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TENNIS AS A RECREATIONAL PHYSICAL ACTIVITY FOR ADULTS: THE EFFECT ON PHYSICAL FITNESS

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ABSTRACT. ***Introduction.*** The benefits of leisure-time physical activity on health are known and proven in the specialized literature. Among these we can mention the reduction of mortality, cardiovascular disease and various types of cancer, low back pain or depressive symptoms; therefore, it can be asserted that practicing physical leisure time activities is one of the key elements of active and healthy aging. ***Objective.*** The purpose of the research is to analyze the effect of a physical leisure time program, based on the organized practice of tennis, on the physical fitness of subjects which work in a sedentary environment. ***Methods.*** The research was carried out on a sample of 43 subjects working in the IT domain in Cluj-Napoca. During the study, which lasted 4.5 months, the subjects in the experiment group (n = 27) participated in a recreational tennis practice program. During this time, the subjects in the control group (n = 16) continued their daily activities without participating in new activities involving physical exercise. The physical fitness of the subjects was evaluated using the Eurofit Test Battery for Adults at the beginning and at the end of the intervention program. The data was statistically processed using SPSS, version 20. ***Results.*** In the case of the experimental group, significant differences were recorded between the two measurements of balance, plate-tapping test, vertical jump, hand grip, bent-arm-hang test, shuttle run and VO_2max, whereas for the control group there were no significant differences in the plate-tapping test. After the intervention, there were statistically significant differences between the two groups as regards the hand grip strength, the bent-arm-hang test, the shuttle run and the VO_2max. ***Conclusions.*** The changes of the indices at the end of the intervention support the hypothesis that a tennis training program can improve the physical fitness of the participants.

Keywords: *fitness, sedentariness, leisure time, tennis, physical activities for adults*

REZUMAT. ***Tenisul de câmp ca activitate fizică recreativă la adulți: efectul asupra fitnesului fizic. Introducere.*** Beneficiile activității fizice de loisir asupra sănătății sunt cunoscute și dovedite în literatura de specialitate. Dintre acestea putem aminti reducerea mortalității, a maladiilor cardiovasculare, a diferitelor tipuri de cancer, a durerilor lombare sau a simtomelor depresive, astfel că

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putem afirma că practicarea activităţilor fizice de timp liber este unul din elementele cheie ale îmbătrânirii active şi sănătoase. ***Obiectiv.*** Scopul cercetării a fost analiza efectului unui program de activitate fizică de timp liber bazat pe practicarea organizată a tenisului de câmp asupra fitnessului fizic la subiecţi care desfăşoară actvitate de muncă de tip sedentar. ***Metode.*** Cercetarea a fost efectuată pe un eşantion de 43 de subiecţi care lucrau în Cluj-Napoca în domeniul IT-ului. Pe parcursul studiului, care a durat 4.5 luni, subiecţii din grupa de experiment (n=27) au participat la un program de practicare a tenisului recreaţional. În tot acest timp, subiecţii din grupa de control (n=16) şi-au continuat activităţile zilnice fără a participa în mod organizat la noi activităţi care implică exerciţiile fizice. Fitnessul fizic al subiecţilor a fost evaluat cu ajutorul bateriei de teste Eurofit pentru Adulţi la începutul şi finalul programului de intervenţie. Datele au fost prelucrate statistic cu ajutorul SPSS, versiunea 20. ***Rezultate.*** În cazul grupului experimental au fost înregistrate diferenţe semnificative între cele două măsurători în privinţa echilibrului, tesului atinge-plăcile, detentei, forţa flexorilor palmari, testului bent-arm-hang, alergării de navetă şi a VO_2max, în timp ce în cazul grupului de control nu există diferenţe semnificative decât în cazul testului atinge-plăcile. După intervenţie s-au înregistrat diferenţe semnificative statistic între mediile celor două grupuri în cazul forţei flexorilor palmari, testului bent-arm-hang, alergării de navetă şi VO_2max. ***Concluzii.*** Modificările indicilor la finalul intervenţiei susţin ipoteza că un program de antrenament în tenisul de câmp poate ameliora fitness-ul fizic al participanţilor.

