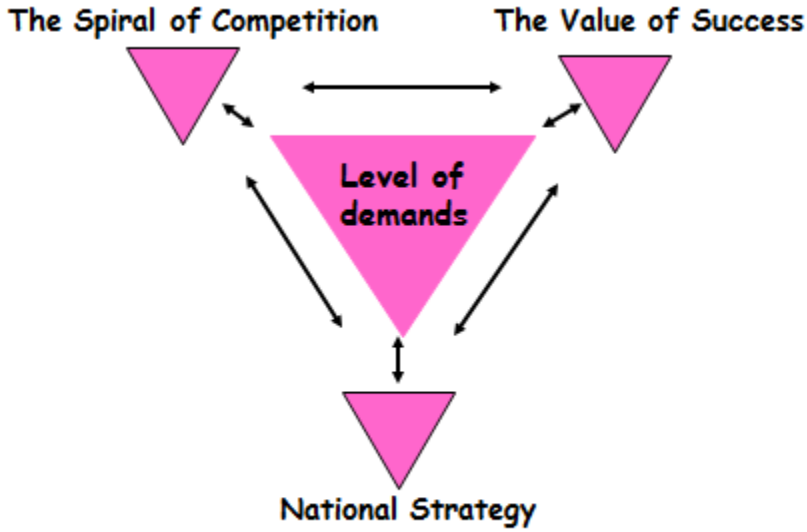

Fig. 2 The totalisation process in competitive sport (after Heinilä)

The spiral of competition refers to the core of competition, the uncertainness of the outcome. The more important the winning and relevant chances to succeed, the greater mobilisation of efforts by the athlete. If the strive to win is strong enough without reaching the goal a risk for use of unpermitted substances might occur. Hence, the input of variations in the speed of growth during puberty as well as criteria for the dividing in competition class must be considered. *The value of success* refers to the recognition of athletic performance. Few.if any, achievements in institutionalised domains receive the attention sport performances most often do. Rewards in terms of status and materialism as a result of Olympic medals, international championships etc are good examples. The appearance of African long distance runners starting in the 1960s and the attention and nations like Kenya, Tanzania and Ethiopia received did no doubt improve international recognition and trade. *National strategy* is exemplified by initiatives to develop athletic talents with governmental support. The system of national sport academies on the upper secondary education level as well as equivalent local initiatives at low or intermediate levels are some examples.

Biathlon competition

One explanation to the expansion of biathlon and its increased popularity in later years is the organisation of the competition system. There are great variations in events, different shooting positions, different numbers of bouts of shootings, different target dimensions giving instant feedback after each shot. Distances vary from 6 to 20 km with stops at a shooting range to shoot two or four times depending on ski distance and type of competition. The competitor starts at a start line, skis one course loop, comes to the range and shoots, skis another loop and shoots and so on and then finishes with a ski loop to the finish line after the last bout of shooting. Five rounds are fired in each bout at five targets except in Relay competition where the competitor has three spare rounds for each bout. The two shooting positions, prone and standing, are done in sequence depending on the competition in question. Target diameters are very small, 115 mm for standing and 45 mm for prone shooting. The clock is running during the entire competition without time-outs for shooting. Time penalties are imposed for each missed target, either as one minute of added time for individual competitions, or as a 150 m penalty loop (takes about 21 to 26 seconds to complete) immediately after each bout of shooting for all other competitions.

There are 8 different competitions, The Individual, The Sprint, The Pursuit, The Mass Start, The Relay, The Mixed Relay, Supersprint Qualification and Supersprint Final. In Individual and Sprint competitions the starting procedure takes place with a 30 second interval between the competitors. In Pursuit competition starts are based on time intervals from a qualifying competition. In Mass Start all competitors start simultaneously. In the Relay competition the first member of all teams start simultaneously. After completing their part they tag the next member to start them off. Relays are mixed and non-mixed. In the first case female biathletes have to complete the first two rounds.

The concept of talent

In competitive sport talent in generally regarded as a developmental process from childhood to adult age emphasising interactional processes between the individual and the developing person (David 2005, Czikscentmihalyi 1993, Mageau&Vallerand 2003, Turman 2003, Kincer 2005, Gould et al 2002, Cotè& Hay 2002, Soberlak&Cotè 2003, Augustsson 2007, Wolfenden& Holt 2005, Cotè et al., 2006, Carlson 2009). In this process (fig. 3) a number of influents have been identified (Carlson 2007). The extent of influence depends of the sport in question, societal structures or cultural identity patterns.

Fig. 3 Influents on talent development (after Carlson)

Great efforts are often devoted to the identification of talents at a very early age. Selections are based on performances achieved before or during puberty. This infers great difficulties and risk of increased drop-out rate. Early developers are favoured while late developers are left out due to factors beyond their own influence (Lindgren 1989, Malina 2009). Many youngsters deserve a second chance – a kind of talent recycling (Veyens et al., 2009). Research does furthermore indicate that internationally successful athletes were involved with several sports on a parallel basis and during early adolescence and got involved with their main sport to be in the mid teens or later (Baker et al., 2005, Carlson 2007).

Results

Athletes` background, early experiences and personal characteristics

The division in competition classes during adolescence is usually based on age. The same goes for biathlon. Using quadruples of a year as a mean for determining time of birth the investigated group was to a far extent born early in a year compared to late (table 1). Furthermore, the elite group was more often born early in a year compared to the controls (table 2) as well as men compared to women (table 3).

Table 1

Time of birth in a year (%), quadruples (N=26)

1	2	3	4
31	38	19	12

Table 2

Time of birth in a year (%), quadruples, elite group (E, N=13) and control group (C, N=13)

	1	2	3	4
E	39	15	31	15
C	22	62	8	8

Table 3

Time of birth in a year (%), quadruples, men (M, N=14) and women (W, N=12)

	1	2	3	4
M	54	38	8	--
W	8	46	23	23

During childhood and early adolescence slight differences appeared between the investigated groups concerning early-life sport involvement. All but a single few were involved with several sports. Cross-country skiing and soccer was a common combination. The local environments offered good opportunities for sportive engagement for both groups. Sport was a dominating leisure time activity. The areas of Sweden where the majority of athletes grew up offered the highest proportions of sport clubs measured per capita, 36 clubs per every 10 000 residents. Sport involvement was a family activity. In every family there were former competitors – elite group parents however more frequent than control group parents. With one exception all competitors had at least one brother or sister. All of those were or had been involved with competitive sport. All but one of the investigated athletes grew up with both biological parents indicating the strong impact of family identity and influence on the development of sportive habits.

Only one member of the elite group and two among the controls started out with biathlon, the rest as cross-country skiers. The number of biathlon clubs was very limited and the rifles not well adapted to children. As cross-country is a very big and popular sport with high demands to reach national level, there is also a possibility that those who did not make it to this level turned to biathlon instead. All investigated athletes were successful cross-country skiers during adolescence, most of them just below national level. Half of them were introduced to biathlon by friends or family with access to a club in the local environment. The 6-time world champion Magdalena Forsberg, a former member of the national cross-country team, also served as an important role model. The most important influent, no matter group identity in the study, was however the possibility to get accepted to RIG. The facilities offer excellent training conditions and highly skilled coaches. There is high trust in RIG and a common belief that the chances to reach national level increase a lot if accepted. Previous research reveals that all but one member of the national cross-country team were former RIG students (Carlson 1993).

