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CONTENT

Hamid Arazi, Seyedeh Shiva Dadvand, Mehnoush Tavakoli Fard NEUROTRANSMITTERS AND CARDIOVASCULAR RESPONSES TO AEROBIC AND RESISTANCE EXERCISE IN MEN ADDICTED TO METHAMPHETAMINE	2
Ram Manohar Basnet, Laxman Manohar Basnet ASSOCIATION OF PHYSICAL ACTIVITY AND ACADEMIC PERFORMANCE IN SCHOOLCHILDREN OF NEPAL	11
Julianna Bircher, Mark D. Griffiths, Krisztian Kasos, Zsolt Demetrovics, Attila Szabo EXERCISE ADDICTION AND PERSONALITY: A TWO-DECADE SYSTEMATIC REVIEW OF THE EMPIRICAL LITERATURE (1995–2016)	19
Alan Franjković, Bojan Matković, Dragan Milanović SITUATIONAL EFFICIENCY PARAMETERS OF SUCCESSFUL AND UNSUCCESSFUL ICE HOCKEY TEAMS AT IIHF WORLD CHAMPIONSHIP DIVISION I B	34
Alen Jerkunica, Toni Miljak, Majda Todorović ECONOMIC IMPACTS OF THE ORGANIZATION OF BIG SPORTS EVENTS BASED ON THE EXAMPLE OF THE EUROPEAN LASER SENIOR CHAMPIONSHIP 2014	41
Daiva Vizbaraitė, Raminta Morkūnaitė THE EFFECTS OF DIET, PHYSICAL ACTIVITY AND SOCIAL FACTORS ON STRESS PERCEIVED BY STUDENTS	49

Editorial Policy

BJSHS is an international quarterly peer-reviewed scientific journal that keeps sports and health professionals up to date with advances in the fields of sports science, health education and promotion and physical rehabilitation. The journal publishes research articles in the following areas: *Social Sciences* (Physical Education, Sports Coaching, Sports Pedagogy, Sports Psychology, Sports Sociology, Research Methods in Sports, Sports Management, Recreation and Tourism), *Biomedical and Health Sciences* (Coaching Science, Sports Physiology, Motor Control and Learning, Sports Biochemistry, Sports Medicine, Physiotherapy and Occupational Therapy, Physical Activity and Health, Sports Biomechanics, Adapted Physical Activity) and *Humanities* (Sports History, Sports Philosophy, Sports Law, Sports Terminology).

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NEUROTRANSMITTERS AND CARDIOVASCULAR RESPONSES TO AEROBIC AND RESISTANCE EXERCISE IN MEN ADDICTED TO METHAMPHETAMINE

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ABSTRACT

Background. This study aimed to examine serotonin, dopamine and cardiovascular responses to aerobic and resistance exercise in men addicted to methamphetamine during rehabilitation.

Methods. Subjects were 10 men addicted to methamphetamine with an average age of 31.2 ± 6.2 years old, height: 173 ± 5.6 cm, weight: 73.66 ± 12.5 kg. In the first session the subjects were acquainted with the environment. The variables measured at the second session were physical and physiological characteristics. In the third and fourth sessions, projects to ensure the effectiveness of the pilot were conducted. In the fifth and sixth sessions which were spaced 7 days apart, aerobic and resistance exercises were carried out. The variables which were measured before and after exercise programs included heart rate, blood pressure and circulatory levels of serotonin and dopamine.

Results. The increase in blood serotonin and dopamine levels after both aerobic and resistance exercise were significant ($p < .05$), but neither of the two aerobic and resistance exercise were superior to each other. In addition, decrease in systolic and diastolic blood pressure, heart rate, mean arterial pressure, pulse pressure and myocardial oxygen cost at some time intervals after these two exercises were significant ($p < .05$). However, there were no significant changes in comparison of exercises ($p > .05$).

Conclusions. Both of these exercises can be used as valuable support factors in treatment of addiction.

Keywords: physical activity, methamphetamine, neurotransmitter, blood pressure.

INTRODUCTION

Among various types of drugs, methamphetamine is a highly addictive stimulant and is widely abused. In 1893, for the first time synthesized methamphetamine was used to treat hyperactivity, narcolepsy, asthma and obesity (Varner, Ogden, Delcarpio, & Meleg-Smith, 2002; Zweben et al., 2004). Stimulants are substances that increase the activity of the central nervous system and generate increased heart rate and blood pressure. As a result, methamphetamine enhances awareness, creates a sense of confidence and energy, increases concentration and conscious behaviour. Chronic methamphetamine abuse reduces dopamine transport in the striatum and to a lesser extent in the frontal cortex of the consumers,

produces depletion of dopamine terminals in the brain (McCann et al., 2008). On the contrary, high doses of methamphetamine also cause depletion of serotonin terminals (Ricaurte, Schuster, & Seiden, 1980). In fact, psycho-stimulants not only inhibit the transmitters of dopamine and increase the release of dopamine (Seiden, Sabol, & Ricaurte 1993), but also inhibit serotonin reuptake and increase it in extracellular space of the cell (Andrews & Lucki, 2001). In a study, Thompson et al. (2004) compared the methamphetamine-dependent patients and healthy subjects and concluded that long-term use of methamphetamine damaged dopaminergic, serotonergic and metabolism systems of the brain. The results showed that the brains of its consumers

had structural anomalies. Based on the results reported by Harvey, Lacan, Tanius, & Melega, (2000), damage caused by drug use in dopaminergic system needs 12 to 17 months for recovery, and the time for serotonergic system is 6 months. A steady state concentration of norepinephrine in the brain of the rat race- Sprague after 8 weeks of interval training program was found by Brown and Van Huss (1973). The expanded findings were explored by checking norepinephrine and serotonin in three regions of the brain (cortex, cerebellum, and remainder of the brain cerebral) of sedentary female rats (Brown et al., 1979). Both norepinephrine and serotonin levels in many brain regions of trained rats were significantly higher. As Spirduso and Farrar (1981) showed, endurance activity in aging rats was weakened, and movement imitation was reduced. As it was shown, movement imitation was connected with the work of nigrostriatal dopamine, and it seems reasonable to suggest that regular physical exercise may directly or indirectly cause changes in the nigrostriatal dopamine. Many neurotransmitters such as dopamine, glutamate, acetylcholine, serotonin, GABA (gamma amino butyric acid) and endogenous opioids (Floresco, Blaha, Yang, & Phillips, 2001) play a role in the development of drug dependency and addiction. Methamphetamine consumption can create a variety of cardiovascular problems including increased heart rate, arrhythmia, hypertension and myocardial infarction (Varner et al., 2002). Addiction treatment was in terms of psychological aspects in the past, but later treatments were replaced by medical therapies (Wendt, 2002). Due to the limited studies on the effects of exercise on treatment and addiction, researchers conducted the current study. Treatment process along with conventional drug therapy, strengthening exercise on serotonin, dopamine levels as factors affected by addiction and, most importantly, the ambiguity in research on common sports activities to promote and protect health encouraged the researchers to investigate serotonin, dopamine and cardiovascular responses to aerobic and resistance exercise in men addicted to methamphetamine during rehabilitation.

METHODS

Participants. This study was a quasi-experimental study conducted on men addicted to methamphetamine at “Tarannom Ehyaye No” Institute in the city of Rasht. The subjects’ inclusion criteria to this study were a lack of

musculoskeletal lesions, no record of mental, cardiovascular, thyroid, gastrointestinal, diabetes, AIDS and hepatitis illnesses, no consumption of drugs and cigarettes, or a lack of physical activity in the past month. At the institute of addiction, people were under medical supervision, and they were selected according to the blood samples analysed and laboratory results checked by physicians. Ten addicted men with an average age of 31.2 ± 6.2 years, height 1.73 ± 0.56 m, weight 73.66 ± 12.5 kg, BMI 24.34 ± 3.03 kg/m² and VO_{2max} 30.77 ± 2.53 ml/kg/min were chosen purposefully. After administering a consent form and a questionnaire for stress management, participants took part in aerobic and resistance exercise program. In order to precisely control the daily diet of the subjects, the diet record form was used. Nutritional assessment was based on 24 hour recall questionnaire. Questionnaires were evaluated based on 3 days a week. It was found that in addition to the same diet, average daily calorie uptake including carbohydrate, fat and protein was not significantly different. Throughout the day, participants had the same type of meals. Validated food frequency questionnaire for nutrients and food groups was used in the same way as in previous studies. Participants also were recommended not to engage in any strenuous physical activity for 48 hours before the test and to avoid taking too much salt. In the first session the subjects were acquainted with the environment and the way to run the test. The variables measured at the second session were physical characteristics such as age, weight, height, body mass index, waist to hip ratio, body fat percentage and physiological variables such as muscular strength and endurance. In the third and fourth sessions, aiming to ensure the effectiveness of the type, duration and intensity of exercise and cardiorespiratory endurance test, the pilot studies were conducted. In the fifth and sixth sessions with an interval of 7 days between them, aerobic and resistance exercises were carried out. Similarly, before and immediately after the implementation of the exercise program, (aerobic and resistance) variables such as serotonin, dopamine, heart rate, blood pressure (systolic, diastolic) and myocardial oxygen were measured. Intervals of 15, 30, 45 and 60 minutes after the exercises were measured and recorded. The procedures were approved by the Institutional Ethics Review Committee of the University.

Procedure. The height of the subjects was measured using a stadiometer (made in Iran with an accuracy of one millimetre) and weight was measured using digital scales (Model Seca, South Korea, with a sensitivity of 0.1 kg). After measuring the height and weight of the subjects the Body Mass Index (BMI) was calculated by dividing weight (kg) by the square of height (m²). In order to determine the amount of body fat, subcutaneous fat in the areas of the chest, abdomen and thigh on the right side of the body was measured with callipers YAGAMI (model Eiyoken type, Japan), and it was calculated using Jackson and Pollock equation which is especially developed for men (Lohman et al., 1991).

Cardiorespiratory endurance test was conducted during one mile walking using a chronometer and pulse meter (Polar model, Finland). Subjects walked the distance at their desired speed. By measuring the time and their heart rate at the end of the determined distance, the maximum oxygen consumption was estimated (George et al., 1993) using the following formula:

$$VO_{2max} = 100.5 + (8.344 \times \text{sex}) - (0.1636 \times \text{Kg}) - (1.438 \times \text{time}) - (0.1928 \times \text{HR})$$

Notes. Gender: Male 0, Female 1; Weight = Kg; time = time for jogging a mile; HR = heart rate.

Blood pressure measurement was done using mercury sphygmomanometer and stethoscope (model ALPK2, Japan). In order to measure the subjects' heart rate *Beurer* Stethoscope (model PM80, Germany) was used. Following the measurement of resting systolic blood pressure, the heart rate of subjects, and the amount of myocardial oxygen expenditure was estimated using the following formula (Kenney et al., 2015):

$$\text{Myocardial oxygen expenditure} = 100 / (\text{HR} \times \text{SBP})$$

In addition, the mean arterial pressure was calculated using the following formula:

Mean arterial pressure = Diastolic pressure + 1.3 pulse pressure. To measure upper body muscular endurance, Swedish push-up was used and the number of correct moves in one minute was recorded. To determine the strength of the participants (in the movements) Brzycki formula was used (Brzycki, 1993):

$$1RM = \frac{\text{weight (kg)}}{1.0278 - 0.0278 \times \text{number of repetitions}}$$

Exercise protocols. Aerobic exercise protocol consisted of three phases: warm up, the main

part and the cool down for 45 minutes. Warm up involved jogging, stretching and flexibility in the upper and lower limbs for 10 minutes. During the main exercise, individuals ran two turns in 15 minutes with an intensity of 75-70% of maximum heart rate, resting at intervals of 3 to 4 in minutes between the stages. Finally, cooling down with stretching and flexibility exercises and relaxation was carried out for 5 minutes. Moreover, the maximum heart rate was calculated using the following formula (Tanaka et al., 2001):

$$\text{Maximum heart rate} = 208 - (0.7 \times \text{age of the subject})$$

Resistance exercise protocol within one week of aerobic protocol implementation consisted of three phases: warm up, the main part, and the cool down (about 45 minutes) in which warming-up and cooling-down phases of the exercises were similar to aerobic exercise phases. In the main part, individuals generally performed four exercises (bench press, leg extension, leg flexion, rowing). Two sets per exercise included 10 repetitions and rest intervals of 2-3 minutes. At the end, cooling activities like aerobic exercise were performed for 5 minutes.