Cuvinte cheie: *fitness, sedentarism, loisir, tenis de câmp, activităţi fizice pentru adulţi*

Introduction

Sedentary workplaces are considered to be a possible health risk factor. According to Wen & Wu (2012), out of the 36 million worldwide deaths related to non-communicable diseases, 5.3 million deaths are related to physical inactivity. As stated by Ng & Popkin (2012), the number of sedentary work and leisure activities has increased a lot lately, from 26 to 38 hours per week between 1965 and 2009 in the United States and from 30 to 42 hours between 1960 and 2005 in the United Kingdom, with alarming prospects for 2030.

According to the French statistics published by La Direction de l' Animation de la recherche, des Études et des Statistiques (DARES) and based on the Sumer survey, the percentage of employees who work more than 20 hours per week in front of a screen increased within the same period of time from 11.9% in 1994 to 22.6% in 2010, with a sharp increase in the case of those who hold positions such as manager, from 18.3% to 46.1% (Arnaudo, et

al., 2012). Due to these reasons, employers are recommended to implement physical activity programs for employees.

On the opposite side, there are the positive effects of regular exercise and physical activity. Among the benefits of leisure-time physical activities on health we can mention the reduction of: mortality in general (Kelly, Kahlmeier, & Gotschi, 2014), mortality and cardiovascular diseases (Wilmot, Edwardson, & Achana, 2012), mortality due to colon cancer (Je, Steffens, Maher, & S, 2016) and breast cancer (Fong, Ho, & P, Conesa, Stubbs, & Vancampfort, 2016), low back pain (Steffens, Maher, & S, 2016) or depressive symptoms (Catalan-Matamoros, Gomez-Conesa, Stubbs, & Vancampfort, 2016). Also, practicing physical activity in leisure time is one of the key elements of active and healthy aging (Hupin, Roche, & Gremeaux, 2015).

Epidemiological studies carried out by Pronk, Lowry, Kottke, Austin, Gallagher, & Katz (2010) highlighted the importance of physical activity in disease prevention, health care, functional status and even in productivity.

Pate & Buchner (2014) present some case studies that provide important insights on efforts to successfully implement health improvement strategies at workplaces. The programs presented were applied to people from a wide variety of companies and organizations: truck drivers, school systems, companies from the energetic industry and healthcare organizations. The common elements of these interventions include the importance of organizational culture, the employee support provided by the company's management, the comprehensive program-related options, the multi-layered interventions (from the behavioral change of the individual to the environmental and resolution solutions), the communication within the program and the assessment which allows the monitoring of the program's impact and continuous improvement.

Studies in the United States consider physical activity and fitness as key components of employee welfare strategies (Pronk, Benedict, Young, & Sill, 2014). As evidence, companies like IBM view the concept of wellness or well-being as something more than just the focus on the reduction of health risks and they are also oriented towards the individual's ability to thrive, to "flourish". Herman, Musich, Lu, Sill, Young, & Edington (2006) determined that, on average, health risks related to reduced physical activity were limited by 8.2% among participants in the program. In addition, participants have experienced significant improvements in their life satisfaction, perception of their own health, risk status, smoking and body weight.

The scientific literature on self-monitoring techniques, change stages, social support, stimulants and exercise played an important role in the design approach of the IBM program (Helsel, Jakicic, &Otto, 2007, Herman, Musich, Lu, Edington, 2006).

Practicing physical exercise regularly results in lowering health care spending. The analyzes conducted by Keyes & Grzywacz (2005) and Lu, Schultz,

Sill, Petersen, Young, & Edington (2008) indicated an increase of 291 USD of the average health care expense for the participants of a workplace in a physical activity program, compared with an increase of 360 USD per year for non-participants. The authors concluded that programs focused on the improvement of physical and mental health and on the employees' vitality contributed to health spending reduction, productivity gains and improvement of life quality indices.

Objectives

The purpose of the research was to analyze the effect which a leisure-time physical activity program, based on the organized practice of tennis, had on physical fitness of subjects which worked in a sedentary environment.

The objectives of this research were the elaboration of an intervention program, an assessment of motor abilities of the selected subjects, before and after the intervention, as well as a comparison of the means of the results of the initial and final measurements.