Environmental structures and its function in the development to elite

Initiated by RF in 1972 the concept of RIG first involved 5 sports. The purpose was to combine sport specific training and upper secondary education for talented young athletes. Supported by the government and the national school board a certain amount of time was devoted to training within the curriculum. RIG was an immediate success and a number of

sports joined the program during the years to come. The program has been cut since the mid 1990s but engages at present some 36 sport in 60 communities throughout the nation. Roughly 140 coaches are involved training 1 300 athletes. In the 2010 Vancouver Olympics 85 % of the Swedish participants in winter sports cross-country skiing, freestyle and biathlon were former RIG students.

There are two RIG biathlon offering 24 athletes 3-4 years of education and training. 2/3 of the athletes graduated from RIG biathlon, the rest from RIG cross-country skiing. Both sites offered excellent training facilities and the combination of both sports. An interesting finding is the fact that representatives from both investigated groups in the study were accepted among a large number of applicants as cross-country RIG students, elite group in particular. Experiencing difficulties to fulfil high expectations they dropped out in favour of RIG biathlon.

Interactive processes between the athlete and the surrounding environment

The athletes spent their late teens at RIG. After 3-4 years of studies and training they graduated at the ages of 19 or 20. During this period in life they had access to the best of facilities and coaches. However, some made it to the national team but some did not. The results revealed the following differences between the two groups.

Injuries and sickness

All athletes had been involved with a number of sports during childhood, team sports as well as individual sports. Just a very few took part in contact- or power sports with normally greater risks for injuries. There are good reasons to assume that this wide sportive engagement favoured good motor and health development. None of the elite group members experienced injuries or sickness to the extent that training was inhibited or strongly negatively influenced. However, four members of the control group – two males and two females, almost 1/3 of the entire group – clearly stated that this was the case. Enduring injuries or sickness were considered strong influents on their unfavourable sportive development.

Training

To achieve a national level in cross-country skiing or biathlon requires a full time engagement and a positive attitude to hard and intensive training. This philosophy or mental approach was more obvious among the elite athletes who more profoundly balanced hard training with daily life realities and routines. Hence, controls more often experienced difficulties in training and to live up to their own and others expectations. With ambitions to succeed, motivation decreased and injuries appeared. This development was explained in terms of too much training or deindividualised content in training. Some experienced difficulties to adapt prescribed training or to conduct summer training. Strong efforts to catch up often resulted in daily life stress with further risks for negative training effects. Lack of motivation affected patience and trust in personal capacities.

Coaches

The investigated athletes all had experiences from cooperation with coaches prior to RIG. Expectations on RIG coaches, well educated and sport specific trained were extremely high and the athletes were all anxious to cooperate with the coaches. However, 8 of the 13 controls suggested that planning, content and the conducting of the training were not fully in line with their own expectations. This was primarily an individualisation issue as well as perceptions of malfunctioning reciprocity in the communication between athlete and coach. In its turn, this was an issue of focusing evaluation, continuous dialogue and follow-up issues on training effects.

Discussion

An analysis of time of birth in a year based on quadruples revealed that about every 3rd athlete was born January through March compared to about every 10th being born October through December. Furthermore, elite group members were more often born early compared to controls. The finding is well in line with previous research and stresses the impact of criteria for the division in competition classes during the period of growth (Carlson 1993, Cobley et al. 2008a, Cobley et al. 2008b, Wattie 2008). Sports with high demands on technique and body dimensions like weight, length or oxygen transport capacities are often more affected than others. Variations in growth spurt are most obvious during the ages 9 to 14 (Malina 2009). During this period the age interval for competitions in biathlon is two years. This infers that the prevailing system favours early developers and misfavours late developers of reasons beyond their own influence (Engström 2000). Most of the investigated athletes were however competing in cross-country skiing during this age. As the division classes in this sport are based on one year age intervals as well as two year the problem still exists. Given these differences between the investigated groups and the fact that all athletes had been RIG students, there are good reasons to believe that early developers more easily could adapt to hard and intensive training at RIG. This in its turn could be referred to as one reason for later national team qualification.

The impact of coaches´ actions and influence during RIG has been referred to as a major explanation to future development. Coaches at RIG were often former competitors on a national level, highly competent and sport specific educated. Still, differences between the investigated groups occurred. The results revealed that sport specific criteria were highly satisfactory among coaches but lack of reciprocity in communication was a decisive aspect often referred to among the control group members. The findings are well in line with previous research stressing the relevance of quality in relations between coach and athletes (Chelladurai 1990, Mageau&Vallerand 2003, Kincer 2005, Bartholomew et al. 2009, Thelwell et al. 2010).

The complexity of biathlon competition requires certain abilities to cope with stress emphasising cross-country skiing and shooting (Soldatov 1983, Hoffman 1992, Manfredini et al 2001, Vickers & Williams 2007, Lemure 2008). All investigated athletes got involved with skiing at an early age, often as the debut sport. Few were involved with organised shooting during early adolescence. Biathlon as such was not available for children due to the construction of weapon. Hence, only three of the investigated athletes were involved with shooting at a young age. The sole elite group member among the three later turned out to be the most successful of all investigated and also proved very able to cope with stress in high level competitions. The study on world cup participants representing 35 nations revealed that 71 percent got involved with the two sports simultaneously (Cholewa et al 2005). Hence, involvement in cross-country skiing parallel to shooting at an early age or the sport of biathlon itself and if appropriate weapon were at stake seems to increase a favourable development in adult age.

Those few involved with shooting at an early age were influenced by family members or close friends. Sport was a dominating leisure time and family activity, in particular in the elite group. Parents of both sexes were often former competitors in sport, in particular elite group parents. An interesting finding was the fact that all but one of the investigated athletes grew up with both biological parents in areas with good access to organised or non-organised sport. Parental influence and environmental structures strongly influenced the athletes´ sport development. They grew up in competitive sport surroundings and experienced competition as a social arena with predominantly positive perceptions comparable to the concept of deliberate play (Cote & Hay 2002, Baker et al., 2003).

With reference to Bronfenbrenner´ s ecological model for human development the results indicate references to all four levels.

Micro level. Parents concern and their experiences from competitive sport contributed to develop in interest for sport participation and acceptance of sportive values. Cross-country skiing was the most common sport. Athletes had most of their friends in sportive contexts and developed sport to a daily life routine. Sport clubs existed at close range in the immediate environment and served as an important arena for social development and interaction with leaders and coaches.

Meso level. Micro level structures were dominant during the early adolescence and found in the immediate environment. They served as strong influents in the entire upbringing process. All involved, athletes, parents, friends, coaches etc interacted to make sport participation an important arena for a favourable future development and well being in a wider perspective – a lifestyle. Thus, the core of the meso level – interaction between micro level systems – was obvious.

Exo level. The RIG academies attracted many and were a goal to reach for the athletes. These schools were in most cases located in the near environment and well known to the athletes. The proportion of sport clubs measured per capita in local areas were the overall highest in the country. Cross-country ski clubs were common in the neighbourhood as well as favourable facilities to practise ski sports.

Macro level. RF serves an umbrella institution for organised sport with 70 different sport association members. The organisation was established in 1903 sponsored by governmental funding and private enterprise. The Swedish Biathlon Federation (SSSF) is one of its members. Members are often connected to international associations who formulate competition standards and guarantee international recognition. In 2002 SSSF formulated a new goal document which served as a guide document.

The micro level content strongly influenced the athletes` development during early adolescence and formed an important base for the future to come. The meso level served as a well functioning joint structure during this period. With respect of the macro framework, the upper secondary education years during the late teens (RIG), was however identified as the strongest influent in this study. Hence, the exo level is referred to as the prime indicator for the development to elite in biathlon.