Blood sampling. To determine the blood levels of serotonin and dopamine before and after aerobic and resistance exercise (with one *week break between the protocols*), blood was withdrawn. Following a 12 hours of fasting at night, 5 ml blood was taken from brachial vein of the subjects in the sitting position at 10 am in the presence of a specialist. The blood sampling was repeated immediately after the exercises and it was placed into dry sterile tubes and sent to the laboratory. The blood was centrifuged at 3000 RPM for 15 minutes. At this point to measure the variables, serum was separated from plasma and was frozen in -70°C temperature. In order to determine serotonin and dopamine of plasma, ELISA and kit LDN method (Germany), the coefficient of variation of dopamine intra assay 22.5 and inter assay 14.2; serotonin intra assay 9.7 and inter assay 10.4 and Device STAT FAX (Made in USA) were used.

Statistical analysis. Normality of the data was checked using the Kolmogorov-Smirnov normality test. A 2 x 6 factorial analysis of variance was conducted with repeated measures (Aerobic and Resistance protocols x blood pressure; and heart rate measurements before and immediately after exercise and at T15, T30, T45, and T60). Post-hoc multiple comparisons with correction of the

confidence interval were made using Bonferroni method. A 2 x 2 factorial analysis of Independent and Paired Sample *t* Test measures (Aerobic and Resistance protocols x blood levels of serotonin and dopamine measurements at before and after exercise programs) were performed. For data analysis, SPSS version 20 was used and significance level was set at $p < .05$.

RESULTS

Characteristics of subjects are shown in Table 1.

Table 1. The mean and standard deviation of the primary characteristics of subjects

Characteristics	Mean \pm SD
Age (years)	32.22 \pm 6.2
Weight (kg)	73.6 \pm 12.5
Height (cm)	173 \pm 5.6
BMI (kg/m ²)	24.3 \pm 3.06
Body fat (%)	25.01 \pm 4.7
Waist-to-hip ratio (WHR)	0.91 \pm 0.04
VO ₂ max (ml/kg/min)	30.77 \pm 2.53
Muscular endurance (')	21.8 \pm 4.3
1RM bench press (kg)	34 \pm 6.7

Note. SD – standard deviation; BMI – Body Mass Index; VO₂max – Maximal Oxygen Consumption, 1RM – One Repetition Maximum.

Serotonin and dopamine Table 2 shows the values of dopamine and serotonin before and after exercise. A significant increase in the levels of dopamine and serotonin was observed in both aerobic and resistance exercises ($p < .05$). The mean difference between the dopamine and serotonin before and after aerobic and resistance exercise was not significantly different ($p < .05$). Effect of both exercises on blood levels of serotonin and dopamine was the same. Considering these two mediators, none of the above mentioned exercises had much advantage over another.

Figure 1 demonstrates systolic and diastolic blood pressure and mean arterial pressure in time intervals before the exercise and immediately, 15, 30, 45 and 60 minutes after exercise. In aerobic exercise, systolic blood pressure after exercise and during 30 to 60 minutes of exercise had a significant difference compared to resting time ($p < .05$). On the contrary, systolic blood pressure did not demonstrate a significant difference 15 minutes after exercise ($p > .05$). Additionally, in resistance exercise there was a significant difference in systolic blood pressure immediately, 45 and 60 minutes after exercise to resting time ($p < .05$). However, in this type of exercise, 15 minutes after exercise there was no significant difference ($p > .05$). According to Figure 1, there was no significant difference between the effects of aerobic and resistance exercises on systolic pressure in different time phases ($p > .05$).

Figure 1 shows immediate significant change in diastolic blood pressure in phases and 60 minutes after aerobic exercise compared to the resting time ($p < .05$). In contrast, 15 to 45 minutes after aerobic exercise, there was no significant difference in diastolic pressure ($p > .05$). Furthermore, in resistance exercise, changes in diastolic pressure immediately after the exercise were significant ($p < .05$), nevertheless at time intervals of 15 to 60 minutes after the exercise, there was no significant change observed compared to the resting time. Also, between aerobic and resistance exercises, there was no significant change observed in diastolic pressure after exercise ($p > .05$). Mean arterial pressure showed significant changes during aerobic exercises and immediately after exercise. This occurred at 45 and 60 minutes, and during resistance exercise immediately and 60 minutes after exercise ($p < .05$). And vice versa, at 15, 30 and 45 time intervals after exercise there was no significant change observed. Also, changes were not significant ($p > .05$) in the mean arterial pressure of the groups.

Variable	Exercise	Before	After	<i>p</i>
Dopamine (pmg/ml)	aerobic	78.8 \pm 5.5	86 \pm 2.3	.147
	resistance	83.88 \pm 7.7	92.11 \pm 2.8	
Serotonin (ng/ml)	aerobic	63.5 \pm 17.5	384.11 \pm 80	.741
	resistance	86 \pm 16	449 \pm 42	

Table 2. Comparing the mean difference between the dopamine and serotonin before and after aerobic and resistance exercise

Note. *_ indicates a significant difference between the aerobic and resistance exercises at level of $p < .05$.

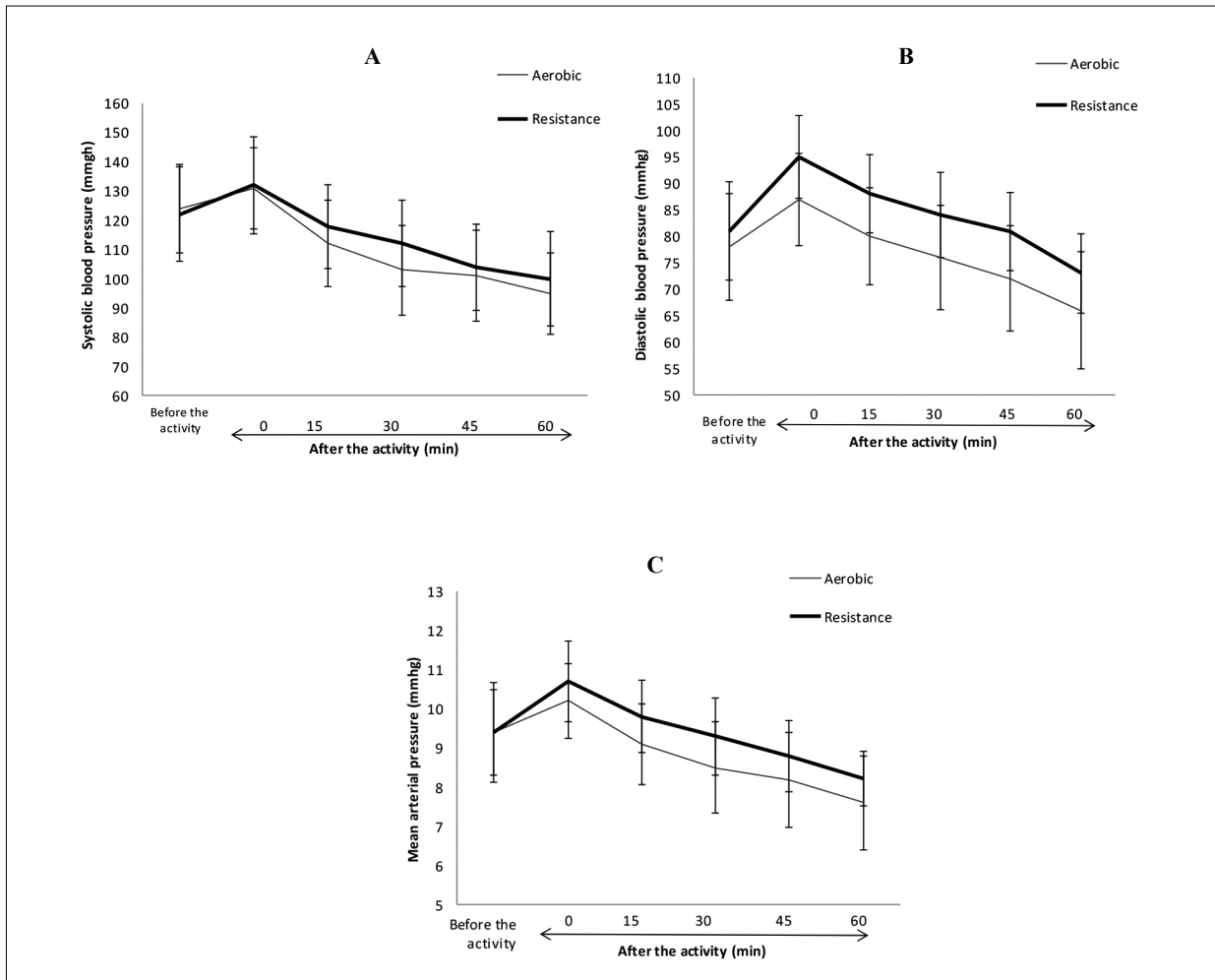


Figure 1. Changes in systolic blood pressure (A), diastolic (B) and mean arterial pressure (C) at intervals before, immediately, 15, 30, 45 and 60 min after aerobic and resistance exercise

Notes. # – Significantly different in comparison with pre- resistance exercise. * – Significantly different in comparison with pre- aerobic exercise.

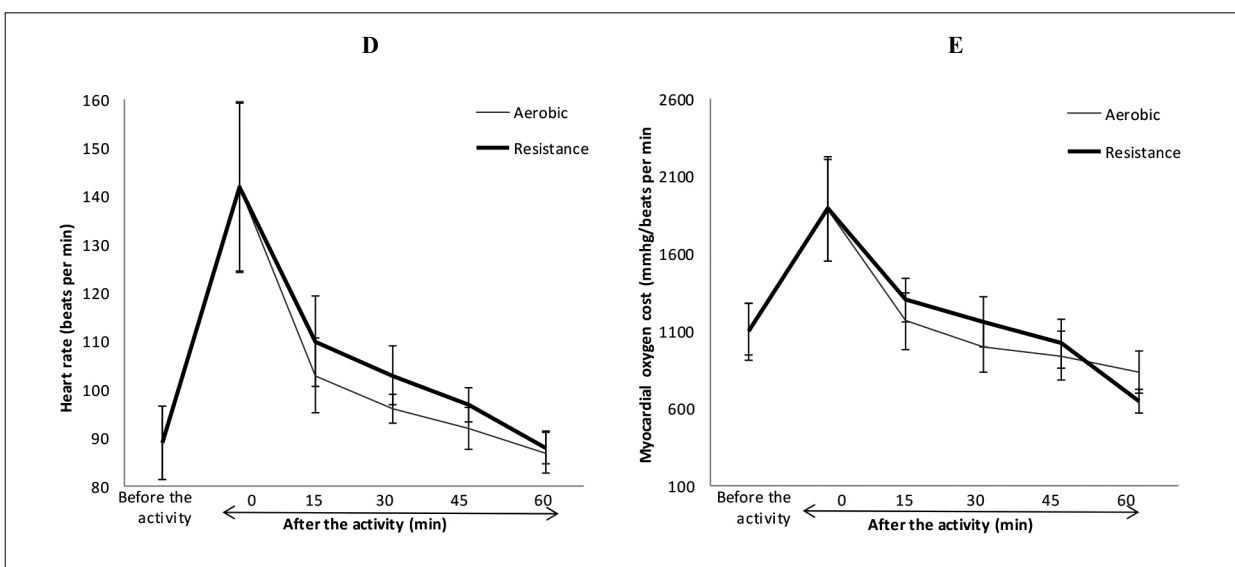


Figure 2. Changes in heart rate (D), and myocardial oxygen cost (E), at intervals before, immediately, 15, 30, 45 and 60 min after aerobic and resistance exercise

Notes. # – Significantly different in comparison with pre- resistance exercise. * – Significantly different in comparison with pre- aerobic exercise.

Heart rate. Figure 2 shows that changes in heart rate immediately after exercise to resting time in aerobic session were significant ($p < .05$), in addition, 15 to 60 minutes after exercise there was no significant change ($p > .05$). Heart rate changes in resistance exercise immediately and 15 minutes after exercise were significant, nevertheless at 30, 45 and 60 minutes after exercise, these changes were not significant ($p > .05$). Changes in the heart rate were not significant in aerobic and resistance exercise ($p > .05$).

Myocardial oxygen expenditure. According to Figure 2, changes in myocardial oxygen expenditure at time intervals immediately and 60 minutes after exercise were significant in aerobic exercise ($p < .05$). Changes in myocardial oxygen expenditure at time intervals immediately, 15 and 60 minutes after exercise were significant in resistance exercise ($p < .05$); nonetheless at other times there was no significant change ($p > .05$). Changes in the expenditure of oxygen consumption were not significant in aerobic and resistance exercise ($p > .05$).