The present research is based on the assumption that physical fitness indices of a group of subjects which worked in a sedentary environment improved as a consequence of their participation at a tennis practice program.

Materials and methods

The research was conducted on a sample of 43 subjects whose workplace implied a sedentary activity (they worked in Cluj-Napoca in the IT field). Participants were divided into two groups - 27 subjects (12 women and 15 men) in the experiment group (EG) and 16 subjects (5 women and 11 men) in the control group (CG). The sampling was non-random and from the non-probabilistic sampling category, the convenience criterion was used. All participants were informed about the content and purpose of the research and they gave their written consent for participation before the start of the study.

For collecting information on the employee's availability to participate in the study, a form was disseminated on the internal communication channels of the companies where the subjects came from. The form contained questions addressed to those interested in participating in this project. The subjects who expressed interest were selected and they accepted to take part in the measurements and the training. They consented on the use of the research results in exchange of anonymity guarantee.

The study was concluded between 1th of November 2016 and 5th of April 2017, period during which the subjects from the experimental group

participated in a tennis recreation program which consisted in 90-minute tennis lessons twice a week. During this time, the subjects from the control group continued their daily activities without taking an organized part in new activities involving physical exercise.

The research began with the initial evaluation of the physical fitness of the subjects through the application of the tests included in the Eurofit Test Battery for Adults (Council of Europe, 1995): sit-and-reach (coxo-femoral mobility), vertical-jump, bent-arm-hang (isometric force of the arms and shoulders), hand grip, single leg balance, plate-tapping (the speed of the limb movement) and the 20 m shuttle run (for the calculation of VO_2 max).

The data resulting from the measurements provided by the Eurofit Test Battery for Adults were statistically processed using the SPSS statistical analysis software, version 20. At first, the Shapiro-Wilk test was used in order verify the normality of the distribution and the descriptive analysis (means and standard deviation), followed by means comparison using parametric (T-test) and non-parametric tests (Wilcoxon and U Mann-Whitney) depending on the distribution of the data.

Results

The study participants (N = 43) were adults with ages between 23 and 38 years (28.95 ± 4.31), 60.46% male (n = 26) and 39.54% females (n = 17), all of them were employed in IT companies. The distribution within the experiment and the control group was based on the participants' choice.

The research started with the initial measurements, followed by the application of the proposed intervention program for a period of 4.5 months. At the end of the research, the final measurements took place in identical conditions with those from the initial testing.

Table 1. Means and standard deviations of the measured variables during initial and final testing

Variable	EG (n=27)		CG (n=16)	
	Initial testing M (±AS)	Final testing M (±AS)	Initial testing M (±AS)	Final testing M (±AS)
Flexibility (cm)	4.67(±7.7)	5.13(±7.76)	5.22(±6.1)	4.88(±6.14)
Balance (rep)	2.37(±2.73)	1.52(±1.16)	2(±1.15)	1.75(±0.86)
Plate-tapping (sec)	11.01(±1.74)	9.88(±1.37)	10.91(±1.46)	10.07(±1.13)
Vertical jump (cm)	50.78(±14.25)	46.04(±11.7)	49.63(±11.14)	46.81(±8.48)
Hand grip (kg)	42.11(±12.11)	45.37(±11.41)	46.75(±12.54)	46.81(±12.11)
Bent-arm-hang (sec)	23.79(±17.3)	28.84(±18.44)	29.83(±23.92)	31.15(±19.68)
20m Shuttle-run-test (level)	5.81(±2.02)	6.65(±2)	5.81(±2.74)	6.25(±2.02)
Relative VO_2 max (ml/kg/min)	35.56(±6.5)	38(±6.48)	31.88(±19.17)	36.21(±6.64)

The normality of the data distribution was verified using the Shapiro-Wilk Test; the results obtained correspond to those shown in Table 2. An analysis of this shows that not all measured data have a normal distribution, so both parametric and non-parametric tests are used to study the significance of the mean difference. Therefore, within the experimental group, the data were normally distributed in terms of flexibility variables, vertical-jump, dynamometry and bent-arm-hang, while within the control group the data concerning balance and VO2 max were not normally distributed.