Conclusion

The investigated athletes were involved with different sports during early adolescence. They grew up in areas with several sport clubs in the near surroundings. To take part in organised sport became a dominating leisure time activity with parents and friends involved. With one exception, all athletes grew up together with both biological parents. Cross-country skiing was the dominating debut sport and the activity the athletes spent most of their time taking part in. Acceptance to a RIG academy was a prime goal and a believed gateway to later competitive success. The 3 or 4 years spent there turned decisive for the future development. The system of RIG has a long tradition. Supported by the government, RF and local communities, the best of facilities and coaches offer excellent conditions to those accepted.

Elite group athletes differed from control group athletes in the following aspects;

- Parental experience and involvement in sport competition. Parents of both sexes had more often been involved with competitive sport.
- With reference to quadruples of a year, a higher proportion were born early thus indicating the impact of variations in speed of growth and criteria for the dividing in competition classes during adolescence.

- More positive experiences from relationships with coaches during RIG years with reference to reciprocity in communication and individualisation in terms of training activities.
- Sickness and injuries occurred less frequently during RIG years thus facilitating training and competition

References

1. Augustsson, Ch. (2007). *Unga idrottares upplevelser av föräldrapress*. (Children and Youth in Sport – Experiences of Parental Pressure).Diss. Estetisk-Filosofiska fakulteten, pedagogik. (Karlstad University Studies 1).
2. Baker, J. & Coté´, J. & Abernethy, B. (2003).Sport-Specific Practice and the Development of Expert Decision-Making in Team Ball Sports.*Journal of Applied Sport Psychology, 15,* 12-25.
3. Baker, J. &Cotè, J.&Deakin, J. (2005). Expertise in Ultra-Endurance Triathletes: Early Sport Involvement, Training Structure and the Theory of Deliberate Practice. *Journal of Applied Sport Psychology, 17,* 64-78.
4. Bergsgard, N. &Houlihan, B. &Mangset, P. &Nödland, S. &Rommetvedt, H. (2007). *Sport Policy. A Comparative Analysis of Stability and Change*. (London: Elsevier).
5. Blomdahl, U. & Elofsson, S. (2006). Hur många idrottar och motionerar för lite och vilka är dom? (How many exercise too seldom and who are they?)*Unglivsstil, 7*.(Stockholm: Idrottsförvaltningen, Idrottsenheten).
6. Breivik, G. (2000).Against Chance – a Casual Theory of Winning in Sports. In: T. Tännsjö& C. Tamburrini (eds.), *Values in Sport – Elitism, Nationalism, Gender Equality and the Scientific Manufacture of Winners*. (London: E & F Spoon).
7. Bronfenbrenner, U. (2000). Ecological Systems Theory.In: A. E. Kazdin (ed.). *Encyclopedia of psychology, vol3,* 129-133. (WashingtonDC: American Psychological Association).
8. Bartholomew, K.J. &Ntoumanis, N. &Thogersen-Ntoumani, C. (2009). A review of controlling motivational strategies from a self-determination theory practice: implications for sport coaches. *International review of Sport and Exercise psychology 2, 2,* 215-233.
9. Carlson, R. (1988). The Socialization of Elite Tennis Players in Sweden: An Analysis of the Players` Backgrounds and Development. *Sociology of Sport Journal, 5,* 241-256.
10. Carlson, R. (1993).The Path to a National Level in Sports in Sweden.*Scandinavian Journal of Medicine and Science in Sport, 3,* 170-177.
11. Carlson, R. (2007).*From Talent to Success in Competitive Sport – example Sweden.*Paper presented at the International Conference for Sport Administrators. (Kanyakumari, India)
12. Carlson, R. (2009).*Talent Development in Competitive Sport – some Theoretical and Practical Implications*. Paper presented at the 3rd International Scientific Symposium in Learning and Teaching Motor Skills. (Jyväskylä, Finland).
13. Chelladurai, P. (1990). Leadership in Sports: a Review. *International Journal of Sports Psychology, 21,* 328-354.
14. Cholewa, J. &Gerasimuk, D.&Szepelawy, M. &Zajac, A. (2005). "Analysis of Structure of the Biathlon Runs".*Acta Univ.Olomuc.,Gymn, vol. 35, 1,* 35-42. (Katowice: UniversitySchool of Physical Education).
15. Coakley, J. (1992). Burnout among Adolescents: a Personal Failure of a Social Problem. *Sociology of Sport Journal 9,* 271-285.

16. Cobley, S. & Abraham, C. & Baker, J. (2008a).Relative Age effects on Physical Education Attainment and School Sport Representation.*Physical Education and Sport Pedagog, 13,* 267-276.
17. Cobley, S. P. &Schorer, J. & Baker, J. (2008b).Relative Age Effects in Elite German Soccer: A Historical Analysis. *Journal of Sport Sciences, 26, 14,* 1531-1538.
18. Cotè, J.& Hay, J. (2002).Children`s Involvement in Sport: A Developmental Perspective. I: J.M. Silva & D. Stevens (eds.) *Psychological Foundations of Sport, 2,* 503-519, (Boston:Allyn& Bacon).
19. Cotè, J. & MacDonald, D. & Baker, J. & Abernethy, B. (2006).When "where" is more important than "when": Birthplace and Birthdata Effects on the Achievements of Sporting Expertise. *Journal of Sport Sciences, 24, 19,*1065-1073.
20. Csikszentmihalyi, M. &Rathunde, K. & Whalen, S. (1993). *Talented Teenagers – the Roots of Failure and Success.*21-38. (Cambridge University Press).
21. David, P.(2005).*Human Rights in Youth Sports. A Critical review of Children`s Rights in Competitive Sports,* 39-50.(London: Routledge).
22. Dunning, E. (1999). *Sport Matters. Sociological Studies of Sport, Violence and Civilization,* 240-248. (London: Routledge)
23. Engström, L-M. (2000). Det viktigaste är att vinna. (Most Important is Winning).*Pedagogiskamagasinet nr 1.Lärarförbundets tidskrift för utbildning, forskning och debatt*, 26-28. Stockholm.
24. Freudenberger, H-J. 1980). *Burnout.* (New York: Doubleday).
25. Gibbons, T. (1998).*The Development of Excellence – a Common Pathway to the Top in Music, Art, Academics and Sports*.Sport Science and Technology Division. United States Olympic Committee.
26. Glamser, F. & Vincent, J. (2004).The Relative Age effect among Elite American Youth Soccer Players.*Journal of Sport Behaviour, vol. 27, 1,* 31-38.
27. Gold, Y. & Roth, R.A. (1993).*Teachers Managing Stress and Preventing Burnout: the professional Health Solution*. (London: The Falmer Press).
28. Gould, D. &. Dieffenbach, K &Moffet, A.(2002).Psychological Charactaristics and their Development in Olympic Champions.*Journal of Applied Sport Psychology, 14,*172-204
29. Greenwood, B.P. &Kanters, M.A. (2009). Talented Male Athletes: Exemplary Character or Questionable Characters. *Journal of Sport Behaviour, 32, 3,* 298-324.
30. Halberstam, D. (2000). *Playing for Keeps. Michael Jordan & the World he Made,* 217-233. (New York: Broadway Books,
31. Hanstad, D. V. (2005). *Fullt Hus – eventyretnorskskiskyting*, 171-173. (Oslo: Akilles).
32. Heinilä, K. (1982). The Totalization Process in International Sport.*Sportwissenschaft, 3,* 230-254.
33. Helsen, W. &Winckel, J. & Williams, A. M. (2005).The Relative Age effect in Youth Soccer Across Europe. *Journal of Sport Sciences, 23, 6,* 629-636.
34. Hertting, K. (2007). *Den sköna föreningen mellan tävling och medmänsklighet. Om ledarskapochlärprocesser i barnfotbollen,* 99-123.(The fragile union between competition and human empathy.On leadership and learning processes in children´s football).Diss. (Luleå Tekn. Univ.:Inst för pedagogik och lärande).
35. Hoffman,M-D., Gilson, P-M., Westenburg, T-M., & Spencer, W-A. (1992). Biathlon Shooting performance after Exercise of Different Intensities.*International Journal of Sports Medicine, 13,* 270-273.
36. Jarvie, G. (2006). *Sport, Culture and Society,* 91-108. An introduction. (London: Routledge).