DISCUSSION

The purpose of this study was to examine serotonin, dopamine and cardiovascular responses to aerobic and resistance exercise of men addicted to methamphetamine during rehabilitation. The findings suggest that aerobic and resistance exercise can cause a significant increase in blood levels of dopamine and serotonin with positive changes in the cardiovascular behaviour. In this regard, Mota et al. (2009) showed that eight weeks of aerobic and resistance exercise improved health and physical performance in men addicted to methamphetamine. Researchers stated that physical activity improved excitement, discomfort and symptoms related to methamphetamine through the effects of the endogenous opioid system and strengthening of the dopaminergic transmission. In addition, it was shown that exercise affected imaging techniques of the nervous system by effecting available receptors of D2/D3 in methamphetamine consumers who were in the process of quitting. The results of Goekint et al. (2012) showed that aerobic exercise increased the dopamine levels. Also Alberghina, Giannetto, & Piccione, (2010) and Langfort et al. (2006) suggested in their research that aerobic exercise could have a positive effect on serotonin level. Exercise resulted in the release of certain nerve messengers in the brain that diminish physical

and mental pain. Most research conducted in this area focused on running, however, all aerobic exercises had such benefits. It has been found that the effects on the brain are applied through several mechanisms, including neuro-genesis, increasing patients' mood and the release of endorphins. Evidence suggests that exercise can change the release of many neurotransmitters such as dopamine, glutamate, acetylcholine, serotonin and endogenous opiate in the brain (Joanna et al., 2011). Fontes-Ribeiro et al. (2011) pointed out that regular exercise had an overlap with drug abuse, therefore, the effect of exercise on the dopaminergic system, and dopamine changes was observed. The use of amphetamines causes lasting changes in brain reward system, accumbency area, and other areas in the brain. In addition, there is a relationship between dopamine and all behavioural aspects like physical activity. It has been proven that exercise increases the release of dopamine synthesis, neuroplasma stimulation, promoting health level and sense of well-being (Dey, Singh, & Dey, 1992). O'dell Galvez, Ball, and Marshall (2012) examined the effects of exercise in improving the damage of dopaminergic and serotonergic terminals in mice addicted to methamphetamine. It was stated in their report that repeating the moderate dose of methamphetamine decreased the dopaminergic and serotonergic terminals as well as their receptors and enzymes. It was suggested that due to increased dopamine and serotonin voluntary exercise could be used in improving the damage resulting from drug abuse as a non-drug therapy (O'dell et al., 2012). Unlike the results of the present study, Dwyer and Flynn (2002) found that short term aerobic exercise in young men would not change the central sensitivity of serotonin receptors. In this study, the subjects had a 30 minutes bike riding with 70% of their maximum aerobic capacity for 3 times. The results showed that no significant changes were found in the regional sensitivity of serotonin receptors. It seems that in this research, exercise movements were not enough to make changes. Also, the findings of Wang et al. (2000) showed that 30 minutes of intense exercise on a treadmill had no effect on the dopamine rate of men and women. It seems that the reason for this lack of effect is the training of the subjects. The rate of dopamine increase in trained subjects was lower. The results indicate that aerobic and resistance exercise lowered systolic and diastolic blood pressure, heart rate, mean arterial pressure and myocardial oxygen cost in men addicted to methamphetamine. Despite some inconsistencies in

the results of studies in blood pressure responses after exercise, most studies have shown that blood pressure is reduced after one session of resistance or acute resistance exercise to resting values before activity so that systolic blood pressure falls between 10 and 20 mmHg per minutes and after about 2 to 3 minutes returns to amounts before activity. However, it takes about 10 minutes for the regulation of normal blood pressure by homeostasis systems (Mohebbi, Rahmani-Nia, Vatani, & Faraji, 2010). Also, the study of Mota et al. (2009) showed that resistance and endurance activities reduce blood pressure, which is in consistent with the findings of the study. The subjects participated in two separate sessions of 20 minutes running on the treadmill at intensity rate of 70 to 80 percent of heart rate reserve and 20 minutes of circular resistance exercise with 40% of one repetition maximum. The results showed a decrease in systolic blood pressure after each activity (this reduction lasted longer after resistance exercise). Moreover, diastolic blood pressure reduction was observed only after resistance exercise and 30 minutes. The expenditure of myocardial oxygen after resistance exercise was higher than that of endurance activity due to more cardiovascular pressure compared to resistance exercise (Mota et al., 2009). The results of Dolezal et al. (2014) showed that physical activity improved the heart rate in those taking methamphetamine, which is in line with the results of this study. The researchers also suggest that physical activity may improve symptoms of cardiovascular disease and the effects of stress and help people manage stress in their life (Zweben et al., 2004). As one of the effects of endurance and resistance exercises, we can name cardiovascular responses which affect heart rate and heart rate variability (HRV). Studies have shown that exercise causes sinusoidal bradycardia in resting conditions in methamphetamine consumer groups and reduces the heart rate at submaximal oxygen consumption (Dolezal et al., 2014). Methamphetamine impact on catecholamines in the peripheral nervous system (such as noradrenaline and dopamine), also through its primary mechanism (heart rate and blood pressure) affects cardiovascular system (Karch & Drummer, 2001). Contrary to the findings of this study, the results of Jones, George, Edwards, and Atkinson (2007) showed that endurance exercise with 40 and 70 percent of maximal oxygen uptake has no significant effect on the hypotension. Also, Williams et al. (2007) showed that systolic, diastolic and mean blood pressure, heart rate, cardiac output, oxygen consumption and myocardial oxygen cost

are increased in response to resistance exercise. Studies have shown that at the beginning of resistance exercise, increase in stimulation of the sympathetic and parasympathetic activity and a decrease in plasma catecholamines transpire (Kenney et al., 2015). The increase in sympathetic activity can partially be related to the static resistance exercise and Valsalva manoeuvre conduction (Williams et al., 2007). During the created Valsalva manoeuvre, the rapid rise of pressure inside the aorta leads to a direct and immediate effect on arterial network which results in an increase in both systolic and diastolic blood pressure. Studies show that if the Valsalva manoeuvre is continued, the systolic and diastolic pressures reduce within seconds, which is due to the reduction in diastolic filling of the heart and its reason in turn is due to disorder in venous return (Mayo & Kravitz, 1999). What seems evident in the effects of aerobic and resistance exercise in blood pressure, heart rate and myocardial oxygen cost, is that 15 to 60 minutes after aerobic and resistance exercise a significant reduction in the factors of cardiovascular occurs. Therefore, we can say that the continuation of such exercises in form of regular exercises will create good health and benefits in consecutive periods in line with cardiovascular health promotion of patients during rehabilitation. But, there were limitations uncontrolled by researchers such as: a) effectiveness of individual differences and genetic factors on the result of the study was not controlled, b) managing the level of motivation to apply maximum effort in the implementation of the tests was not possible, c) level of stress and psychological conditions in the subjects during the test and measurements was rampant.

CONCLUSION

According to the results of the study it could be concluded that aerobic and resistance exercise can affect blood levels of serotonin and dopamine in men with addiction, also it can reduce the harmful effects of methamphetamine on cardiovascular behaviour and be beneficial as a non-drug treatment. Thus, both aerobic and resistance exercises can be a valuable aid in the treatment of addiction and improvement of the addicted men's situation.

Authors' Contributions. All the authors were involved in study conceptualization, design, quality control and interpretation of the results. Hamid Arazi directed the fieldwork and drafted the

manuscript. All the authors contributed to the final version of the manuscript.

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ASSOCIATION OF PHYSICAL ACTIVITY AND ACADEMIC PERFORMANCE IN SCHOOLCHILDREN OF NEPAL

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ABSTRACT

Background. There is growing interest in the association between physical activity (PA) and academic performance (AP) in children, especially in the developing world. However, no in-depth study of such kind has yet been undertaken in Nepal. Therefore, this study was carried out to determine if there is correlation between PA and AP in secondary schoolchildren in Nepal.

Methods. A cross-sectional study was carried in four schools of Nepal. Two schools (one private and one public) were randomly selected from two different districts. Physical activity and academic performance levels of students were obtained via questionnaires and Pearson's correlation was done to determine any association.

Results. Our study showed a significant correlation between physical activity and academic performance in the study population. The correlation was significant for male students, students from rural and urban areas and from public schools. However, there was no significant correlation in the female population and students of private schools. We also observed a significant difference in the physical activity performed by male versus female students (male > female), along with a significant difference in their academic performance (male > female). Further analysis of correlation on the basis of gender showed that physical activity of male students was significantly correlated with the academic performance irrespective of the location and type of school. However there was no such correlation in the female students.

Conclusion. Our study found that male students who were physically active showed positive correlation between physical activity and academic performance while no such correlation was found in the female students.

Keywords: physical activity, academic performance, schoolchildren, Nepal.

INTRODUCTION

The World Health Organization (WHO) defines physical activity (PA) as any bodily movement produced by skeletal muscles that requires energy expenditure (World Health Organization, 2017b). Highlighting the importance of PA in the prevention of non-communicable diseases, WHO has developed a recommendation strategy entitled "Global Recommendations on Physical Activity for Health", which addresses three age groups: 5–17 years old, 18–64 years old and 65 years old and above (World Health Organization, 2017a).

PA is vital in improving general circulation, increasing blood flow to the brain, as well as raising norepinephrine and endorphin levels.

These all play a role in reducing stress, improving mood, and inducing a calming effect, therefore it could be argued that PA is helpful in improving achievement. Adolescents that are physically active are less likely to attempt suicide and are more likely to adopt risk-taking behaviours that may have an association with better academic outcomes (Taras, 2005). Regular participation in sport activities also results in improved behaviour in the classroom and aids concentration required during academic lessons (Singh, Uijtewilligen, Twisk, van Mechelen, & Chinapaw, 2012).

Prior to 2005, limited studies were done analysing PA and its association with academic performance (AP) (Taras, 2005). However, after

2005, research in this domain gained significant momentum and currently extensive research has been done on this topic around the world. A recent study by Fox, Barr-Anderson, Neumark-Sztainer, and Wall (2010) found positive associations between PA involvement and AP among middle school and high school students, and further studies were recommended to understand the complex nature of this association. Singh et al. (2012) drew from their research and also found that participation in PA is positively related to AP in children, with similar results also found by various other studies (Booth et al., 2013; Correa-Burrows, Burrows, Ibaceta, Orellana, & Ivanovic, 2014; Janak et al., 2014; Stea & Torstveit, 2014). Some researchers have also studied the correlation between physical inactivity and academic achievements. A study by Shin and So (2012), analyzing the association between physical inactivity and academic record in Korean adolescents, concluded that Korean adolescents who spend more time engaged in physical inactivity are predisposed to a below average academic record.

However, not all studies have shown positive associations between PA and AP. Research done by LeBlanc et al. (2012) showed that increased PA did not result in significantly improved AP. Additionally, Esteban-Cornejo et al. (2014) found that PA might influence AP in both children and adolescents, but this association was in fact negative and very weak. Likewise, a study done in the United States found a positive association of PA and AP among females, while no such association was found among males (Carlson et al., 2008).

The purpose of our research was to determine if an association existed between PA and AP among secondary schoolchildren in Nepal. Nepal has four major topographical zones: the mountains, the hills, the valleys, and the terrain. This diversity in geography has given way to the creation of various cultures and social groups (Pokharel & Poudel, 2013). Additionally, this diversity, coupled with a weak economic resource base, as well as inefficient and poor mobilization of available resources, has created extreme social and economic inequalities (Sharma, 1989–1992), which can greatly impact the quality of education a child receives (Devkota & Bagale, 2015).

As of yet, no study has been undertaken in Nepal to understand if an association between PA and AP exists. Our research will therefore open academic discussions unique to this part of the world. We first aimed to understand the intensity of PA students partake in during school, after school and during

the weekends. Secondly, by comparing academic outcomes with the frequency that students perform PA, we aimed to identify if there was any significant relationship between PA and AP.

METHODS

Participants. A total of 419 school students were selected for the study, all aged between 12–16 years and studying in the 8th and 9th grade. Thirteen students were excluded due to incomplete and/or incorrectly filled responses, and therefore 406 students participated in the study. The schools were selected based on public/private and urban/rural areas. Four schools were selected, two each from two different districts: two schools (one government and one private) from the Kathmandu district (urban area) and two other schools (one government and one private) from the Dhading district (rural area). According to the United Nations Development Programme (UNDP), the human development index (HDI) of Kathmandu is 0.632 (> 0.550) and that of Dhading is 0.450–0.459, while the overall HDI of Nepal is 0.458 (United Nations Development Programme and National Planning Commission, 2014). Our chosen study areas included districts that have slightly lower and higher HDIs than the average national HDI of Nepal. 40.1% of the students were studying in rural area (Dhading) and the remaining 59.8% were studying in an urban area (Kathmandu).