Tabelul 2. Initial testing – normality of data distribution

Variable	Shapiro-Wilk test of normality			
	EG (n=27)		CG (n=16)	
	Statistic	p	Statistic	P
Flexibility (cm)	0.97	0.63	0.96	0.58
Balance (rep)	0.55	<0.001	0.79	0.002
Plate-tapping (sec)	0.87	0.003	0.92	0.15
Vertical jump (cm)	0.93	0.08	0.97	0.88
Hand grip (kg)	0.93	0.07	0.93	0.25
Bent-arm-hang (sec)	0.97	0.57	0.93	0.21
20m Shuttle-run-test (level)	0.92	0.03	0.95	0.45
Relative VO_2 max (ml/kg/min)	0.91	0.02	0.68	0.001

Taking into account the distribution of the data and the number of individuals, the significance of the difference between means in the case of variables with a normal distribution was analyzed using the parametric test T-test for paired samples and the non-parametric test Wilcoxon for variables which did not have a normal distribution. The comparative analysis of the significance of the differences for the paired samples is presented in table 3.

Table 3. Paired samples means comparison

Variable	EG (N=27)		CG (N=16)	
	t/Z	p	t/Z	p
Flexibility (cm)	-0.79*	0.44*	0.57*	0.58*
Balance (rep)	-2.43**	0.01**	-0.83**	0.41**
Plate-tapping (sec)	-4.46**	<0.001**	3.87*	0.01*
Vertical jump (cm)	2.04*	0.05*	1.87*	0.08*
Hand grip (kg)	-3.52*	0.02*	-0.06*	0.95*
Bent-arm-hang (sec)	-2.77*	0.01*	0.75*	0.46*
20m Shuttle-run-test (level)	-3.64**	<0.001**	0.17*	0.86*
Relative VO_2 max (ml/kg/min)	-3.68**	<0.001**	-0.5**	0.96**

* Paired samples T-test

**Wilcoxon test

According to Table 3, as regards the experimental group, significant differences can be observed between the two measurements of all variables, except for flexibility (t = -0.79, df = 25, p = 0.44). In the case of the control group, there were no significant differences between the mean of the initial and the final measurement aside from the plate-tapping test (t = 3.87, df = 14, p = 0.01).

At the end of the intervention, by the use of the Mann-Whitney test, the statistical significance of the differences between the means of the variables measured in the experimental and control groups was checked. From the results presented in Table 4, we can observe that there is a statistical significance between the means in the case of hand grip (U = 133.5, p = 0.04), bent-arm-hang test (U = 134.5, p = 0.04), shuttle-run-test (U = 98.5, p = 0.003) and VO2max (p = 0.002) after the intervention.

Table 4. U Mann Whitney test for independent samples means comparison

Variable	U	z	p
Flexibility (cm)	171	-1.14	0.25
Balance (rep)	192.5	-0.62	0.54
Plate-tapping (sec)	169.5	-1.17	0.24
Vertical jump (cm)	205.5	-0.26	0.79
Hand grip (kg)	133.5	-2.08	0.04
Bent-arm-hang (sec)	134.5	-2.05	0.04
20m Shuttle-run-test (level)	98.5	-3	0.003
Relative VO_2 max (ml/kg/min)	102	-3.03	0.002

Discussion

The general findings of similar research indicate that those who choose to practice tennis as a recreational leisure activity experienced positive benefits on their physical fitness and implicitly on their health. Lower body fat percentages, more favorable lipid profiles and improved aerobic capacity contributed to a generally smaller risk of cardiovascular morbidity (Pluim, Bonita, Marks, Miller, Miley, 2007). The same authors also outlined the results of numerous studies which identified better bone health, not only for tennis players which took part in tennis activities over the course of their lives, but also for those who started to practice tennis in adulthood.

The comparative analysis concerning the signification of the difference between the mean variables for the experimental group research shows that all variables, except flexibility (t = -0.79, p = 0.44), registered a significant difference between the initial and the final testing, whereas the only significant difference in the case of the control group is within the plate-tapping test (t = 3.87, p = 0.03).

