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# Physical Fitness, Menstrual Cycle Disorders and Smoking Habit in Croatian National Ballet and National Folk Dance Ensembles

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**A B S T R A C T**

*The study investigated differences in morphological, motor and functional abilities between folk and ballet dancers. The sample comprised 51 female subjects: Croatian National Ballet (N=30) and Croatian National Folk Ensemble »LADO« (N=21). The data regarding menstrual cycle, menarche, number of births and smoking habit were collected and the morphological, motor and functional abilities measured. Significant correlations between the amount of fat tissue and number of births were found in both groups. Folk dancers were as tall as ballet dancers but weighted more and had a larger body frame ($p<0.001$). Ballet dancers were more flexible but there were no differences in absolute maximal oxygen uptake (2.65 vs. 2.35 L/min, $p=0.101$). Still, as the ballet dancers weighted less, their relative maximal oxygen uptake was significantly higher (37.62 vs. 50.22 mL/kg/min, $p<0.001$). Also, a high number of 45% of smokers among professional ballet and professional folk dancers was found.*

***Key words**: folk dance, ballet dance, physical fitness, aerobic capacity*

## Introduction

National Ballet Ensemble and National Folk Dance Ensemble are known as the most elite of their kind in the country. There is a large body of knowledge about physical load of the ballet dance and that is why the morphological, motor and functional characteristics and abilities of ballet dancers have been previously researched[1–4]. From those studies one can conclude that physiology and physical fitness are as important for dancers as choreography and performance skills are. Physical demands of ballet dance resemble those in many sports. On the contrary, there are only few studies that investigate the physical requirements in folk dancing. Among these, there is a study of Wigaeus and Kilbom[5] who investigated physical demands during Swedish »hambo« folk dancing and observed that exercise intensity during folk dance was more than sufficient to induce training effects in the average individual, provided that the dancing was performed at the frequency and length of time usually recommended for physical training. Srhoj[6] found that Croatian folk dance from the island of Hvar resulted in improvement of motor skills, rhythmic coordination, balance, agility on ground, and repetitive strength in young girls. Beneficial influence of folk dance on cardio-respiratory fitness and body composition was confirmed also on amateur dancers of Indonesian Balinese folk dance[7–8].

Even though folk dancing can be very strenuous activity and professional folk dancers often train as much as professional ballet dancers, the professional folk dancers were never a part of the study investigating physical fitness of the dancers. As the members of both ensembles, the ballet and the folk ensemble are professionals they are not otherwise employed. That is why their whole working day is dedicated to the training and perfection of their performance. Unfortunately, the physical load and the stress during folk dance are rarely seen as the athletic performance. In many countries the national folk ensembles do not conduct conditioning training that would improve physical fitness as the part of their training regime. The directors of the ensembles dedicate the

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whole number of training hours to the dance and choreography practice and seldom to the physical conditioning. National folk dance ensembles are not considered »athletes« and that is why they do not undergo an athletic preparation. Still, as the aesthetics appearance is significant in folk dance, as well as in ballet dance, the female members of the groups are under constant pressure to control their eating habits and to control their weight which in extreme cases might lead to the disorders of menstrual cycle[9–10].

The aim of this paper was to give better insight into the morphological, motor and functional characteristics and abilities of folk dancers and to compare them to ballet dancers of the same level. That would provide useful information about the requirements of physical conditioning training that should be implemented into their everyday routine.

## Materials and Methods

The sample encompassed 51 female subjects, coming from two backgrounds: Croatian National Ballet (N=30) and Croatian National Folk Ensemble »LADO« (N=21). The groups did not differ significantly according to the age, which enabled us to conduct further analysis (the results of t-test for independent samples: 30.70±8.33 vs. 33.97±8.33, p=0.187). The basic characteristics of the sample (number of subjects, age) are shown in Table 1.

**TABLE 1**
BASIC DESCRIPTIVE PARAMETERS OF THE SAMPLE

| | Ballet | Folk |
|---|---|---|
| N | 30 | 21 |
| Age (X±SD) | 30.70±8.33 | 32.94±8.32 |

The subjects were tested during their practice in the morning hours in a week with no major performances so that we could exclude fatigue from the previous night show. Before the testing, the subject filled in the 4 items questionnaire regarding their menstrual cycle, eventual disturbances of the menstrual cycle, number of births given and smoking habits. After that the subjects underwent the measuring of the morphological characteristics and some motor and functional abilities. The variables that were investigated were:

- Height
- Weight
- Biacromial distance (shoulder width)
- Bicristal distance (hip width)
- Upper arm girth during the extension and flexion phase and their difference
- Percentage of fat tissue measured by three skinfold method
- Handgrip measured by Lafayette hand dynamometer
- Flexibility measured by »Sit and Reach« test
- Estimated maximal oxygen consumption – VO2max

The data were analysed in Statistic for Windows package and the data analysis methods consisted of descriptive statistics, Student t-test for independent samples, correlation analysis and canonical discriminant analysis of the two groups in order to establish differences between groups.