37. Johnson, M.B. & Edmonds, W.A. & Jain, S. & Cavazos, J. (2009).Analyses of Elite Swimming Performances and Their respective Between-Gender Differences over Time.*Journal of Quantitative Analysis in Sports, 5,4,* 1-18.
38. Kellmann, M. (2002).*Enhancing Recovery: Preventing Underperformance in Athletes.*Champaign, (Ill.: Human Kinetics).
39. Kincer, K. 2005). Coach-Athlete Relations – Connecting with Athletes throughout their Careers. In: Cecile Reynaud (ed.) *She Can Coach*. (Champaign, Ill.: Human Kinetics).
40. Lemure, P-N.& Hall, H.K. & Roberts, G.C.(2008). A Social Cognitive Approach to Burnout in Elite Athletes.*Scandinavian Journal of Medicine and Science in Sports, 18,* 221-234.
41. Light Shields, D. & Light Bredemeier, B. (2009).*True Competition.A Guide to Pursuing Excellence in Sport and Society*, 94-100. (Champaign, Ill.: Human Kinetics).
42. Lindgren, G. (1989). Auxology and Education: some Practical Implications from the Relationships between Physical and Mental Growth in Swedish Schoolchildren. *ActaPaediatrSuppl,* 350:105.
43. Mageau, G. &Vallerand, R. J. (2003).The Coach-Athlete Relationship: a Motivational Model. *Journal of Sport Sciences, 21,* 883-904.
44. Malina, R. &Beunen, G. (1996).*Monitoring of Growth and Maturation*. In: O. Bar-Or. The Child and Adolescent Athlete, 660-672. (London: Blackwell Science.
45. Malina, Robert. *Youth Sport for All and the Elite*. Paper presented at the 3rd International Scientific Symposium on Learning and Teaching Motor Skills. (Jyväskylä, Finland October 1-3, 2009).
46. Manfredini, F. &Manfredini R, &Carrabre, J.E. & Litmanen, H. &Zhukovskaja, L. & Dal Fallo, D. &Haberstroh, J. (2002). Competition Load and Stress in Sports: a Preliminary Study in Biathlon. *International Journal of Sports Medicine, 23,*348-352.
47. Musch, J.&Grondin, S. (2001). Unequal Competition as an Impediment to Personal Development.A Review of the Relative Age Effect in Sport.*Developmental Review, 21,*147-167.
48. Norstat Sponsor Insight.(2009). *Investigation of TV-viewers.*
49. Reidecke, T.D., & Smith, A.L. (2001).Development and Preliminary Validation of an Athlete Burnout Measure.*Journal of Sport Exercise Psychology, 23,* 281-306.
50. Sherar, L. & Baxter-Jones, A. & Faulkner, R. & Russell, K. (2007). Do Physical Maturity and Birth Date Predict Talent in Male Youth Ice Hockey Players? *Journal of Sport Sciences, 25, 8,*879-886.
51. Soberlak, P. &Cotè, J. (2003).The Development Activities of Elite Ice-hockey Players.*Journal of Applied Sport Psychology, 15,* 41-49.
52. Soldatov, O.A. (1983). Reserves of Long-Distance Speed in the Biathlon.*Theory and Practice, 6,*16-17.
53. Thelwell, R. & Weston, J.V. &Greenlees, I. (2010).Coping with Stressors in Elite Sport: A Coach Perspective.*European Journal of Sport Science, 10 (4),* 243-253.
54. Twist, P. & Anderson, S. (2005). Trainability of Children.*IDEA Fitness Journal, 2, (3),* 56-65.
55. Turman, P.D. (2003).Coaches and Cohesion - The Impact of Coaching Techniques on Team Cohesion in the Small Group Sport Setting. *Journal of Sport Behaviour, 26, 1,* 86-94.
56. Vickers, J. N. & Williams, A. M. (2007).Performing under Pressure: The Effects of Physiological Arousal, Cognitive Anxiety and Gaze Control in Biathlon.*Journal of Motor Behaviour, 39, 5,* 381-394.

57. Vaeyens, R. &Philippaerts, R. &Malina, R. (2005). The Relative Age Effect in Soccer: a Match Related Perspective. *Journal of Sport Sciences, 23, 7,*747-756.
58. Vaeyens, R. &Gullich, A. &Warr, Ch. R. &Philippaerts, R. (2009).Talent Identification and Promotion Programmes of Olympic Athletes.*Journal of Sport Sciences, 27, 13*, 1367-1380.
59. Vuolle, P. (1998ed.). *Sport in Social Context by KaleviHeinilä. Commemorative Book in Honour of Professor KaleviHeinilä,* 130-138. (Jyväskylä:University of Jyväskylä.
60. Wattie, N. (2008). Towards a Unified Understanding of Relative Age Effects.*Journal of Sport Sciences, 26, 13*, 1403-1409.
61. Wiersma, L. (2000). Risks and Benefits of Youth Sport Specialization: Perspectives and Recommendations. *Pediatric Exercise Science, 12,* 13-22.
62. Wolfenden, L. & Holt, N. L. (2005).Talent Development in Elite Junior Tennis: Perceptions of Players, Parents and Coaches. Journal of Applied Sport Psychology, 17,
63. Wulf, G., McConnel, N., Gartner, M., & Schwarz A. (2002). Enhancing the Learning of Sport Skills through External-focus Feedback. *Journal of Motor Behaviour, 34,* 108-126.

Submitted: October 30, 2010
Accepted: November 29, 2010

VALUE PRIORITIES IN THE VIEWS OF LATVIAN AND ITALIAN SPORTS SCIENCE STUDENTS

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Abstract

Humans' values include the bio-ontological existence and fundamental development and self-protection concept, which are expressed in each individual's value priorities and attitude towards them. To understand the position of emerging sports pedagogues, health specialists and active recreation specialists who are going to advance the society's understanding and implementation of a healthy lifestyle, it is necessary to comprehend the youths' value priorities.

Main aim of the research is to determine the personal value priorities of Italian and Latvian sports science students and the significant differences between them. 200 students from each country were chosen for the research (100 male and 100 female) all of which are sports science students in Latvian Academy of Sports Education in Riga and "Foro Italico" university in Rome. Value priorities were assessed through a questionnaire that was dubbed in Italian and Latvian (Gervilla, 2000). Students expressed differentiated support or negation towards statements evaluated in interval scale relating to 10 personal value groups: biological, ecological, instrumental, sport – dynamical, social – emotional, ethical, aesthetical, religious, intellectual and hedonistic.

The gained data were statistically processed with the SPSS methodology. Results showed that value priorities of both countries' sports science students were dominated by hedonistic values. Considerable differences are noticeable in the religious and socio-emotional value groups; these are determined by the traditions in the living environment with the individual perception of cultural and religious factors.

Key words: *Values, students, sport science.*

Introduction

The personality is an entity or system that presents multiple levels of complexity (biological, psychological, social, emotional, etc.), it has multiple dynamically changing values. In sport pedagogy and psychology and from the phenomenology point of view, the body is seen essentially as a lived one (*Erlebnis*), as something which is inseparable from the experience of the person, as an integrated and integral entity not divisible into parts and comprehensible only as a whole. The body looks like a bio-physiological and cultural integrated system involving various levels of freedom and possibility. This system must be interpreted as a whole and cannot be analyzed in the strict sense. The body must be considered as a whole that is comprehensible only as such (Bilsky, Schwartz, 1994).