The study also highlights the fact that the effect of a recreational tennis program depends on its duration and the duration of a training session. Comparing the results of this research with those of a previous one (Şerban & Baciu, 2017), we find that the effect of the intervention program extends to several evaluated variables. We mention that the research methodology of the present study underwent several changes. These changes include the following: for the calculation of the VO2 max, the 2 km walk test was replaced by the 20 m shuttle run, the duration of the intervention was extended from 6 weeks to 4.5 months, the duration of the training lesson was 90 minutes instead of 60, other technical elements and techniques were involved.

Comparing the results of the significance tests of the mean differences of the two studies, we note that there were statistical significance changes only in the case of sit-and-reach (p = 0.02) and hand grip abilities (p = 0.01) (p = 0.04) within the 2017 study, whereas the present study registered statistical significance developments in the case of the bent-arm-hang test (p = 0.04), shuttle run (p = 0.003) and VO2max (p = 0.002). For means of other variables, there is no statistical significance.

As regards the control groups of the two studies, it can be noticed that there were no statistically significant changes in the mean of the measurements, except for the plate-tapping test of the current study (p = 0.003).

Table 5. Results of the statistical signification tests for mean differences

Variable	Previous study (2017)			Present study (2019)		
	p (U M -W)[a]	p (W,GC)[b]	p (W,GE)[c]	p (U M-W)[a]	p (W, GC)[b]	p (W,GE)
Flexibility (cm)	0.02	0.10	0.001	0.25	0.55	0.34
Balance (rep)	0.40	1.00	0.04	0.54	0.41	0.01
Plate-tapping (sec)	0.09	0.07	0.001	0.24	0.003	0.001
Vertical jump (cm)	0.26	0.28	0.19	0.79	0.11	0.06
Hand grip (kg)	0.01	0.11	0.003	0.04	0.84	0.003
Bent-arm-hang (sec)	n.a.	n.a.	n.a.	0.04	0.46	0.01
20m Shuttle-run-test (level)	n.a.	n.a.	n.a.	0.003	0.75	0.001
Relative VO_2 max (ml/kg/min)	0.46	0.18	0.43	0.002	0.96	0.001

[a] - Postintervention U Mann-Whitney Test for independent samples
[b] - Wilcoxon Test for paired saples in the CG
[c] - Wilcoxon Test for paired saples in the EG

Conclusions

The analysis of the results registered in the current study revealed the presence of some statistically significant changes in the physical fitness indices of the subjects in the experimental group: balance (p = 0.01), plate-tapping test

($p < 0.001$), vertical-jump ($p = 0.05$), hand grip test ($p < 0.01$), bent-arm-hung ($p = 0.001$), shuttle run ($p < 0.001$) and aerobic resistance ($p < 0.001$).Thus, the hypothesis that the participation of individuals which carried out a sedentary activity at their workplace at a tennis practice program improved their physical fitness indices was confirmed. However, at the end of the study we reach the conclusion that differences between the means of the variables measured in the two research groups are not significant for flexibility, balance, coordination and vertical-jump.

Several difficulties were encountered in the carrying out this study: the number of participants was reduced due to the particularities of tennis training- for a good density of activity, a coach can manage at the same time a maximum of 6 players on a field; the relatively late hours at which the intervention was held, with workers being forced to start workouts after the work schedule and to finish them more quickly in order to be able to rest for the next day; costs are not to be neglected, but if such programs are supported by both employers and employees, they should not represent a major difficulty.

Considering the mentioned facts, we can conclude that such programs are useful and should be implemented in as many companies and business units as possible and the study new methods of implementing and conducting such interventions is necessary.

BIBLIOGRAPHY

Arnaudo, B., Léonard, M., Sandret, N., Cavet, M., Coutrot, T., & Rivalin, R. (2012). L'évolution des risques professionnels dans le secteur privé entre 1994 et 2010 : premiers résultats de l'enquête SUMER DARES. 1-10.

Catalan-Matamoros, D., Gomez-Conesa, A., Stubbs, B., & Vancampfort, D. (2016). Exercise improves depressive symptoms in older adults: an umbrella review of systematic reviews and meta-analyses. *Psychiatry Res, 244*, 202-209.