## Results

First, the descriptive parameters for both groups were calculated and the mean values and standard deviations expressed (Table 2 and 3). Also, the Student t-test was conducted for all measured variables.

Among 30 ballet dancers 5 reported mild irregularities of menstrual cycle and 5 had amenorrhoea. Among 21 folk dancers 4 reported mild irregularities of menstrual cycle and 3 had amenorrhoea, so the differences between the ensembles were proved to be statistically insignificant (p=0.371). Discriminant analysis involving variables age at menarche, duration of menstrual bleeding, irregularities of menstrual cycle and numbers of births given did not prove to be significant (Wilks Lambda=0.906, R=0.307, p=0.372).

Significant correlations between the amount and fat tissue and number of births and between duration of menstrual bleeding, and irregularities of menstrual cycle were obtained (Table 3).

Forty-five percent of ballerinas reported smoking habit, which was similar to the number of smokers among folk dancers (44%). The smokers smoked in average the similar number of cigarettes per day (7.00±5.88 vs. 5.68± 4.71, p=0.625). The results of Student t-test comparing morphological, motor and functional abilities are shown in Table 4.

Even though the results of t-test for independent samples pointed to the variables that were significantly different the canonical discriminant analysis was performed in order to find out the variables that contribute the most to distinction of the groups. The obtained

**TABLE 2**
MEANS AND STANDARD DEVIATIONS OF AVERAGE MENARCHE AGE, DURATION OF MENSTRUAL BLEEDING AND NUMBER OF BIRTHS GIVEN

| | Ballet (X±SD) | Folk (X±SD) | t-value | p |
|---|---|---|---|---|
| Age at menarche (years) | 14.22±1.76 | 13.68±0.67 | 1.255 | 0.216 |
| Menstrual bleeding (days) | 4.83±1.36 | 5.00±1.10 | –0.460 | 0.648 |
| Births given | 0.52±0.78 | 0.75±0.91 | –1.742 | 0.188 |

**TABLE 3**
CORRELATION COEFFICIENTS AMONG THE AMOUNT AND FAT TISSUE, DURATION OF MENSTRUAL BLEEDING, IRREGULARITIES OF MENSTRUAL CYCLE AND NUMBER OF BIRTHS

| | Mens. Irreg. | Dur. Bleed. | Births | % Fat |
|---|---|---|---|---|
| Mens. Irre. | 1 | –0.491* | –0.254 | –0.096 |
| Dur. Bleed. | –0.491* | 1 | –0.069 | 0.071 |
| Births | –0.254 | –0.069 | 1 | 0.331* |
| % Fat | –0.096 | 0.073 | 0.331* | 1 |

% Fat – fat tissue percentage, Dur. Bleed. – duration of menstrual bleeding, Mens. Irreg. – irregularities of menstrual cycle, Births – number of births

**TABLE 4**
MEANS AND STANDARD DEVIATIONS OF MEASURED CHARACTERISTICS AND ABILITIES AND THE RESULTS OF STUDENT T-TEST FOR INDEPENDENT SAMPLES

| | Ballet (X±SD) | Folk (X±SD) | t-value | p |
|---|---|---|---|---|
| Weight (cm) | 52.70±4.05 | 62.68±8.36 | –5.607 | 0.000* |
| Height (cm) | 164.31±5.60 | 166.24±5.33 | –1.193 | 0.239 |
| Body mass index (BMI) | 19.52±1.28 | 22.65±2.42 | –5.887 | 0.000* |
| Shoulder width (cm) | 36.62±1.69 | 36.96±1.40 | –0.725 | 0.472 |
| Hip width (cm) | 27.63±1.27 | 27.52±1.19 | 0.304 | 0.762 |
| Elbow diameter (cm) | 5.73±0.56 | 6.31±0.43 | –3.798 | 0.000* |
| Knee diameter (cm) | 8.63±0.34 | 8.87±0.378 | –2.290 | 0.027 |
| Upper arm flexion girth minus extension girth (cm) | 1.62±0.53 | 1.68±0.99 | –0.279 | 0.782 |
| Percentage of fat tissue (%) | 13.87±2.61 | 18.81±3.12 | –5.970 | 0.000* |
| Hand grip (kg) | 36.30±10.01 | 32.37±6.25 | 1.503 | 0.140 |
| Flexibility (cm) | 22.80±4.12 | 12.41±6.46 | 6.892 | 0.000* |
| Maximal oxygen uptake (L/min) | 2.65±0.71 | 2.35±0.38 | 1.679 | 0.101 |
| Maximal oxygen uptake (mL/kg/min) | 50.22±12.60 | 37.62±5.04 | 4.139 | 0.000* |