Research on the body and it's values is now considered fundamental in the research field of sport sciences and sport studies. Sport is a concept that contains three basic components: body, playing/games and movement. The importance of the body in contemporary research has led to the development of an autonomous research field called body studies (Cole, 2007). This research field has been found especially interesting by psychologists, sociologists, philosophers and educationists of sport, who have investigated the relationship between the body and the values of the person, with particular attention

paid to youth education in the modern society (Fernández-Balboa, 1997; Isidori, Fraile, 2008). There exists a correlation between the choice of values preferred by youth and the changes taking place in the contemporary society. One can say that the post-modern society is a society in which body values prevail over all the other ones; the type of body values which are dominant in the capitalist society are mostly those which are connected to the hedonistic, esthetical and emotional dimension of the body itself.

The aim of the research is to evaluate the value priorities of Latvian and Italian sports science students.

Materials and Methods

The main assumption of the research was that by detecting the hierarchy of values in sport science students, first of all one can understand their attitudes and culture better; and then their way of thinking relating not only to sport but also to the entire society they live in and the people there.

In this assumed hierarchy of modern body values, the religious ones tend to be regarded least important. This occurs not only in accordance with the modern society's ongoing process of secularization but also with the announcement of the so called *grand narratives' eclipse* (that is, first of all, ideologies and religions) (Lyotard, 1984).

The human body is always tied to the values of the person. According to Max Scheler (1874-1928), the values are not created by the man/woman but they exist objectively and depend on human cognition. The values are different and form a hierarchy, different for each person.

One of the tools currently used to detect these preferences is the body value test (Cesares García, 1995; Gervilla, 2000), which has also been applied to the field of sport sciences (Gutierrez Sanmartín, 2003).

The scenario of this research involved the two University centres for the study of sport sciences in the two capital cities of Italy and Latvia: that is Rome and Riga.

To carry out the research, 100 subjects per country – 50 female and 50 male students – attending the first, second and third years of course in sport sciences at LASE in Riga (average age= 20.5 yr) and at UFR in Rome (average age=22.1 yr), were selected (a total 200 students).

The students' values hierarchy was obtained through a Spanish test (Gervilla, 2000) adapted and double translated into Italian and Latvian. The aim of the test was to detect the level of agreeability or disagreeability expressed by each student when presented with some words regarding 10 main body values models, that is: biological body (BIO); ecological body (ECO); instrumental body (INS); sport – dynamical (DYN), social – emotional body (EMO); ethical body (ETH); esthetical body (EST); religious body (REL); intellectual body (INT); pleasure body (PLE) (Gervilla, 2000). These models aim to represent all the dimensions of the human body and they are based on the theory of multiple intelligences by Howard Gardner (2006).

The test consisted of 10 value groups, each of 25 statements, concerning the 10 body models identified above. Students expressed differentiated support or negation towards statements evaluated in interval scale (from +2 to -2) relating to 10 personal value groups. An algebraic addition of the scores obtained was made (according to the interval scale). The closer the score reported for each group is to 50 (or -50), the more the subject supports (or negates) that body values' model.

Data analysis.

The data obtained (interval scale points) were statistically processed using the SPSS program (Statistical Package for the Social Sciences). The analysis performed the variance to. The results gained were compared in the following ways:

- by country (see Figure 1);

- by gender (see Figure 2);
- by gender and country (see Figure 3).

Starting from hermeneutical background, this study aimed to draw the hierarchy of body values among sport sciences students at university, who will be future educators and professionals of body care and well-being in European society. In order to understand their preferences, the limitations of moral education taught in Latvian and Italian universities and the cultural differences that can emerge from the two societies were assessed.

Results

The two countries which this comparative research has been carried out in are very different in terms of culture, language and social traditions. Italy is one of the most densely populated countries of the European Union; it is a Latin country in its language and culture, characterized by Catholic religious traditions. Latvia, on the other hand, is one of the smaller countries of Europe, a state belonging to the former USSR, which has only recently made its entry into the European Union (2004) and with the official language belonging to the Baltic branch with religion playing a lesser role in its culture and Lutheranism being the dominant religion.

Figure 1 shows that the differences are the smallest in biological and esthetical values, and the greatest in Intellectual and especially Religious values ($p<0.01$). There are also considerable differences in Ecological and Instrumental values ($p<0.01$), and small but noticeable difference in Dynamic, Ethical and Pleasure values ($p<0.05$).

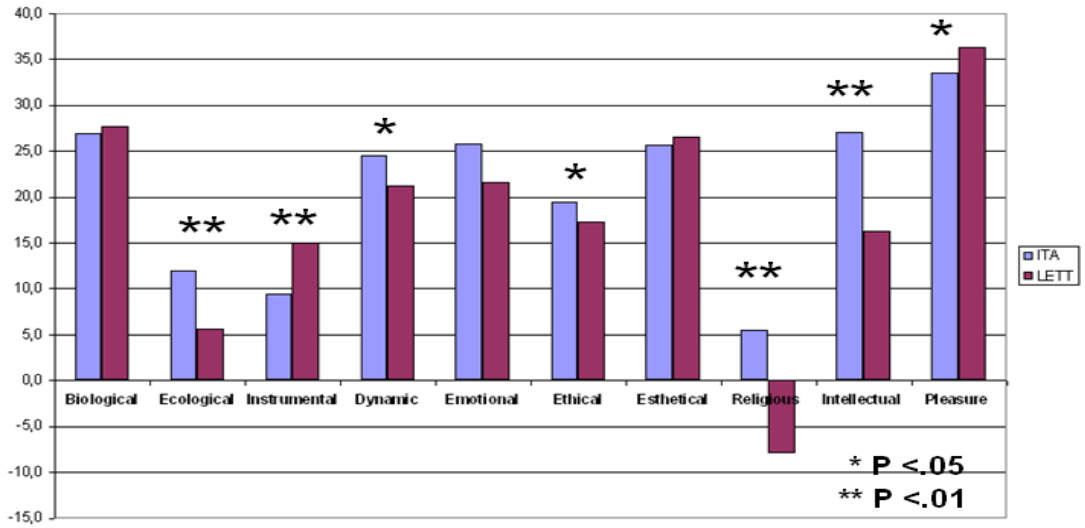

Fig. 1: Analysis of value priorities by country (points)

Figure 2 shows that there is a considerable difference between genders in Ethical and Esthetical values with women considering both more significant ($p<0.01$). The rest of the value priorities did not show any significant differences between genders.