Council of Europe. (1995). *Eurofit for Adults.* Bruxelles.

Fong, D. Y., Ho, J. W., & P, H. B. (2012). Physical activity for cancer survivors: meta-analysis of randomised controlled trials. *BMJ, 344*, 70.

Harari, G., Green, M. S., & Zelber-Sagi, S. (2015). Combined association of occupational and leisure-time physical activity with all-cause and coronary heart disease mortality among a cohort of men followed-up for 22 years. *Occup Environ Med, 72*, 617-624.

Helsel, D. L., Jakicic, J. M., & Otto, A. D. (2007). Comparison of techniques for self monitoring, eating and exercise behaviors on weight loss in a correspondence-based intervention. *J. Am. Diet. Assoc. 107*, 1807-1810.

Herman, C. W., Musich, S., Lu, C., Sill, S., Young, J. M., & Edington, D. E. (2006). Effectiveness of an incentive-based online physical activity intervention on employee health status. . *J. Occup. Environ. Med. 48(9)*, 889-895.

Holtermann, A., Marott, J. L., & Gyntelberg, F. (2016). Self-reported occupational physical activity and cardiorespiratory fitness: importance for cardiovascular disease and all-cause mortality. *Scand J Work Environ Health, 42*, 291-298.

Hupin, D., Roche, F., & Gremeaux, V. (2015). Even a low-dose of moderate-to-vigorous physical activity reduces mortality by 22 % in adults aged ≥ 60 years: a systematic review and meta-analysis. *Br J Sports Med*, 1262-1267.

Je, Y., Jeon, J. Y., Giovannucci, E. L., & Meyerhardt, J. A. (2013). Association between physical activity and mortality in colorectal cancer: a meta-analysis of prospective cohort studies. *Int J Cancer, 133*, 1905-1913.

Kelly, P., Kahlmeier, S., & Gotschi, T. (2014). Systematic review and meta-analysis of reduction in all-cause mortality from walking and cycling and shape of dose response relationship. *Int J Behav Nutr Phys Act, 11*, 132.

Keyes, C., & Grzywacz, J. G. (2005). Health as a complete state: The added value in work performance and health care costs. . *J. Occup. Environ. Med. 47(5)*, 523-532.

Lu, C., Schultz, A. B., Sill, S., Petersen, R., Young, J. M., & Edington, D. W. (2008). Effects of an incentive-based online physical activity intervention on health care costs. . *J. Occup. Environ. Med. 50(11)*, 1209-1215.

Ng, S. W., & Popkin, B. M. (2012). Time use and physical activity: a shift away from movement across the globe. *Obes Rev, 13*, 659-680.

Pate, R. R., & Buchner, D. M. (2014). *Implementing Physical Activity Strategies.* Champaign, IL: Human Kinetics.

Pluim B.M., J.B., Bonita, Marks l., Miller S., Miley D. (2007). Health benefits of tennis. *Br J Sports Med* 2007; 41:760–768. doi: 10.1136/bjsm.2006.034967

Pronk, N. P., Lowry, M., Kottke, T. E., Austin, E., Gallagher, J., & Katz, E. (2010). The association between optimal lifestyle adherence and short-term incidence of chronic conditions among employees. *Popul. Health Manag. 13(6)*, 289-195.

Şerban, R.-T., & Baciu, A. M. (2017). Effects of recreational tennis practice on information technology industry employees'fitness - a pilot study. *Studia Educatio Artis Gymnasticae*, 41-47.

Steffens, D., Maher, C. G., & S, P. L. (2016). Prevention of low back pain: a systematic review and meta-analysis. *JAMA Intern Med, 176*, 199-208.

Wen, C. P., & Wu, X. (2012). Stressing harms of physical inactivity to promote exercise. *Lancet, 380*, 192-193.

Wilmot, E. G., Edwardson, C. L., & Achana, F. A. (2012). Sedentary time in adults and the association with diabetes, cardiovascular disease and death: systematic review and meta-analysis. *Diabetologia, 55*, 2895-2905.