*Significant differences on $p<0.001$ level

**TABLE 5**
THE RESULTS OF DISCRIMINANT ANALYSIS AND THE SIGNIFICANCE OF THE DISCRIMINATIVE FUNCTION

| Eigen-value | Canonical R | Wilks' Lambda | $\chi^2$ | p |
|---|---|---|---|---|
| 2.503 | 0.845 | 0.285 | 48.266 | 0.0000 |

discriminant function significantly discriminates the ballet dancers from folk dancers at the level of significance 0.00 with a high canonical correlation (R=0.845). It may be concluded that the selected variables differentiate well between the members of the two ensembles (Table 5).

The factor structure matrix pointed to the variables that contributed the most to the discrimination of the groups (Table 6).

**TABLE 6**
FACTOR STRUCTURE MATRIX (CORRELATIONS VARIABLES – CANONICAL ROOTS) AND POSITION OF THE MEANS OF THE GROUPS (CENTROIDS ON CANONICAL DISCRIMINANT FUNCTION)

| Variable | Root 1 |
|---|---|
| Weight | –0.508 |
| Height | –0.103 |
| Shoulder width | –0.074 |
| Hip width | 0.041 |
| Elbow diameter (cm) | –0.364 |
| Knee diameter (cm) | –0.209 |
| Upper arm flexion girth minus extension girth | –0.031 |
| Percentage of fat tissue | –0.532 |
| Hand grip | 0.143 |
| Flexibility | 0.629 |
| Aerobic capacity | 0.355 |
| Group means on discriminant function | |
| Ballet | 1.298 |
| Folk | –1.844 |

## Discussion

Though only several authors refer to dancers as to athletes, the insight into functional and motor abilities of

dancers, especially ballet dancers, points to the fact that the physical fitness of dancers might be compared to the physical fitness of many athletes.

Both folk as well as ballet dancers performed better in all measured tests in comparison with average Croatian female population of that age[11] which was expected. The lack of difference in the average age of the groups (Table 1) enabled us to perform further analysis and the insignificant difference in average height of the groups was even more helpful in comparisons because there are some abilities that are in correlation with the height of the examinees[12].

The significant difference was observed in Body Mass Index between the groups (19.52 in ballet and 22.65 in folk dancers). In both groups the average Body Mass Index was above 19.00, which was considered encouraging because it does not represent a major risk for injury. According to Benson et al.[13] higher incidence of injuries among dancers with Body Mass Index 19.00 or lower occurred.

The morphological characteristics that contributed the most to the discrimination of the groups were body weight, elbow diameter and fat tissue percentage. In general, ballet dancers were leaner with smaller body frames. The significantly lower percentage of fat tissue in ballet dancers (13.87±2.617 vs. 18.81±3.121, $p=0.000$) might lead to presumption that the differences in the regularity of menstrual cycle might be present. Surprisingly, that difference was not determined ($p=0.648$). The lack of significance in menstrual cycle disturbances in ballet dancers, with only 13% of fat in average, might be explained by results of Scott and Johnston[9] who claimed that critical weight or critical fat theory hypothesis cannot be accepted. Interestingly, the professional folk dancers in our study had in average the same amount of fat (18%) as the female ballet dancers in the study of Mihajlovic and Mijatov[14].

As the age at menarche was higher than in average Croatian population[15] in both groups it might be presumed that the low amount of fat tissue was present in subjects even in the early age. Duration of menstrual bleeding was in the range for general population, meaning 4–5 days (Table 2). No differences were observed between the groups in incidence of menstrual cycle irregularity and eventual amenorrhoea though the incidence of dysmenorrhoea was 28.6% for ballet and 26.3% for folk dancers ($p=0.581$) while in USA dancers the reported incidence was around 20%[16]. The subjects in the USA study were not professionals.