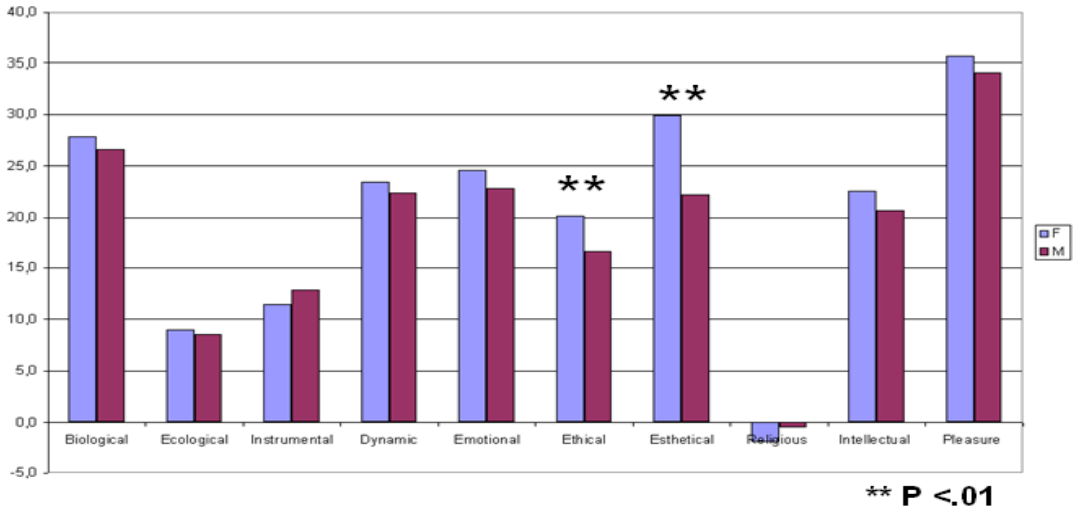

Fig. 2: Analysis of value priorities by gender (points, F – female, M – male)

This analysis (Figure 3) has helped to both detect the hierarchy of preference of every LASE and URFI student for each of the 10 body value group models identified, and demonstrate the differences existing among students due to their country's culture and gender.

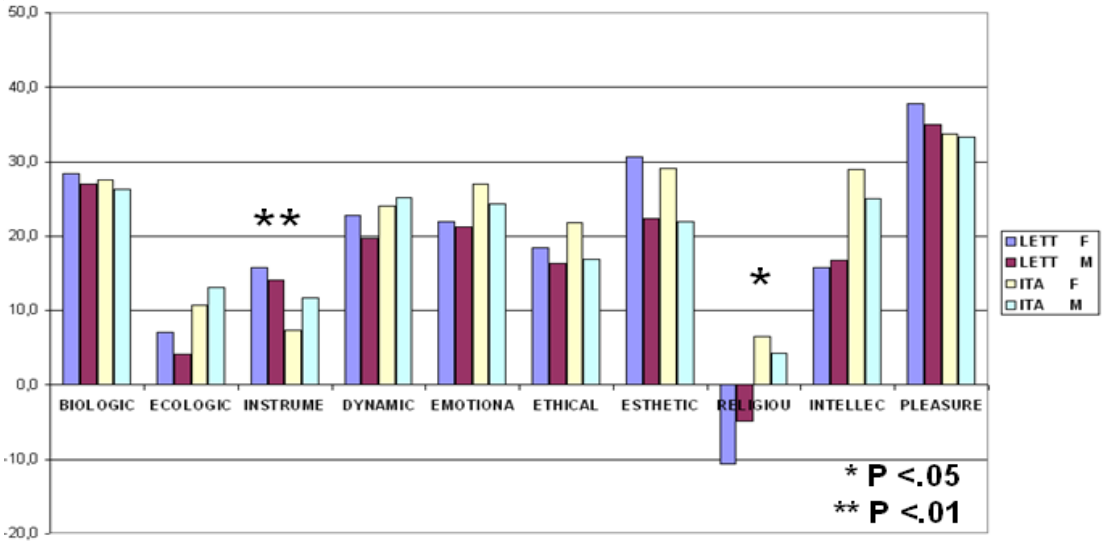

Fig. 3: Analysis of value priorities by country and gender (points; LETT – Latvia, ITA – Italy)

All the data collected has been used to outline Italian and Latvian sports science students' body value hierarchy. This hierarchy, which allows drawing a general body value profile, has then been compared.

Table 1

Body Value Scores (average points)

AVERAGE (P<,0000)										
	BIO	**ECO**	**INS**	**DYN**	**EMO**	**ETH**	**EST**	**REL**	**INT**	**PLE**
LATVIA	27,7	5,6	15,0	21,3	21,6	17,3	26,6	-7,9	16,2	36,4
ITALY	26,9	12,0	9,5	24,6	25,7	19,4	25,5	5,4	27,0	33,5

Table 1 shows the average Latvian and Italian students' response regarding each body value while table 2 shows the arrangement of values in order of their significance in the views of these students.

Both countries' sports science students, although with a considerable difference, consider pleasure values the most important (36,4 point average among Latvians and 33,5 point average among Italians). Likewise religious values are considered the least important with a considerable difference (-7,9 point average among Latvians and 5,4 point average among Italians).

Table 2

Body Value Ranking by URFI and LASE Sports Science Students

Foro Italico	Values Hierarchy	LASE	Values Hierarchy
1	Pleasure	1	Pleasure
2	Intellectual	2	Biological
3	Biological	3	Esthetical
4	Emotional	4	Emotional
5	Esthetical	5	Dynamic
6	Dynamic	6	Ethical
7	Ethical	7	Intellectual
8	Ecologic	8	Instrumental
9	Instrumental	9	Ecologic
10	Religious	10	Religious

Discussion

The results of this research have showed that the hierarchy of body values in students of sports science is broadly in line with those of modern society and education and that there are differences in the perception of these values among students due to cultural differences, curricula and the traditions of the society they live in.

The research has also highlighted the need to develop a more effective moral education in the curricula of the two universities studied. This education ought to focus on ethics and environmental values, which are considered less important by students. The pedagogical point of view of this research is that all the body values are important and for this reason there are no values more or less important for education, because they always express the multidimensionality of the human being. A lack of values in any of these dimensions can obstruct a correct moral development of the youth.

The body can be thought of as existing in nature and culture at the same time. It is always culturally loaded and inscribed by the dominant values of particular cultures (Tinning, 2010) and nowadays the dominant culture is the materialistic and the capitalistic one. Education can perform a fundamental task in changing this culture. It is important to develop a personality though understanding the need of intellectual, ethical and dynamic values.

In the two sport sciences Universities studied, curricula focusing on education for body values must be developed. It has to be aimed on developing deeper intellectual, moral and ethical qualities, through the use of specific teaching programs or didactical tools, in students who will be the future sport professionals of Italy and Latvia.

Conclusions

The results of this research have shown some differences in the perception of body values between Latvian and Italian students. Generally speaking the two groups of students have shown differences in the following values:

- Ecological/Ethical body values: the Italian students are more sensible and aware of these values than Latvian students.

● Dynamic and intellectual body values: the Latvian students like these body values less than their Italian counterparts.

● Practical and pleasure body values: these are considered more important by Latvian students who appear more hedonistic.

The student value analysis by gender showed some additional differences:

1) Instrumental body values: girls from URFI are less interested in the practical dimension of the body and they reveal to be less practical than Italian male and Latvian male and female students.

2) Religious body values: Latvian girls have a very low interest in religious values, less than their Latvian and Italian male and Italian female fellows.

3) Ethical and esthetical body values: Italian and Latvian girls are more sensitive towards these values than their fellow-countrymen.

References

1. Bilsky, W. & Schwartz, S. H. (1994). Values and personality. *European Journal of Personality, 8,* 163-181.
2. Cesares García P. (1995). Test de valores: un instrumento para la evaluación. *Revista Española de Pedagogía,* 203, 513-537.
3. Cole C. (2007*). Body studies*. In Coakley J., Dunning E. (Eds). *Handbook of sports studies*. Thousand Oaks, CA: Sage, 439-460.
4. Fernandez-Balboa M. (Ed), (1997). *Critical postmodernism in human movement, physical education and sport*. Albany: SUNY.
5. Gervilla E. (2000). *Valores del cuerpo educando*. Barcelona: Herder.
6. Gardner H. (2006). *Multiple intelligences: new horizons in theory and practice*. New York: Basic books.
7. Gutiérrez Sanmartín M. (2003). *Manual sobre valores en la educación física y el deporte. Barcelona*: Paidós.
8. Isidori E., Fraile A. (2008). *Educazione, sport e valori. Un approccio critico-riflessivo*. Roma: Aracne.
9. Lyotard J.F.(1984). *The postmodern condition: A report on knowledge*. Minneapolis: The University of Minnesota Press.
10. Tinning R. (2010). *Pedagogy and Human Movement. Theory. Practice, research*. Routledge: New York.