Study Design. We conducted a cross-sectional study of Nepalese schoolchildren in 2014. For our study, we prepared a questionnaire (see supplementary information for full questionnaire) which consisted of two parts: the first part contained questions about the students' PA levels and the second part contained questions about AP. The first part of the questionnaire was adopted from Kowalski, Crooker, and Donen (2004). The second part of the questionnaire was cross-checked with the respective class teachers, after receiving the required permission from guardians and the respective schools. A formal consent was also obtained from the school administration of each participating school, prior to data collection, and only those students willing to volunteer in the study were included. Before handing out the questionnaires, students were first informed about the nature of the research.

Upon distributing the questionnaires, in order to avoid any confusion, all questions were orally explained to the students. The first part of the

Table 1. Part one: questions on physical activity levels in the past seven days

Questions	Answer options
In the last 7 days, during your physical education (PE) classes, how often were you very active (playing hard, running, jumping)?	a) We don't have PE; b) Hardly ever; c) Sometimes; d) Quite often; e) Always
In the last 7 days, what did you do most of the time at your spare time at school?	a) Sat down (talking, reading, doing schoolwork); b) Stood around or walked around; c) Ran or played a little bit; d) Ran around and played quite a bit; e) Ran and played hard most of the time
In the last 7 days, after school on how many times did you do sports, dance, or play games in which you were very active?	a) None; b) 1 time; c) 2 to 3 times; d) 4 to 5 times; e) 6 or more times
In the last 7 days, on how many evenings did you do sports, dance, or play games in which you were very active?	a) None; b) 1 time; c) 2 to 3 times; d) 4 to 5 times; e) 6 or more times
On the last weekend, how many times did you do sports, dance, or play games in which you were very active?	a) None; b) 1 time; c) 2 to 3 times; d) 4 to 5 times; e) 6 or more times

questionnaire was modified from the documents in the study by Kowalski et al. (2004). Five questions were used for evaluating the physical activity of a subject in the last seven days. Each question was close-ended and scaled in the Likert scale from the lowest to the highest level of PA. Each student was asked about the physical activity he/she performed during the period of last seven days (Table 1).

After obtaining the student responses, the PA level of each student was quantified, to obtain each student's PA score. For this reason, we assigned specific points to each option of the questionnaires. The lowest level of physical activity (option a) was assigned 20 points, following with 40 (option b), 60 (option c), 80 (option d) to a maximum of 100 points (option e). The PA score of each student was calculated after taking the mean of the cumulative scores obtained from the responses to these five questions.

The academic performance of the students was self-reported within the questionnaires. In order to assist with recalling their scores, students were given the option to report their AP in ranges: less than 50, 50–60, 60–70, 70–80, 80–90 and > 90%. Students were asked to report their AP of the year 2013, as the 2014 session was just starting during the research period. The overall academic score of the year 2013, along with scores in science, mathematics, and languages (English and Nepali) were also obtained for reference, although we did not consider the subject scores in science, mathematics and languages for this study. The AP reported from the students was then cross-checked with the help of their respective class teachers. Any incompletely and incorrectly filled questionnaires were excluded from the study. For data analysis purposes, AP less than 50% was scored as 1,

50–60% was scored as 2, 60–70% was scored as 3, 70–80% was scored as 4, 80–90% was scored as 5 and > 90% was scored as 6.

Statistical Analysis. Pearson's correlation analysis was used to study the correlation between PA and AP in the school children, using a number of variables such as gender, public/private, urban/rural. Two-tailed *t*-test was used to see if there were any significant differences in PA performed by male and female students and their AP. All data analyses were done using GraphPad Prism 5, La Jolla California USA. The alpha value for both the correlation and significance test was .05.

RESULTS

Our study found a significant association between physical activity and academic performance in the total study population ($r = .2158, p < .0001$). The association were significant for male students ($r = .296, p < .0001$), for students from rural areas ($r = .1877, p = .0164$) as well as for students from urban areas ($r = .2276, p = .0003$) and for students from public schools ($r = .3125, p < .0001$). However, there was no significant correlation between PA and AP found in the female population ($r = .1199, p = .0793$) and among students from private schools ($r = .1246, p = .1275$). Also, linear regression analysis showed that the line of goodness of fit obtained was significantly non-linear in the overall population ($r^2 = .0465, p < .0001$), in the male students ($r^2 = .0875, p < .0001$), rural students ($r^2 = .0352, p = .0161$) and urban students ($r^2 = .0518, p = .0003$) and students from public schools ($r^2 = .0976, p < .0001$). The results of the correlation analysis are tabulated in Table 2 and graphically shown in Figure 1.

Table 2. Correlation between physical activity (PA) and academic performance (AP) of overall population and different subgroups

	<i>r</i> -value	<i>p</i> -value	<i>r</i> ²	<i>p</i> -value
Overall (<i>n</i> = 406)	.2158	< .0001	.04658	< .0001
Female (<i>n</i> = 215)	.1199	.0793	.01438	.0793
Male (<i>n</i> = 191)	.296	< .0001	.08759	< .00001
Rural (<i>n</i> = 163)	.1877	.0164	.03524	.0161
Urban (<i>n</i> = 243)	.2276	.0003	.05181	.0003
Public (<i>n</i> = 255)	.3125	< .0001	.09764	< .0001
Private (<i>n</i> = 151)	.1246	.1275	.01552	.01275

Notes. *n* – number of sample size; *r* – correlation coefficient; *r*² – goodness of fit.

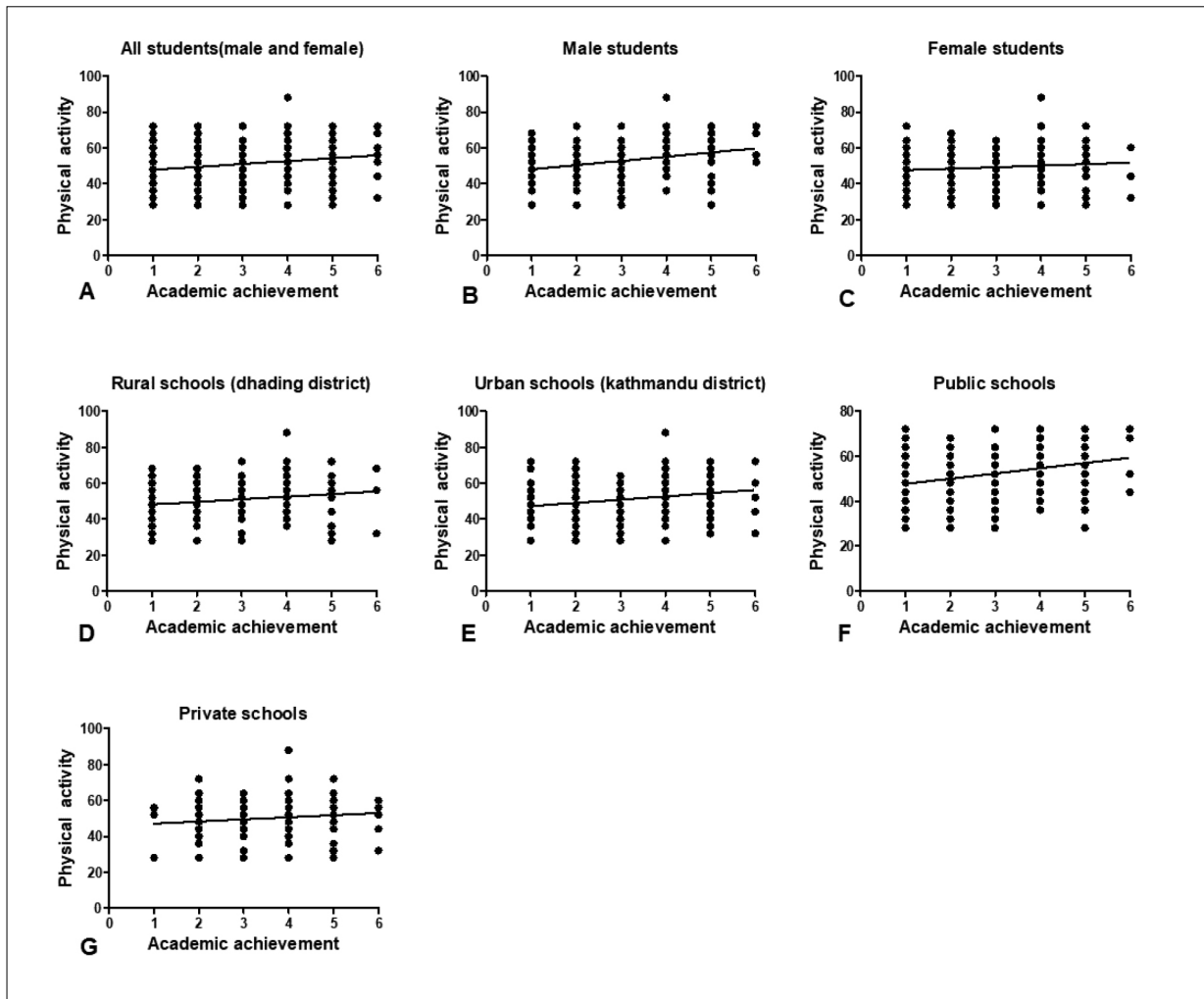


Figure 1. (A) Correlation between physical activity (PA) and academic performance (AP) in all school children; (B) male students; (C) female students; (D) rural school children; (E) urban school children; (F) public school; (G) private school

Note. PA – physical activity; AP – academic performance.

The average PA performed by males was 53.05 while that of females was 49.04, out of a maximum amount of 100 and a minimum of 20. Similarly, the average AP in males was 3.15 and in females was 2.84, with a maximum point of 6 and a minimum of 1 (Figure 2). We performed a significance test to see whether there was any significant difference between PA of males and females, as well as a significant

difference in their respective AP. Two tailed *t*-test showed that there was a significant difference in the PA levels of males and females ($p = .0001$) as well as a significant difference in their AP ($p = .02$)

As there was a significant difference in the PA and AP of the male and female students, we did a further statistical analysis and performed the correlation analysis on the gender basis. The

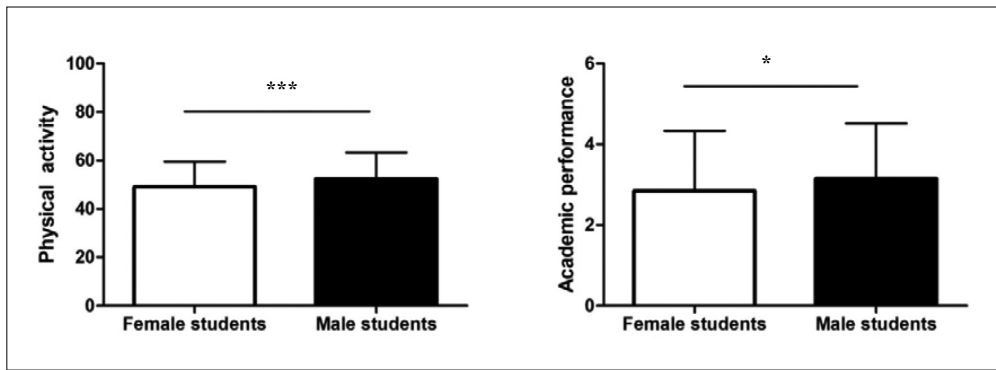


Figure 2. Left: physical activity performed by the female and male students. Right: academic achievement of female and male students. Asterisk indicates a significant difference between the male and female students (* $p \leq .05$, *** $p \leq .001$)