Professional ballet dancers had lower mean number of births given than the folk dancers but the difference was insignificant. In both groups the number of births was lower than the number of births given in that age in Croatian population (women under 33 year in Croatia had in average 0.98 births according to the EUROFIT project, unpublished paper by Heimer et al., 2004). Correlation analysis confirmed previously known correlation[17] between the fat tissue percentage and number of births given probably resulting from increase in body mass during pregnancy.

The smoking habit should be seen as a problem, because the number of dancers who smoke habit is of very high in both groups. The 45% female smokers under the age of 35 should be considered as alarming health concern and it was much higher than in USA dancers among whom only 17% smoked[18].

According to Heimer and al.[11] average maximal oxygen uptake for women aged 30–35 in Croatia is only 21.03±6.30 mL/kg/min, which is much lower than the aerobic capacity of the folk dancers tested in this study (37.62±5.04 mL/kg/min). In ballet dancers the maximal oxygen uptake was much higher (50.22±12.60 mL/kg/min) and it equalled to the aerobic capacities found many aerobic-anaerobic female athletes[19–21]. The aerobic capacity of ballet dancers was larger than those in folk dancers but only if we consider the relative maximal oxygen uptake (37.62 vs.50.22 mL/kg/min). The absolute maximal oxygen uptake (2.65 vs. 2.35 L/min) was not significantly different between ballet and folk dance ensemble members but of course, ballet dancer had significantly lower weight, which contributed to the better relative maximal oxygen uptake. That was kind of surprising, because ballet dance is usually considered to be more strenuous endurance type of activity than the folk dance, so we expected ballet dancers to have higher absolute aerobic capacity. In comparison with international ballet ensembles, the Croatian National Ballet[22–23] had better aerobic capacity than their Scandinavian and American colleagues. If we consider the intensity and the duration of the ballet performances, better aerobic capacity surely contributes to the better performance by reducing and delaying the onset of fatigue and blood lactate accumulation.

Of course, the ballet dancers were more flexible in comparison to the folk dancers (22.80±4.12 cm vs. 12.41±6.45 cm, $p=0.000$ on Sit&Reach test) but even folk dancers were much more flexible then the average Croatian population of that age and gender who performed in average only 8 cm on the same test[11]. Considering the impact of flexibility training on injury incidence it was a good indicator for injury prevention[24–25].

No difference in handgrip between the groups was found probably because the both groups consisted of ensemble dancers, with no solo dancers included. Hand strength was previously found to be higher in leading ballerinas (solo-performers)[3] probably because they had different demands during choreography that included pair dancing and lifting of the ballerinas.

## Conclusion

The limitation of the study surely lies in the absence of a control sample of sedentary women, but obtained results pointed to the fact that the demands of the ballet, as well as the folk dance, resulted in much better physical fitness than the average population. The subjects of both groups performed better in all functional and motor

tests then the general Croatian population compared to the data published by Heimer and associates[11]. Ballet dancers had higher aerobic capacity and better flexibility than the folk dancers but there was no difference in handgrip strength. Fat tissue percentage was lower in ballet dancers but there were no differences observed in menstrual cycle data between the groups. Of rather large concern were 45% of smokers among professional ballet and folk dancers. In some prospective study, it would be interesting to compare bone mineral density in ballet and folk dancers. According to some authors[26–27] despite relatively late menarche and low fat tissue percentage, the high levels of weight-bearing physical induced in ballet dancers relatively high bone mineral density