Submitted: July 25, 2010
Accepted: October 14, 2010

Short communication

BRANCH OF SPORT SCIENCE IN LATVIAN ACADEMY OF SPORT EDUCATION

Juris Grants

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The Latvian Academy of Sport Education (LASE) is the only higher education institution in Latvia that coordinates and carries out research in sport science, as well as trains education and sport specialists. Up to the academic year 2009/2010 the Latvian Academy of Sport Education realised the Bachelor, Master and Doctor Study Programmes "Pedagogy". For several recent years the content of the programme was gradually developed transferring from pedagogy science to sport science which we consider as separate field of science investigating regularities of human's physical health, development, preparedness and sport achievement. This transition facilitated wider sports-linked and integrated research on questions of pedagogy, psychology, medicine, biology, biomechanics, sociology and economics sciences.

In the division of the data base of the Latvian Council of Science (LCS) concerning science branches and sub-branches Sport Science is separate science branch (N. 38). Sport Science together with its two sub-branches Sport Theory and History and Sport Pedagogy is a relatively new science branch in Latvia which studies the regularities of human's physical health, development, condition, and sport achievement formation [3]. It includes related to sport integrated research of the questions of pedagogy, psychology, medicine, biology, biomechanics, sociology, and economics science. In several science branch classifiers of the European countries Sport Science appears as a separate branch already since 1970s and 1980s. In Latvia Sport Science as a separate science branch was affirmed by the act of LCS on February 17, 1998.

The way of sport specialists to the nomination of their science branch was not easy. Its beginnings can be found in the act of the Republic of Latvia Council of Ministers (04.10.1991, Nr.262) "On Regulation of Awarding of Scientific Degree" and in the acts of the Latvian Council of Science (19.03.1992, Nr.35-3-4 and 35-3-5). Taking the mentioned documents as the basis by the order of the Rector of the Latvian Academy of Sport Education (LASE) Prof. U. Gravitis (23.03.1992. Nr.68) the Promotion Council in the branch of pedagogy and sub-branch of physical culture and sport had been affirmed. It included seven members from science branches of pedagogy and medicine, and the elected chairman of the Council was LASE Prof. I. Forands. On June 29, 1992 J.Grants, the lecturer of LASE Skiing Department, was the first person who was awarded PhD in Sport Pedagogy in the renewed Latvia (*Sport History of Latvia,* 1994, p 266). In the further years LASE gained the rights to establish a council with promotion rights in the science branch of pedagogy, sub-branch of sport pedagogy. In the course of time from 1998 when the sport science branch was nominated up today 20 promotion thesis in sport science branch have been defended.

The academic and research staff of LASE includes 80 staff members, 40 of them have PhD degree. Work load is 0.25 up to 1.5, which depends on the post a person is

elected in (Professor, Associated Professor, Docent, Lecturer or Assistant). The academic and research staff undertakes both academic and research activity.

LASE research directions and themes

Following the analysis of the research experience and themes of the academic staff, we have advanced five main LASE research directions for the period of 2011-2016:

I Health and kinesiology;
II Top sports;
III Psychological preparedness and sports;
IV Recreation and environment in the development of human mental and physical abilities;
V Sustainable sport education.

Following these directions, research is carried out in the departments and research laboratories of LASE. Three new research laboratories were established at LASE on November 4, 2010:
LASE Sports Psychology Research Laboratory (LASE SPRL),
LASE Sports Pedagogy Development Research Laboratory (LASE SPDRL) and
LASE Recreation Research Laboratory (LASE RRL).
Research projects are realized there by the academic staff, research groups or the academic staff together with their Doctoral programme students. Table 1 shows several prior research projects and cooperation partners of 2010. Some of the projects listed below are finished already, but some remain active.

Table 1

LASE PRIORITY THEMES IN RESEARCH 2010

Nr.	Research project	Supervisor and doctoral student	Research contracts between institutions
1.	Innovative methods to increase ice-hockey player physical conditioning	Supervisor: prof.I.Kisis Student: P. Murans	Ltd. "Grindeks" ISC "Dinamo" Latvian Institute of Organic Synthesis
2.	Effectiveness of vibration training in increasing athlete work capacity	Supervisor: prof. L.Cupriks Student: U.Ciematnieks	Riga Stradins University
3.	Physical health improvement for 45-60 years old people in the city Madona using outdoor recreation activities	Supervisor: prof.J.Grants Student: I.Kundzina	Madona City Local Government Institute of Electronic and Computer Science
4.	Local vibration as a training tool for athletes strength preparation in cross country skiing	Supervisors: prof. V.Krauksts (LASE) prof. J.Nilsson (GIH) Students: K.Ciekurs, U.Ciematnieks	In cooperation with Swedish School of Sport and Health Science (GIH), Stockholm
5.	Life stories of young athletes: reflections on dual career in Latvia	LASE project group: asoc. prof.I.Kravalis, asoc. prof.I.Belousa, prof. J.Grants, prof. J.Zidens	In cooperation with 8 HEIs in European Union Project "Dual Career, Training and Education in Europe" Project manager: Bosön Sport College, Sweden

Doctor's Degree Study Programme in Sport Science

The content of the LASE Doctor study programme provides the following professional competence - the totality of knowledge, skills and attitudes necessary to carry out research activity in sports science and similar to it science fields; scientific basis to professional activity, developing the ability to carry out independent research, developing the skills of scientific analysis, and the skills to solve different problems independently. The study results correspond to the qualification framework of the European Higher Education Area (of the Bologna process) and the Lifelong education qualification framework of the European Union (EQF). A great part of the Doctoral programme students are young academic staff members of different higher education institutions of Latvia. Every year the average number of the Doctoral students is about 30, and a half of them are in the state budget programme. The grants given by the European Social Fund (ESF) to both students and their supervisors is a great contribution in young sports specialist training and sport science development.

Since 2000 eighteen Doctoral theses have been defended. LASE Promotion Board in Sports Science was not working for several years, as it had not been accepted by the Latvian Council of Science (LCS). Therefore several LASE graduates of the Doctoral study programme defended their theses both in other higher education institutions in Latvia and abroad in Bulgaria, USA. Table 2 shows the themes and authors of the defended dissertations during some recent years. Several of them research sport education and sport pedagogy direction, one – sports medicine.

Table 2

Number and titles of promotion thesis defended in LASE in 2009 and 2010

Nr.	Title of promotion (dissertation) thesis	Name surname and supervisor
1.	Constructivism approach to professional physical preparation in competence development of students	Aldona Homiča Supervisor –Prof. R.Jansone
2.	Development of student versatile physical conditioning for serving in police	Ivars Kravalis Supervisor – Prof. J.Grants
3.	Shoulder joint dynamic stability in sport	Una Veseta Supervisor – Assoc. Prof. A.Paeglītis
4.	Psychic stability and team cohesion of 16-29 years old basketball players	Žermēna Vazne Supervisor – Prof. A.Rudzītis
5.	Innovative model of acquiring Olympic education for the improvement of sport pedagogue professional competence	Antra Gulbe Supervisor –Prof. R. Jansone
6.	Optimization of risk element learning in rhythmic gymnastics (age group: 7- 10 years)	Vita Mikitanova Supervisor –Prof. N. Jaruznijs

To promote sport science further on April 24, 2009 in the framework of the Baltic Sport Science Conference in Vilnius **Baltic Sport Science Society (BSSS)** was founded with the aim to provide the development of sport science in all three Baltic States, establishing a uniform inter-state Doctoral study programme in sport science and with common effort to integrate it in the field of the European and the world sport science.