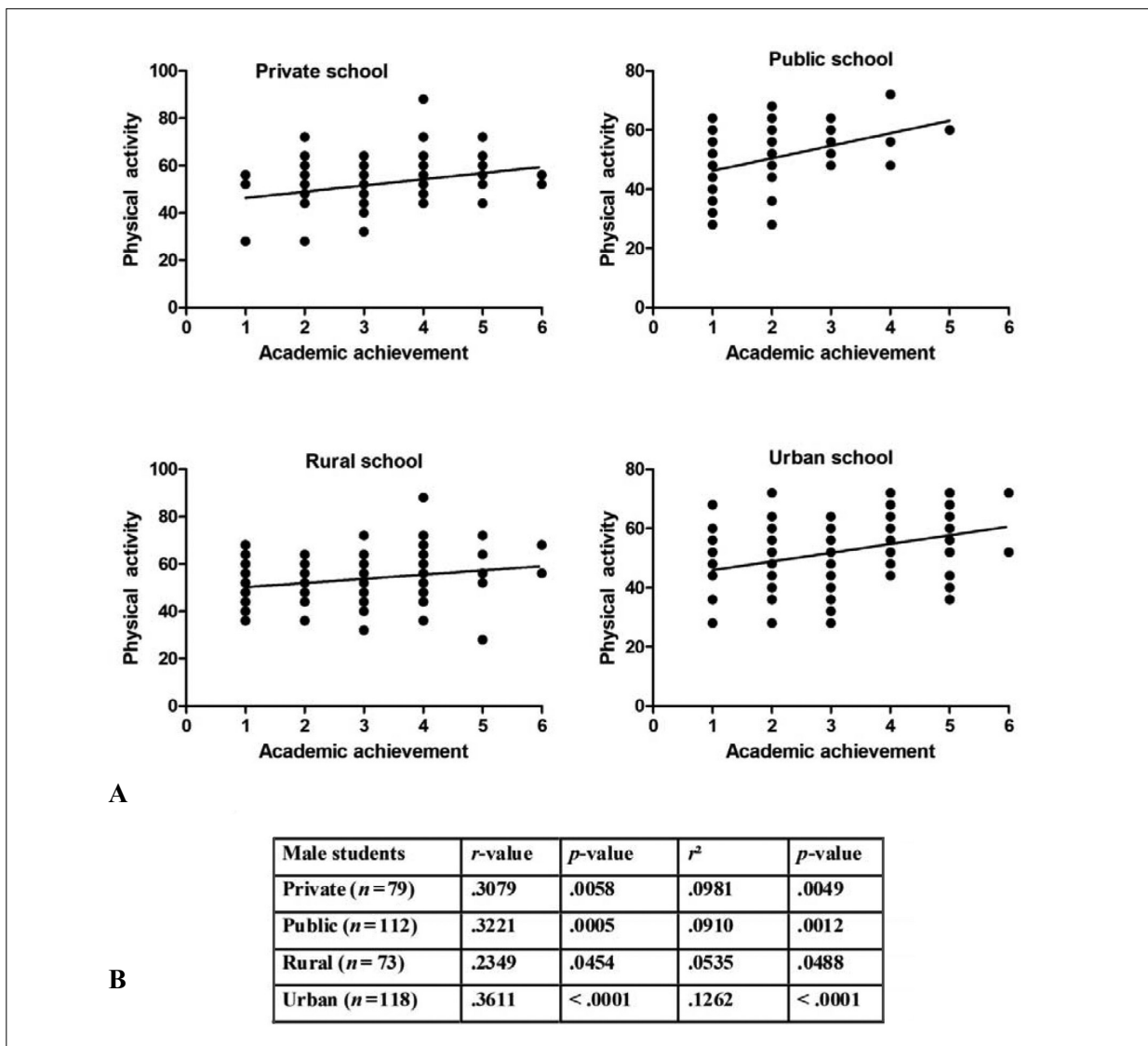


Figure 3. A-Correlation between physical activity (PA) and academic performance (AP) of male students in private, public, rural and urban Schools. B-corresponding table illustrating spearman correlation coefficient (r) and goodness of fit (r²)

Note. n – number of students.

correlation of PA and AP was obtained for the private, public, rural and urban school for each group of male and female students. We found that PA and AP correlated positively in the male

students irrespective of the type and location of school (Figure 3) whereas in case of female students there was significant correlation only in the female students of public schools (Figure 4).

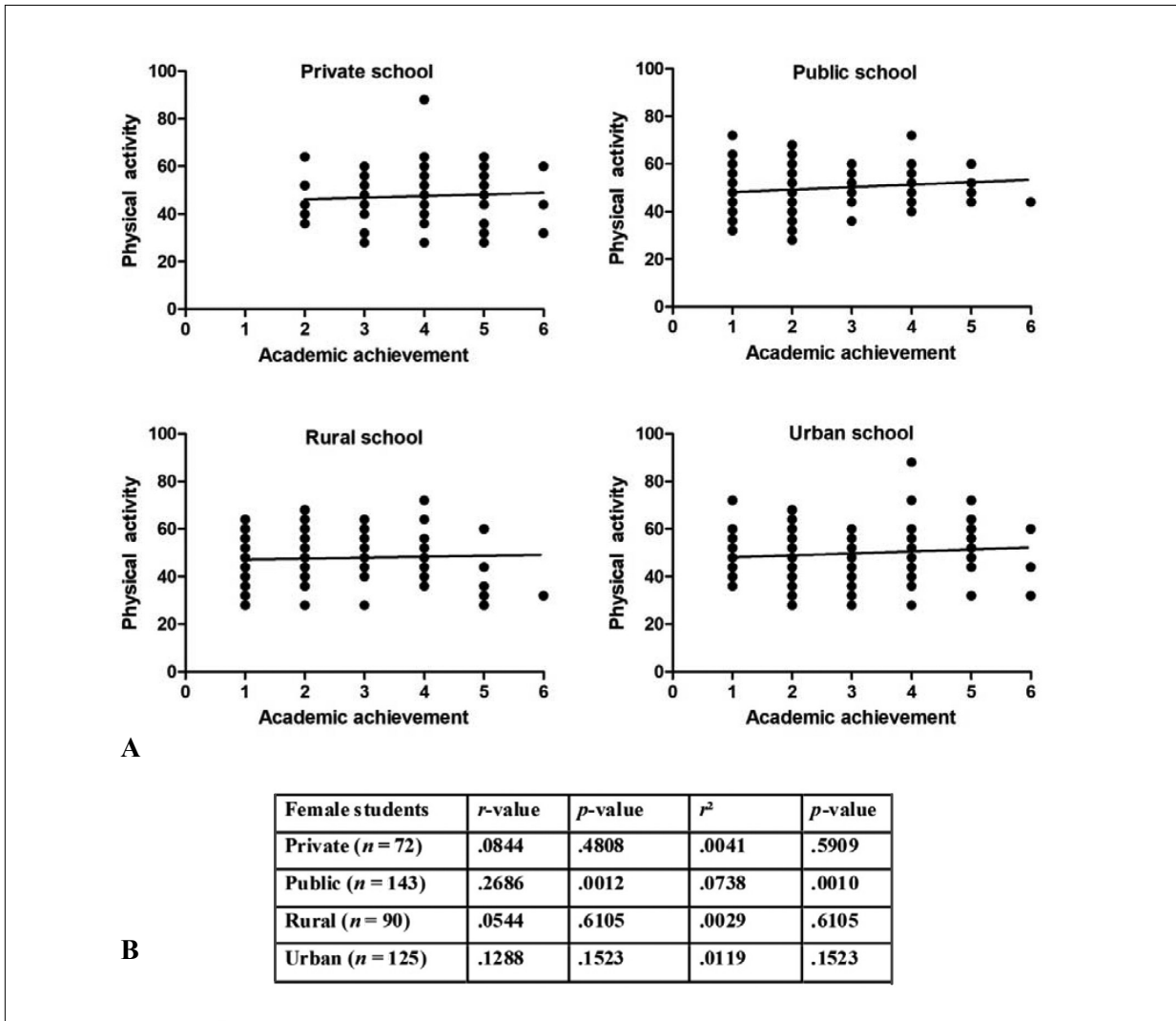


Figure 4. A-Correlation between physical activity (PA) and academic performance (AP) of female students in private, public, rural and urban Schools. B-corresponding table illustration spearman correlation coefficient (*r*) and goodness of fit (*r*²)

Note. *n* – number of students.

DISCUSSION

Increased physical activity has the potential to improve academic performance, as it increases the cognitive skills and academic behavior of students. It can also increase the concentration and attention, thereby improving classroom behavior (Centers for Disease Control and Prevention, 2010). Therefore, it can be postulated that PA has a positive influence on AP. This was re-enforced in the findings of our study, where we observed an association between PA and AP in school children aged 12–16 years, in two districts of Nepal. These results are supported by similar studies from various different cultures and countries which have also shown a positive association between AP and PA (Sardinha,

Marques, Martins, Palmeira, & Minderico, 2014; So, 2012; Van Dusen, Kelder, Kohl, Ranjit, & Perry, 2011). However, the academic performance and physical activity levels in our study population were associated in only some of the subgroups. There was a significant positive correlation between AP and PA among male students, students at public schools and students from both rural and urban areas.

However, analyzing the results through the gender lens, we found that PA of male students was positively correlated with AP irrespective of the location and type of schools. Whereas the PA of female students did not shown any correlation with AP. The non correlation between PA and AP

in the female students could partly be explained by the finding that the female students were engaged in lesser PA than their male counterpart. In fact, another study done in Nepalese students have also shown that female students were less engaged in PA compared to male students (Paudel et al., 2014). Therefore, less PA could be one of the reasons that PA was unrelated to AP in the female students. Also, we found that the AP of male students was significantly better than their female counterparts. These findings showed that male students who were involved in more PA had better AP than their female counterparts who were involved in less PA. Thus, our results showed a plausible evidence of the involvement of PA in the improvement of AP. However, no definitive causation was established by our study and different socioeconomic variables must be considered before implying any causality.

Overall, our results showed that male students who were involved in higher physical activity also had a better academic performance. However, our study didn't take into account the effects of socioeconomic variables and psychometric variables that might have influenced our results. Having said that, our findings support, encourage and highlight the important role that PA may play in the AP of students in Nepal.

CONCLUSIONS

Physical activity forms a significant part of modern day life, regardless of age and gender. It is

even more important for the well-being of the young population, not only for improving health, but also for ensuring an effective education. Our study found that females were physically less active than the males in the study population. Male students who were physically active than female students showed positive correlation between physical activity and academic performance, whereas no such correlation was seen in the female students. However, various socioeconomic variables need to be analyzed further before implying the causality.

Future Perspectives. This is the first study analyzing an association between physical activity levels and academic performance in Nepalese students. In Nepal, where studying is heavily prioritized over extracurricular activities, specifically sports, we hope that the results of this study will help open up a debate regarding the role and necessity of physical activity in school and students' overall academic performance.

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Conflicts of interest – The authors declare no conflict of interest.

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EXERCISE ADDICTION AND PERSONALITY: A TWO-DECADE SYSTEMATIC REVIEW OF THE EMPIRICAL LITERATURE (1995–2016)

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ABSTRACT

Background. It is largely unknown why among millions of exercisers a small proportion become addicted to the behaviour in a similar manner to other common addictions, such as alcohol addiction. Some scholars believe that specific personality characteristics may be involved in predisposing some individuals to exercise addiction.

Method. The objective of the current paper was to systematically review papers concerning exercise addiction over a two-decade period (1995–2016) and to establish the extent to which personality factors are related to the aetiology of exercise addiction.

Results. The results demonstrated that perfectionism and narcissism are associated with exercise addiction and that the association is stronger in the presence of obsessive-compulsiveness. It was also found that other factors (e.g., anger, hostility, anxiety, depression, and dysfunctional psychological regulation) appear to be associated with exercise addiction. In relation to the Big Five personality traits, it was found that exercise addiction could not be unequivocally associated with openness, extroversion, neuroticism, and conscientiousness. Furthermore, the diverse focus, methodologies, and samples on which the empirical research base relies make it difficult to develop a model accounting for the role of personality factors in exercise addiction.

Conclusion. The conclusion that can be drawn is that personality factors are clearly involved in exercise addiction, but the extent to which they exert their effects in the many different situations and stages of addiction requires further research using more robust methods and representative samples.

Keywords: athletes, exercise addiction, exercise dependence, physical activity, training, compulsive exercise, obligatory exercise, personality traits.

INTRODUCTION

In the addiction research field, study into behavioural addictions have received far less attention than substance addictions. However, over the past two decades, research into behavioural addictions has considerably grown, including that of exercise addiction. According to Glasser's (1976) conceptualization, exercise addiction is a positive addiction, but Morgan (1979) disagreed and determined exercise addiction to be a negative behavioural dysfunction. Exercise addiction is char-

acterized by obsessive and compulsive exercise behaviour which typically becomes exaggerated in volume and leads to negative personal and social consequences in the individual's life. Furthermore, it may trigger injuries, as well as a loss of control over exercise. Exercising at an appropriate or moderate level is healthy and recommended by health professionals. On the other hand, when a person uses exercise to escape from a psychological hardship, the behaviour may become pathological (Szabo, 2010).

In the literature, several different terms are used to describe problematic exercise behaviour, and the most popular is ‘exercise dependence’ (Cockerill & Riddington, 1996; Hausenblas & Downs, 2002a). In the present paper, the term ‘exercise addiction’ is used because it includes both compulsion and dependence (Berczik et al., 2012). Exercise addiction can be defined in its simplest terms as a behavioural process in which individuals gain pleasure or get relief from difficulties but it causes negative consequences for the individual and those around him/her. It is characterized by lack of control and maintenance despite continued negative consequences (Goodman, 1990), and described by some as comprising six main components: salience, mood modification, tolerance, withdrawal symptoms, personal conflict, and relapse (Brown, 1993; Griffiths, 2005; Szabo, 2010). Depending on its behavioural goal, exercise addiction can be classified as primary or secondary addiction. Primary exercise addiction refers to individuals that use exercise for mediating or moderating psychological distress (Szabo, 2010). Secondary exercise addiction refers to individuals who use exercise to maintain or reach an ideal body shape and/or weight and co-occurs with other comorbid psychological dysfunctions such as anorexia nervosa and bulimia nervosa (Bamber, Cockerill, & Carroll, 2000; Blaydon, Lindner, & Kerr, 2002; de Coverley Veale, 1987).