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## REFERENCES

1. SCHANTZ, P. G., P. O. ASTRAND, Med. Sci. Sports. Exerc., 16 (1984) 472. — 2. BALDARI, C., L. GUIDETTI, J. Sports. Med. Phys. Fitness., 41 (2001) 177. — 3. MISIGOJ-DURAKOVIC, M., B. R. MATKOVIC, L. RUZIC, Z. DURAKOVIC, Z. BABIC, S. JANKOVIC, M. IVANCIC-KOSUTA, Coll. Antropol., 5 (2001) 585. — 4. KOUTEDAKIS, Y., A. JAMURTAS, Sports. Med., 34 (2004) 651. — 5. WIGAEUS, E., A. KILBOM, Eur. J. Physiol. Occup. Physiol., 45 (1980) 177. — 6. SRHOJ, LJ., Coll Antropol., 26 (2002) 539. — 7. ADIPUTRA, N., J. Hum Ergol., 23 (1994) 93. — 8. ADIPUTRA N., P. ALEX, D. P. SUTJANA, K. TIRTAYASA, A. MANUABA, Hum. Ergol., 25 (1996) 25. — 9. SCOTT, E. C., F. E. JOHNSTON, J. Adolesc. Health. Care., 2 (1982) 249. — 10. ELIAKIM, A., S. ISH-SHALOM, A. GILADI, B. FALK, N. CONSTANTINI, Int. J. Sports. Med., 21 (2000) 598. — 11. HEIMER, S., M. MIŠIGOJ-DURAKOVIĆ, L. RUŽIĆ, B. MATKOVIĆ, I. PRSKALO, S. BERI, M. TONKOVIĆ-LOJOVIĆ, Coll. Antropol., 28 (2004) 223. — 12. CRAWFORD, J. O., E. WANIBE, L. NAYAK, Ergonomics, 20 (2002) 922. — 13. BENSON, J. E., C. J. GEIGER, P. A. EISERMAN, G. M. WARDLAW, J. Am. Diet. Assoc., 89 (1989) 58. — 14. MIHAJLOVIC, B., S. MIJATOV, Med. Pregl., 56 (2003) 579. — 15. PREBEG, Z., Ann. Hum. Biol., 25 (1998) 425. — 16. STENSLAND, S. H., J. SOBAL, Am. Diet. Assoc., 92 (1992) 319. — 17. RODRIGUES, M. L., T. H. DA COSTA, Br. J. Nutr., 85 (2001) 107. — 18. PHELP, R., Dance Magazine, 3 (1996) 7. — 19. WASSERMAN, K., J. HANSEN, D. SUE, B. WHIPP: Principles of exercise testing and interpretation. (Lea Febiger, Philadelphia, 1987). — 20. HELLER, J., T. PERIC, R. DLOUHA, E. KOHLIKOVA, J. MELICHNA., H. J. NOVAKOVA, Sports Sci., 16 (1998) 243. — 21. WILMORE, H. W., D. L. COSTILL, Physiology of sport and exercise. (Human Kinetics, Champaign, 1999). — 22. COHEN, J. L., K. R. SEGAL, I. WITRIOL, W. D. MCARDLE, Med. Sci. Sports. Exerc., 14 (1982) 212. — 23. RAMEL, E., O. THORSSON, P. WOLLMER, Scand. J. Med. Sci. Sports., 7 (1997) 293. — 24. HAMILTON, W. G., L. H. HAMILTON, P. MARSHALL, M. MOLNAR, Am. J. Sports. Med., 20 (1992) 267. — 25. ASKLING, C., H. LUND, T. SAARTOK, A. THORSTENSSON, Scand. J. Med. Sci. Sports., 12 (2002) 230. — 26. KARLSSON, M. K., O. JOHNELL, K. J. OBRANT, Bone Miner., 21 (1993) 163. — 27. VAN MARKEN LICHTENBELT, W. D., M. FOGELHOLM, R. OTTENHEIJM, K. R. WESTERTERP, Br. J. Nutr., 74 (1995) 439.

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## FUNKCIONALNE SPOSOBNOSTI, POREMEĆAJI MENSTRUALNOG CIKLUSA I NAVIKA PUŠENJA ČLANICA HRVATSKOG NACIONALNOG BALETA I ANSAMBLA HRVATSKIH NARODNIH PLESOVA

## SAŽETAK

Cilj ovog rada bio je dati uvid razlike u morfološkim, motoričkim i funkcionalnim karakteristikama i sposobnostima plesačica narodnih plesova i baleta. Uzorak su činile 51 ispitanice iste dobi, pripadnice Hrvatskog državnog baleta (N=30) i Hrvatskog državnog ansambla narodnih plesova »LADO« (N=21). Ispitanice su popunile anketu i podvrgnute su mjerenju morfoloških karakteristika, te motoričkih i funkcionalnih sposobnosti. Uočena je značajna korelacija između postotka masnog tkiva i broja poroda u obje grupe. Diskriminacijska analiza morfoloških i funkcionalno motoričkih sposobnosti je ukazala na značajne razlike između grupa (Wilk's Lambda 0.285, R=0.845, p<0001). Plesačice narodnih plesova bile su jednako visoke kao balerine ali teže jače konstitucije (p<0.001). Balerine su bile fleksibilnije ali nije postojala razlika u apsolutnom primitku kisika (2.65 vs. 2.35 L/min, p=0.101). Ipak, kako su balerine bile lakše njihov relativni maksimalni primitak kisika bio je značajno viši (37.62 vs. 50.22 mL/kg/min, p<0.001). Zabrinjavajući su podaci od čak 45% pušaća u obje skupine.