Among the founders of the Society we can find the Faculty of Exercise and Sport Sciences of Tartu University, Lithuanian Academy of Physical Education, Faculty of Sport and Health of Vilnius Pedagogical University and Latvian Academy of Sport Education. The first Baltic Sport Science Conference took place in Tartu in May, 2008 with the participation of 70 Baltic sports scientists. The second Conference was held in Vilnius in April, 2009, which gathered about 110 participants not only from the Baltic States, but also there were about 30 representatives from other countries. The Latvian Academy of Sport Education was the host of the third Baltic Sport Science Conference that was held in Riga from April 29 up to May 1, 2010. The 1st day of the conference was young scientist conference in five sections where 57 Baltic doctoral students participated with oral and poster presentations. During the second day of the conference 112 oral and poster presentations in five sections from 14 European countries had been presented. The 4th Baltic Sport Science Conference will be held on April 7-9, 2011 in Tartu, Estonia.

LASE together with two other HEIs from Poland (Jozef Pilsudski University of Physical Education in Warsaw, Faculty of PE in Biala Podlaska and State College of Computer Science and Business Administration in Lomza) organized the first International Outdoor Sports and Recreation Education Summer School in August, 2010 - *Recreational Outdoor Games from the Historical Perspective in Latvia.* The aim of the summer school was to introduce Doctoral and Master students with qualitative research, to develop interviewing and inquiring skills for gaining needed information and to conduct outdoor games and plays in accordance with Latvian social life traditions and festivals [2]. The International Outdoor Sports and Recreation Education Summer School will continue its work next year.

In this short communication paper we are reflecting LASE sport science guidelines which are based on the motto of our *Alma Mater*: education based on innovations, combined study and research work and creative and open study, research and environment.

References

1. Kehris, E., Ķīse, A., Forands I., Vītola A. (1994). *Latvijas sporta vēsture.* Rīga: Latvijas Izglītības fonds.
2. Voitiņa, L. (2010, August 24). *Madonas reģionā pētīs tradicionālās spēles.* Stars. Message posted to Ref-Links electronic mailing list, archived at http://www.estars.lv/raksti/23/11246
3. Latvian Council of Science (2010, November) *Latvijas Zinātnes padomes Zinātņu nozaru un apakšnozaru anotācijas /Annotation of the science branches and sub-branches of the Latvian Council of Science.* Retrieved November 10, 2010, from http://www.lzp.gov.lv/index.php?option=com_content&task=view&id=144&Itemid=51

Review form
Guidelines for Contributors

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The **LASE Journal of Sport Science** is a journal of published manuscripts in English from various fields of sport science. It covers the following types of papers:

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- ✓ *review papers* commissioned by the Editor (maximum 20 standard pages of typescript, including documentation),
- ✓ *short communications* (maximum 3 standard pages of typescript plus two table or figure and up to 5 references),
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- ✓ *current news* (information on conference, abstracts of PhD. theses and Post-Doc. theses, book reviews, biographical notes),
- ✓ *advertisements* that may be covered on separate pages of the journal (prices are subjects to individual negotiations).

Format
Document format – Microsoft Word 97-2003 or 2007.
Page format – 210x297 mm (A4).
Text – single column (font Times New Roman, letter size 12 pt), line spacing – Single, paragraph alignment – Justified, left margin – 20mm, right margin – 20mm, bottom margin – 25mm.

Style
Papers must be written in a clear, concise style appropriate to an international readership. Familiar technical terms may be used without explanation. Acronyms and abbreviations are likely to need full presentation at least once.

Content
Research or project reports, case studies of practice, action research reports, and reports on teaching practice or techniques will be accepted.
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2. Abstract
3. Body text

Title page should contain: title of the paper, first and last names of authors with affiliation, first and last name of corresponding authors with postal address, telephone, fax and e-mail.

Abstract (up to 250 words) consisting of the following sections: justification and aim of the study, material and methods, results, conclusions, as well as 3-6 key words, should be provided before the body text.

Body text should be sectioned into: Introduction, Material and Methods, Results, Discussion, Conclusions, Acknowledgements (If necessary) and References. In articles of others types, the text should follow in a logical sequence and headings of its particular sections should reflect issues discussed therein.

Introduction – should be short and concise; it should introduce readers into research problems addressed in the study as well justify undertaking the research and specify its aim.

Material and methods – should describe the subject of the study (in the case of human subjects data should include their number, age, sex and any other typical characteristics) and methods applied in a sufficiently exhaustive way to enable readers to repeat the experiments or observations. For generally known methods only references should be given, whereas detailed descriptions are to be provided for new or substantially modified methods.

Results – should be presented in a logical sequence in the text, tables and figures. Data collated in table and figures should not be repeated in the text which should summarize the most important observations.

Discussion – should emphasize new or important aspects of experimental results and discuss their implications. Results of own studies are to be compared with findings described in the respective domestic and international references used by the Authors.

Conclusions – should be started in points or descriptively and should be logically connected with objectives stated in the *Introduction*. Statements and conclusions not derived from own observations should be avoided.

References – following instructions for Authors on References (APA style).

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Following artificial text shows different types of in-text citation:

Claessens (2010) found evidence that attention will be given to multi-compartment models, such as the 3-water, 3-mineral and 4-compartment models, to assess percentage of body fat. However, Raslanas, Petkus and Griškonis (2010) noted that Aerobic physical load of low intensity got 35.1 % of total trainings time. Research on physical loading also focused on identifying the basis of many years' research of physical activity (Bytniewski et al. 2010). According to Ezerskis (2010), "… heavy physical loads had the undulating

character depending on the dynamics of workloads…" (p. 71) yet girls are more ascertained that the Track & Field training helps to develop courage.

Instructions for Authors on References (APA style)

This document describes standards for preparing the references in the APA style. The following sections give detailed instructions on citing books, journal articles, newspaper articles, conference papers, theses, web pages and others.

Please provide all the required elements in the references to your paper. Please pay particular attention to spelling, capitalization and punctuation. Accuracy and completeness of references are the responsibilities of the author. Before submitting your article, please ensure you have checked your paper for any relevant references you may have missed.

A complete reference should give the reader enough information to find the relevant article. If the article/book has DOI number, the author should include it in the references. And most importantly, complete and correct references may allow automatic creation of active links by the MetaPress technology that we use for making the electronic version of our journal. Active reference linking is regarded as the greatest benefit of electronic publishing and it adds a lot of value to your publication.

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The articles should be sent to Inta Bula - Biteniece
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Congratulations!

We congratulate **Antra Gulbe**, the student of doctoral studies at the Latvian Academy of Sport Education, for successful defence of her thesis "Innovative model of acquiring Olympic education for the improvement of sport pedagogue professional competence" (Sport Science) at the Latvian Academy of Sport Education on June 29, 2010. Supervisor prof. R.Jansone.

Dr. Antra Gulbe, Project leader of Project management center in Latvian Academy of Sport Education, Project leader of Latvian Olympic Academy, Lecturer of the Department of Sports Theory in Latvian Academy of Sport Education.

We congratulate **Vita Mikitanova**, the student of doctoral studies at the Latvian Academy of Sport Education, for successful defence of her thesis "Optimization of risk element learning in rhythmic gymnastics (age group: 7- 10 years)" (Sport Science) at the Latvian Academy of Sport Education on November 16, 2010. Supervisor prof. N.Jaruznijs.

Dr. Vita Mikitanova, Rhythmic gymnastics coach of Riga region sport school.