Many different research approaches exist for studying the onset, progression, and maintenance of exercise addiction. One important and relatively extensive approach focuses on personality characteristics. While the definition of personality is often debated in the literature, Allport (1937, 1961) described it as the dynamic organization of the psychophysical systems within individuals that determines their adaptation to the environment, its specific behaviour, and thinking. However, there are many further definitions of personality (Kazdin, 2000), but is beyond the remit of the present paper. In the following sections of this review, examining the extent of the association between personality and exercise addiction, personality is defined as specific persistent or long-term traits that characterize the exercising individual.

METHOD

From the perspective of exercise addiction, the review is limited to primary and/or the non-specified (undefined) version of exercise

addiction (excluding all research on secondary exercise addiction). However, studies were included if the research examined both forms of exercise addictions in relation to personality trait differences between the two types. Regarding inclusion criteria, all studies were excluded if they examined social, demographic, motivational, and/or appearance-related factors. Consequently, the present review concentrates on the primary and/or the non-specified version of exercise addiction, and its relationship with 16 different personality constructs. This includes the ‘Big Five’ traits (i.e., extraversion, conscientiousness, openness, emotional stability/neuroticism, and agreeableness), Temperament traits (persistence, novelty seeking, harm avoidance and reward dependence), Character traits (i.e., self-directedness, cooperativeness and self-transcendence), as well as the traits of perfectionism, narcissism, trait anxiety, and self-esteem.

The search was limited to empirically published refereed research papers in the English language between 1995 and 2016 and utilized four major databases: *SportDiscus*, *PubMed*, *Science Direct* and *Google Scholar*. The search terms used were: exercise dependence, exercise addiction, exercise abuse, obsessive exercise, compulsive exercise, excessive exercise, dance addiction, dance dependence, and dance abuse AND personality, trait(s), big five, extraversion, conscientiousness, openness, emotional stability/neuroticism, agreeableness, temperament, persistence, novelty seeking, harm avoidance, reward dependence, character, self-directedness, cooperativeness, self-transcendence, perfectionism, narcissism, anxiety, and self-esteem. Although the present review concentrates on primary exercise addiction, the type of addiction investigated in some studies was not clear, so these were included for evaluation. All studies specifically investigating secondary exercise addiction were excluded (although studies examining the state type or special type of anxiety [e.g. social physique anxiety] were included). Studies from non-peer reviewed outputs (e.g., book chapters, theses, etc.) were also excluded. Unfortunately, not all papers had full-text that could be accessed via the databases (or even after directly emailing the author). However, the few papers that did not have full texts had an abstract with sufficient information containing the study’s main aims, participant numbers, instruments used, and main findings. The Figure highlights in detail the search strategy.

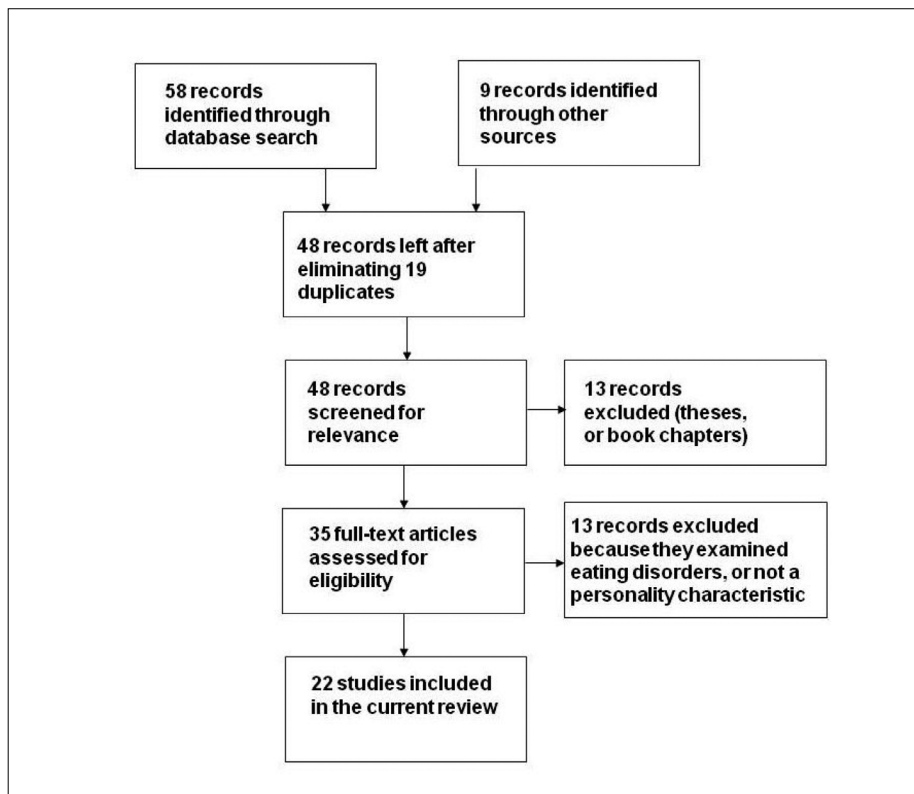


Figure. The process of selecting studies for review

RESULTS

Description of the Relevant Studies. A total of 22 studies, meeting the inclusion and exclusion criteria, were reviewed. Concerning the terminology used in describing problematic exercise, 15 studies termed the behaviour as ‘exercise dependence’, three studies termed it ‘exercise addiction’, two studies termed it ‘compulsive exercise’, and the remaining study termed it ‘obligatory exercise’ and ‘commitment to exercise’. The mean age of the populations varied between 18.9 years and 40.1 years. The frequency of exercise addiction shows great variability which may support the unstable nature of the concept and the fact that different kinds of populations are not at the same level of vulnerability and/or risk. In 14 studies, professional or amateur exerciser groups were examined or compared with non-exercisers, whereas the other eight studies comprised students as focus population or did not specify the sample recruited. The majority of the studies ($n = 20$) examined both sexes or were not specific about the gender of the participants, whereas the other two studies examined females only. The most frequently used instrument to assess the problematic behaviour was the Exercise Dependence Scale (EDS; Hausenblas & Downs, 2002b). Five of the studies utilized qualitative methodologies. Only one study

used a follow-up design. Six of the studies clearly investigated primary exercise addiction, whereas the remaining studies did not specify the type of exercise addiction, but did not examine eating disorders.

The Big Five traits and exercise addiction. As noted above, one of the most popular models in personality psychology is the Big Five (see Table 1). After many theories and changes, the final Big Five traits are extraversion, neuroticism, conscientiousness, openness to experience and agreeableness. It is generally agreed that extraversion refers to individuals being active, sociable and cheerful, while introversion refers to being reserved, solitary and sober. Neuroticism refers to an individual’s frequency of negative emotions, threatening interpretations, social withdrawal, and stress reaction to little frustration, while emotional stability is the positive opposite. Highly scrupulous individuals are goal-oriented, methodical and persevering, while non-conscientious individuals are unambitious, disorderly, and careless. Openness to experience refers to individuals being intellectual, imaginative, sensitive, and open-minded as well as being down-to-earth, intensive, and conventional. Finally, agreeableness refers to individuals who are good-natured, compliant,

Table 1. Summary of studies between 1995 and 2016 investigating the relationship between exercise addiction and Big Five factors

Authors (years)	Term used+ frequency*	Sample**	Objectives	Methods***	Outcomes****
1. Hausenblas & Giacobbi Jr. (2004)	Exercise dependence	N = 173 (170 ♀, 203 ♂) non-athlete university students, age = 21.81y	To examine the relationship of primary exercise dependence symptoms with personality	Exercise Dependence Scale (Hausenblas & Downs, 2002b), NEO Five Factor Inventory (Costa & McCrae, 1992)	+ extraversion, +neuroticism, +agreeableness, -conscientiousness, -openness
2. Costa & Oliva (2012)	Exercise dependence	N = 423 (207♀, 216 ♂) voluntary gym users, age = 35.68y (females), 34.27y (males)	To investigate the association between exercise dependence and personality traits (five-factor model)	Exercise Dependence Scale (Hausenblas & Downs, 2002b), Big Five Questionnaire (Caprara, Barbaranelli & Borgogni, 1993)	+extraversion, +neuroticism, +agreeableness, +conscientiousness, +openness
3. Mathers & Walker (1999)	Exercise addiction, 3.33% (but directly selected so many)	36 Australian university students: Group1: 12 low committed to exercise (8♀, 4♂, age = 19y), Group2: 12 high committed but not addicted to exercise (9♀, 3♂, age = 20y), Group3: 12 addicted to exercise (9♀,3♂, age = 22y)	To compare exercise dependent participants with frequently exercisers and non-exercisers in the level of extraversion	Negative Addiction Scale (Hailey & Bailey, 1982), Eysenck Personality Questionnaire (Eysenck & Eysenck, 1985)	-extraversion
4. Martin, Martens, Serrao & Rocha (2008)	Exercise dependence	N = 283 (142♀, 141 ♂) university students, age = 20.12y	To explore the co-occurrence of alcohol use and exercise dependence and whether personality characteristics are responsible for this relationship	Exercise Dependence Questionnaire (Ogden, Veale, & Summers, 1997), Ten Item Personality Inventory (Gosling, Rentfrow & Swann, 2003)	partial relationship (as mediators)
5. Kern (2010), abstract	Exercise dependence	N = 806 (337♀, 469♂) participants from university (208♀, 276♂, age = 21.24y) and sport centres (129♀, 193♂, age = 30.08y), age = 24.77y	To examine the relationship between exercise dependence and personality and if there is an addictive personality type	EDS-R (Exercise Dependence Scale (Hausenblas & Downs, 2002b; Kern, 2007)	-extraversion, +neuroticism, +agreeableness, +openness

Table Abbreviations (for all tables):

*Other terms are also used (see the other tables);

** Females: Males number, type of population, age = mean age, y = years;

*** given only measurements used to assess exercise addiction and personality;

****+ an association found, –no association found.

modest, gentle, and cooperative, while non-agreeable people are irritable, ruthless, suspicious, and inflexible (Matsumoto, 2009).

In the majority of the studies, exercise addiction is positively associated with extraversion (Costa & Oliva, 2012; Hausenblas & Giacobbi Jr., 2004).

For instance, Costa and Oliva (2012) specifically examined the different dimensions of exercise addiction in the context of personality traits and found that energy/extraversion positively related to tolerance, time spent engaging in the activity, and intention effects (i.e., exercising longer or more than intended; Hausenblas & Downs, 2002b). Mathers and Walker (1999) – who examined extraversion only – found no significant difference in the level of extraversion between addicted and non-addicted exercisers. Kern (2010) also found no relationship between exercise addiction and extraversion. Neuroticism was shown to have a positive association with exercise addiction by Hausenblas and Giacobbi Jr. (2004). In line with this, in the study by Costa and Oliva (2012) reported that emotional stability was negatively associated with exercise addiction and various addiction components (i.e., withdrawal, continuance, loss of control, and reductions in engaging in other activities). In both studies, agreeableness was negatively associated with exercise addiction. Costa and Oliva (2012) also reported a negative association with continuance, reductions in engaging in other activities, time spent exercising, and intention effects.

Hausenblas and Giacobbi Jr. (2004) reported that conscientiousness had no association with exercise addiction, whereas Costa and Oliva (2012) found that it was negatively related to continuance, loss of control, reductions in engaging in other activities, and total dependence score. Hausenblas and Giacobbi Jr. (2004) reported that openness also appeared to be independent of exercise addiction, while Costa and Oliva (2012) found an association between exercise addiction and intention effects. The strongest predictors of exercise addiction were the total scores on the Leisure-Time Exercise Questionnaire (Godin & Shepard, 1985) explaining 40.8% of variance, along with neuroticism, extraversion, and agreeableness explaining an additional 8% of variance (Hausenblas & Giacobbi Jr., 2004). Demographic variables have a small contributory role in predicting exercise addiction, explaining 3% of variance. More specifically, age and BMI negatively predicted exercise addiction, whereas gender was not a significant predictor. After entering personality traits into the model, extraversion positively predicted exercise addiction, whereas conscientiousness and emotional stability were negative predictors. Age was also a significant negative predictor (Costa & Oliva, 2012).

A study by Kern (2010) reported that the strongest explanatory traits of exercise addiction were openness to experience with emotional stability or with agreeableness. Kern also posited the existence of an addictive personality type. The findings of another study supported the co-occurrence of alcohol use and abuse with exercise addiction, even after controlling for demographic and personality variables (Martin, Martens, Serrao & Rocha, 2008). Personality traits were only partially responsible for this relationship. Consciousness was associated with alcohol use, and extraversion showed an association with multiple alcohol use. Overall, neuroticism was most frequently associated with exercise addiction. This association may mean that exercise is used as a way to cope with negative emotions. Only Costa and Oliva (2012) have reported an association between exercise addiction and the Big Five traits.

Temperament, character traits and exercise addiction. A psychological model for temperament and character was developed by Cloninger, Svrakic, and Przybeck (1993). The model comprised four temperament traits: (i) novelty seeking, (ii) reward dependence, (iii) harm avoidance, and (iv) persistence, and three character traits: (i) self-directedness, (ii) cooperativeness, and (iii) self-transcendence. According to this model, the four temperament traits are independently heritable and expressed in early life. These traits reflect a response style to novel stimuli, cues of reward and punishment, aversive stimuli, and monotony (Cloninger, 1987). In the self-directedness trait, the individual identifies the self as an autonomous individual. In cooperativeness, the self is identified as an integral part of humanity, while in self-transcendence, the self is identified as the integral part of the whole universe (Cloninger, Thomas, Przybeck, & Svrakic, 1994). In research by Grandi, Clementi, Guidi, Benassi, and Tossani (2011) participants with primary exercise addiction showed higher persistence and harm avoidance, but lower self-directedness. Persistence appears to be associated with exercise addiction, and harm avoidance may be mediated via other variables (e.g., health anxiety). For individuals with lower self-directedness, it may be more important what others think about them, and exercise may be a positive way to maintain a good body image (see Table 2).

Table 2. Summary of the one study between 1995 and 2016 investigating the relationship between exercise addiction and temperament and character factors

Authors (years)	Term + frequency *	Sample**	Objectives	Methods***	Outcomes****
1. Grandi, Clementi, Guidi, Benassi & Tossani (2011)	Exercise dependence 29.9% primary, 36.4% among all 107 participants	N = 79 (45♀, 34♂) habitual fitness club visitors, age = 30y	To assess personality and psychological distress associated with primary exercise dependence	Exercise Dependence Questionnaire (Ogden, Veale & Summers, 1997), Temperament and Character Inventory [Cloninger et al., 1994; Conti, 2002)	+persistence, +harm avoidance, -novelty seeking, -reward dependence, +self-directedness, -cooperativeness, -self-transcendence

Perfectionism and exercise addiction.

The most frequently explored trait in exercise addiction research is perfectionism (see Table 3). Perfectionism is the trait-based tendency to have extremely high expectations of the self or others, by attaining a goal as well (Matsumoto, 2009). Hagan and Hausenblas (2003), using the Exercise Dependence Scale, found that high scoring exercise dependent participants were more perfectionist compared to less addicted ones. The high exercise addiction group also showed more exercise addiction symptoms than low scoring subjects. In other studies, the different dimensions of perfectionism have been examined. Hall, Kerr, Kozub, and Finnie (2007) showed that a combination of goal orientation, perceived ability, concern about mistakes, and high personal standards explained 31% variance in obligatory exercise. In women, the combination of high ability with elements of perfectionism explained 49% of variance in exercise addiction, while in males, the combination of achievement related over-striving (i.e., high task and ego goals) and elements of perfectionism explained 27% of variance in exercise addiction. According to a study by Hall, Hill, Appleton, and Kozub (2009) self-oriented perfectionism directly and positively influences exercise addiction. Unconditional self-acceptance was a mediator of the relationship between socially prescribed perfectionism and exercise addiction, while labile self-esteem was a mediator between unconditional self-acceptance and exercise addiction. A higher proportion of explained variance emerged by females than males in unconditional self-acceptance (34% vs. 23%) and exercise addiction (43% vs. 19%). The path coefficients values from a self-oriented perfectionism to the unconditional self-acceptance were statistically significant only in females. Labile self-esteem was a full mediator of the association

between unconditional self-acceptance and exercise addiction in males, and a partial mediator in females.

In a study by Hill, Robson, and Stamp (2015), the same dimensions of perfectionism were investigated and similar results were found. The strongest predictor of exercise addiction was self-oriented perfectionism. A self-presentational style that was pessimistic in nature was positively related to exercise addiction. After controlling for trait perfectionism, perfectionist self-presentational styles accounted for additional variance in four exercise addiction symptoms (withdrawal, loss of control, reduction, and time spent engaging in the activity). Miller and Mesagno (2014) found that exercise addiction was directly linked to self-oriented perfectionism and to socially prescribed perfectionism. Narcissism and self-orientated perfectionism jointly predicted exercise addiction even more, explaining 31% of total variance. A moderate association emerged between exercise addiction and perfectionism in both men and women. The same study also revealed that exercise addiction showed a significant relationship with specific types of perfectionism, including self-oriented and socially prescribed perfectionism, but in women only.

According to Taranis and Meyer (2010), exercise addiction showed a positive association with the 'high personal standards' dimension of perfectionism. Significant positive correlations of self-criticism with avoidance and rule-driven behaviour, weight control exercise, and exercise rigidity were also reported. After accounting for the common variance with self-criticism, the link between high 'personal standards' dimension of perfectionism and compulsive exercise was no longer statistically significant. Costa, Coppolino, and Oliva (2016) examined different models. In the first model, a path from maladaptive perfectionism to exercise addiction emerged. In

Table 3. Summary of studies between 1995 and 2016 investigating the relationship between exercise addiction and perfectionism

Authors (years)	Term + frequency *	Sample**	Objectives	Methods***	Outcomes****
1. Hagan & Hausenblas (2003)	Exercise dependence, 50,63%	N = 79 (52♀, 27♂) university students from the USA, age = 21.78y	To examine the relationship of primary exercise-dependence symptoms with perfectionism and with exercise behaviour	Exercise Dependence Scale (Hausenblas & Downs, 2002b), Perfectionism Subscale from Eating Disorder Inventory – 2 (Garner, 1991)	+perfectionism
2. Hall, Kerr, Kozub & Finnie (2007)	Obligatory exercise	N = 246 (80♀:166♂) middle distance runners from England and Scotland, age = 34.6y	To explore the relationship between athletes' goal orientations, perfectionism, perceived ability and obligatory exercise behaviour	Obligatory Running Questionnaire (Blumenthal, O'Toole, & Chang, 1984; Pasman & Thompson, 1988), Frost Multidimensional Perfectionism Scale (Frost, Marten, Lahart & Rosenblate, 1990)	+perfectionism
3. Hall, Hill, Appleton & Kozub (2009)	Exercise dependence, 52%	N = 307 (109♀, 194♂ +4 non-respondents), middle-distance runners from recreational running clubs, age = 40.1y	To examine the psychological processes underlying the relationship between exercise dependence and perfectionism	Exercise Dependence Questionnaire (Ogden, Veale, & Summers, 1997), Multidimensional Perfectionism Scale (Hewitt & Flett, 1991)	+perfectionism, +self-oriented perfectionism, +self-esteem (as mediator), +perfectionistic self-presentational styles
4. Taranis & Meyer (2010)	Compulsive exercise	97 female exercisers from the UK, age = 21y	To explore the relationship between compulsive exercise and perfectionism dimensions (high personal standards and self-criticism), and to explore how much self-criticism accounts for the relationship of high personal standards and compulsive exercise	Compulsive Exercise Test (Taranis, Touyz, & Meyer, 2011), Frost Multidimensional Perfectionism Scale (Frost et al., 1990)	+perfectionism,
5. Miller & Mesagno (2014)	Exercise dependence	N = 90 (56♀, 34♂) regular exercisers, age = 27.41y	To examine the associations between exercise dependence, narcissism and perfectionism	Exercise Dependence Scale-Revised (Downs, Hausenblas, & Nigg, 2004), Multidimensional Perfectionism Scale (Hewitt & Flett, 1991), Narcissistic Personality Inventory (Raskin & Hall, 1979; Raskin & Terry, 1988)	+perfectionism, +self-oriented perfectionism, +socially prescribed perfectionism
6. Costa, Coppolino & Oliva (2016)	Exercise dependence, 9% AR, 68% NS, 23% NA	N = 169 (84♀, 85♂) regular adult exercisers, age = 22.76y	To explore the mediating role of basic psychological needs (Autonomy, Competence, and Relatedness) in the relationship of exercise dependence and maladaptive perfectionism, in the frame of the Self-Determination Theory	Exercise Dependence Scale-Revised (Downs et al., 2004), Frost Multidimensional Perfectionism Scale (Frost et al., 1990; Lombardo, 2008)	+maladaptive perfectionism,
7. Hill, Robson & Stamp (2015)	Exercise dependence, 9.5% AR*, 37.2% NS, 48.3% NA	N = 248 (102♀, 146♂) gym members, age = 25.74y	To investigate the relationship between exercise dependence symptoms, perfectionism and perfectionistic self-presentational styles	Exercise Dependence Scale-Revised (Downs et al., 2004), Multidimensional Perfectionism Scale (Cox, Enns, & Clara, 2002; Hewitt & Flett, 1991), Perfectionistic Self-presentational Styles (Hewitt et al., 2003)	+perfectionism, +perfectionistic self-presentational styles

Note. *AR = at risk, ND=nondependent-symptomatic, NS = nondependent-asymptomatic.

the second model, maladaptive perfectionism was inversely related to exercise addiction, emerging via the ‘needs satisfaction’ and ‘needs thwarting’. The link between maladaptive perfectionism and needs thwarting was positive, but not in the relationship between maladaptive perfectionism and needs satisfaction. Both needs satisfaction and needs thwarting positively related to exercise addiction. In a third model, after accounting for the basic psychological needs, and adding a direct path from maladaptive perfectionism to exercise addiction, the model had a less good fit index than the full mediation model. After entering needs satisfaction and needs thwarting into the model, the path between maladaptive perfectionism and exercise dependence became non-significant. The indirect impact of maladaptive perfectionism on exercise addiction through needs thwarting was statistically significant, but through needs satisfaction, it was not. Taken together, these findings suggest that perfectionism – particularly the self-oriented type – appears to be a key component in the development of exercise addiction symptoms. However, narcissism and self-esteem may modify this relationship.

Narcissism and exercise addiction. The concept of narcissism refers to extreme grandiosity

of self, and preoccupation with fantasies about success and power. Narcissistic people have an exaggerated sense of entitlement, and they approach others exploitatively (Matsumoto, 2009). Spano (2001) found that narcissism resulted in greater amount of physical activity, but not commitment to exercise. In another study, Bruno et al. (2014) found that participants with high risk for exercise addiction scored higher on self-esteem and narcissism when compared to participants with low risk for addiction. The most significant predictors of exercise frequency were: self-esteem, total narcissism, and three specific narcissism factors (i.e., authority, superiority, and exploitativeness), which explained 15.4% of the variance. Narcissism alone was a strong predictor of exercise frequency (explaining 7.9% and of variance), as well as narcissism and self-esteem together. A study by Miller and Mesagno (2014) demonstrated that exercise addiction had a positive relationship with narcissism. Its combination with self-orientated perfectionism was a predictor of higher exercise addiction scores, explaining 31% of total variance. Overall, research suggests that narcissism may be one of the key traits in exercise addiction, but its predictive value may be stronger in combination with other traits (see Table 4).

Table 4. Summary of studies between 1995 and 2016 investigating the relationship between exercise addiction and narcissism

Authors (years)	Term + frequency *	Sample**	Objectives	Methods***	Outcomes****
1. Spano (2001)	Commitment to exercise	N = 210 (142♀, 68♂) New York residents, age = 36.54y	To explore the association of commitment to exercise with trait anxiety, with obsessive-compulsiveness and with narcissism.	Commitment to Exercise Scale (Davis, Brewer, & Ratusny, 1993), State-Trait Anxiety Inventory (Spielberger, 1983), Obsessive-Compulsive Personality Scale (Lazarre, Klerman, & Armor, 1966, 1970), Narcissistic Personality Inventory (Raskin & Hall, 1979; Raskin & Terry, 1988)	+obsessive-compulsiveness, +trait anxiety, -narcissism
2. Bruno, Quattrone, Scimeca et al. (2014)	Exercise addiction, 42.5%	N = 120 (51♀, 69♂) consecutive gym goers, age = 31.14y (counted)	To examine the risk and possible factors of exercise addiction in fitness clubs	Exercise Addiction Inventory (Terry, Szabo & Griffiths, 2004), Narcissistic Personality Inventory (Raskin & Terry, 1988; Shulman & Ferguson, 1988), Coopersmith Self-esteem Inventory (Coopersmith, 1981)	+narcissism, +self-esteem
3. Miller & Mesagno (2014)	Exercise dependence	N = 90 (56♀, 34♂) regular exercisers, age = 27.41y	To examine the associations between exercise dependence, narcissism and perfectionism	Exercise Dependence Scale-Revised, Multidimensional Perfectionism Scale (Hewitt & Flett, 1991), Narcissistic Personality Inventory (Raskin & Hall, 1979; Raskin & Terry, 1988)	+perfectionism, +self-oriented perfectionism, +socially prescribed perfectionism

Self-esteem and exercise addiction. Self-esteem refers to how individuals evaluate their body, mental processes, history, and behaviour and what their attitude towards them and opinion about them (Matsumoto, 2009). Some of the aforementioned studies investigated self-esteem, but in the context as a mediator of other traits (Bruno et al, 2014; Hall et al., 2009). However, other studies have directly examined self-esteem and related traits. A study by Groves, Biscomb, Nevill, and Matheson (2008) found an association between self-esteem and exercise addiction, but the nature of this relationship differed across the universities where the participants were recruited. According to their additional interviews, symbolic interactionist identity theory might explain such differences. The origin of self-esteem is identity reinforcement. Exercise addiction was more strongly related to self-esteem in environments where identity was linked to sport and exercise.

A study by Banbery, Groves, and Biscomb (2012) found a relationship between exercise addiction and identity formation. Maintaining a healthy body image was the main factor in exercise behaviour, as the cessation of exercising meant they could not maintain their body image, meaning they could not get their expectations of the generalized others to confirm their identity. Béres, Czeglédi and Babusa (2013) found that body-mass index and the discrepancy between self and ideal self were the lowest in the 'at risk' (AR) group, and the highest in the 'non-dependent asymptomatic (NA) group, with the 'non-dependent symptomatic' (NS) group being in the middle. The AR and NS groups evaluated their bodies as better than the NA group. The AR group exercised most frequently, and the NA group the least. Again the NS group was in the middle. More frequent exercise and less discrepancy between self and ideal self were predictors of exercise addiction, while younger age showed only a tendency in predicting exercise addiction. The model explained 39.7% of variance. Research by Liptai-Menczel et al. (2014) showed that there were differences between exercise addiction categories in wellbeing and self-esteem. According to the scores on the Exercise Addiction Inventory (Terry, Szabo, Griffiths, 2004; Griffiths, Szabo, Terry, 2005), exercise addicts had more positive impressions in their life compared to the symptomatic group, while

on the Exercise Dependence Scale (Hagan & Hausenblas, 2003), asymptomatic participants had higher self-esteem than symptomatic participants. Age, frequency of sports engagement, and self-esteem were predictors of EDS scores. These results demonstrate that self-esteem is very important factor that needs to be considered among exercise addicts. It should also be obvious from the aforementioned studies that self-esteem is also a key mediator in the association between other traits and exercise addiction. When focus becomes the body in exercising, these findings are not surprising (see Table 5).

Trait anxiety and exercise addiction. Trait anxiety refers to the general fearfulness associated with high arousal level (Matsumoto, 2009). The majority of studies in the exercise addiction field have investigated state anxiety. The present review briefly focuses on trait anxiety as part of personality (see Table 6). In the study by Spano (2001), trait anxiety had a relationship with exercise addiction. Antunes, Andersen, Tufik, and De Mello (2006) reported that exercise addiction and moderate anxiety emerged in their sample of athletes, but they did not show any indication of mood disorders. Exercise addiction itself did not generate changes in mood or in quality of life. Furthermore, there were no differences between men and women in the level of anxiety, exercise addiction, and life quality. A study by Li, Nie, and Ren (2015) showed that their exercise dependent group had a higher level of depression and state anxiety than a non-exercise dependent group, but they were not different in the level of trait anxiety. Exercise dependent participants scored lower on self-satisfaction, social behaviour, and energy in the context of wellbeing, and they also scored higher in negative mood than non-exercise dependent subjects. Groups did not differ in life satisfaction, positive mood, family satisfaction, or interpersonal relationships. Using structural equation modelling, exercise addiction had a positive influence on state anxiety, depression, and negative mood, but negatively affected self-satisfaction, social behaviour, and energy.

Weinstein, Mayan, and Weinstein (2015) found that after comparing different levels of exercise, the recreational exercising group showed the signs of mild depression, while the professional exercising group showed severe symptoms of depression. The average trait anxiety score was higher in the examined

Table 5. Summary of studies between 1995 and 2016 investigating the relationship between exercise addiction and self-esteem

Authors (years)	Term + frequency *	Sample**	Objectives	Methods***	Outcomes****
1. Groves, Biscomb, Nevill & Matheson (2008)	Exercise dependence	quantitative data 3-times: 260 (1.) → 123 (3.) students from 3 universities in the UK (age1 = 18.90y, age2 = 19.70y, age3 = 21.47y), qualitative data: 2:2 students per universities	To examine the relationship of exercise dependence with self-esteem and identity reinforcement among three universities in the UK.	Exercise Dependence Questionnaire (Ogden, Veale, & Summers, 1997), Rosenberg Self-esteem Scale (Rosenberg, 1965), semi-structured interview	+self-esteem
2. Banbery, Groves & Biscomb (2012)	Exercise dependence	2♀, 8♂ participants from 3 universities	To investigate the association between exercise dependence and identity reinforcement in a gym-based environment in the UK	Semi-structured in-depth interview	+identity formation
3. Béres, Czeglédi & Babusa (2013)	Exercise addiction, 6.7% *AR, 62.4% NS, 30.9% NA	1231 fitness exerciser females, age = 31.3y	To examine the correlates of exercise addiction and the psychometric characteristic of the Hungarian version of Body Appreciation Scale in a sample of fitness centre user females	Exercise Addiction Inventory (Demetrovics & Kurimay, 2008; Terry, Szabo, & Griffiths, 2004), Body Appreciation Scale (Avalos, Tylka, & Wood-Barcalow, 2005)	+discrepancy between self and self-ideal
4. Liptai-Menczel et al. (2014)	exercise dependence, 2.2% (EDS)**, 7% (EAI), + 69.3% (EDS), 76.5% (EAI) ED-related symptoms	1021♀, 722♂ (eating disordered participants were removed) → 786♀, 653♂ fitness centre users from Hungary, age = 31.7y	To examine the prevalence of exercise dependence among Hungarian fitness centre users.	Exercise Dependence Scale – 21 (Downs et al., 2004; Hausenblas & Downs, 2002b), Exercise Addiction Inventory (Demetrovics & Kurimay, 2008; Terry, Szabo, & Griffiths, 2004), Rosenberg Self-esteem Scale (Rosenberg, 1965)	+self-esteem

Note. *AR = at risk, ND = nondependent-symptomatic, NS = nondependent-asymptomatic; **EDS = Exercise Dependence Scale, EAI = Exercise Addiction Inventory.

sample compared to the North American norms. Depression and trait anxiety positively correlated among the whole sample. Compulsive exercise was positively related to depression and to trait anxiety among those who regularly exercised. In the recreational group, compulsive exercising had a positive association with depression, while in the professional exercising group, compulsive exercise had a positive correlation with depression

and trait anxiety. The professional group displayed more compulsive exercise and depression than the recreational group, but in trait anxiety, there was no difference between the groups. According to the results of these studies, anxiety may have a relationship with exercise addiction. However, the findings are sometimes inconsistent regarding the type of anxiety (state or trait). It is possible that individuals' actual anxiety levels also affect the results of the trait scale.

Table 6. Summary of studies between 1995 and 2016 investigating the relationship between exercise addiction and trait anxiety

Authors (years)	Term + frequency *	Sample**	Objectives	Methods***	Outcomes****
1. Spano (2001)	Commitment to exercise	142♀, 68♂ New York residents, age = 36.54y	To explore the association of commitment to exercise with trait anxiety, with obsessive-compulsiveness and with narcissism.	Commitment to Exercise Scale (Davis et al., 1993), State-Trait Anxiety Inventory (Spielberger, 1983), Obsessive-Compulsive Personality Scale (Lazarre et al., 1966, 1970), Narcissistic Personality Inventory (Raskin & Hall, 1979; Raskin & Terry, 1988)	+obsessive-compulsiveness, +trait anxiety, -narcissism
2. Antunes, Andersen, Tufik & De Mello (2006)	Physical exercise dependence	6♀, 11♂ adventure race athletes, age = 31.11y	To investigate exercise dependence, quality of life, and mood indicators among adventure race athletes	Exercise Dependence Scale based on Negative Addiction Scale (Hailey & Bailey, 1982, Rosa, Mello, & Souza-Formigoni, 2003), State-Trait Anxiety Inventory (Andreatini & Seabra, 1993; Spielberger, Gorsuch & Lushene, 1970)	+moderate anxiety
3. Li, Nie & Ren (2015)	Exercise dependence, 11.3%	617 ♀ 984♂ Chinese students, age = 20.5y	To examine the psychological effects of exercise dependence in a Chinese college student population	Exercise Addiction Inventory (Terry, Szabo, & Griffiths., 2004), State-Trait Anxiety Inventory (Spielberger, 1966)	+state anxiety, -trait anxiety, +depression, subjective well-being: +self-satisfaction, +social behaviour, +energy, +negative mood, -life satisfaction, -positive mood, -family satisfaction, -interpersonal relationship
4. Weinstein, Maayan & Weinstein (2015)	Compulsive exercise	32♀:39♂ recreational (51) and professional (20) exercisers, } age = 30y	To examine the association between compulsive exercise and depression and anxiety	Compulsive Exercise Scale (Tuttle, 1992), State-Trait Anxiety Inventory (Spielberger, 1983)	regularly exercisers: +trait anxiety, +depression, recreational exercisers: +depression, -trait anxiety, professional exercisers: +trait anxiety, +depression

DISCUSSION

The present review attempted to examine the extent to which an exercise addiction prone personality exists based on the empirical research carried out over a two-decade period. Taking the 22 studies as a whole, it is difficult to define a specific personality profile, but there is convergence among some studies. There is some consistency among studies examining exercise addiction and the Big Five traits. Extraversion appears to show a positive relationship with exercising (Mathers & Walker,

1999) and with exercise addiction (Costa & Oliva, 2012), but other studies show no such association (Hausenblas & Giacobbi Jr., 2004; Kern, 2010). Higher neuroticism appears to be related to exercise addiction (Costa & Oliva, 2012), although one study found no association (Hausenblas & Giacobbi Jr., 2004). Being less agreeable and conscientiousness also appears to be associated with exercise addiction (Costa & Oliva, 2012), although Hausenblas and Giacobbi Jr. (2004) found no relationship with

conscientiousness. An association was reported between exercise addiction and openness by Costa and Oliva (2012), but other studies have found no relationship (Hausenblas & Giacobbi Jr., 2004).

Personality factors may also influence the relationship between at least two different types of addiction (i.e., alcohol use and exercise addiction; Martin et al., 2008). In relation to Cloninger's traits, exercise addiction was associated with higher persistence and harm-avoidance, and with lower self-directedness and maturity (Grandi et al., 2011). Perfectionism appears to be positively associated with exercise addiction (Hagan & Hausenblas, 2003; Hall et al., 2007), mainly self-oriented perfectionism (Hall et al., 2009) or the maladaptive type of perfectionism (Costa, et al 2016). However, it is also important to take into consideration the role of self-esteem (Bruno et al., 2014; Hill et al., 2015) and self-criticism (Taranis & Meyer, 2010). Narcissism also has an association with higher physical activity (Spano, 2001) and exercise addiction (Bruno et al., 2014).

The obsessive tendencies in the personality of an exercise addict individual are obvious (Spano, 2001). The combination of narcissism with perfectionism and with obsessive-compulsiveness may be strong determinants in the onset and progression of exercise addiction (Miller & Mesagno, 2014). Because exercise is a behaviour that can improve an individual's body image, self-esteem can undoubtedly be associated with exercise addiction directly or be associated with another self-related concept (Banbery et al., 2012; Béres et al., 2013; Groves et al., 2008; Liptai-Menczel et al., 2014) or be influential as a mediator or moderator (Bruno et al., 2014; Hall et al., 2009). Self-esteem is a main feature of personality, and might have an association with almost every personality trait. As a consequence, the association between self-esteem and exercise addiction is very complex.

Many people exercise to improve mood. Several studies have investigated the association between exercise addiction and anxiety, but only few have examined trait anxiety. Most of these few studies found a positive relationship between exercise addiction and trait anxiety (Antunes et al., 2006; Spano, 2001; Weinstein et al., 2015), while others have only associated exercise addiction with state anxiety (Li et al., 2015).

CONCLUSION

There are specific limitations to the present review. Relatively few studies met the inclusion and exclusion criteria and so the empirical base used to conduct an examination of these traits was small. Even among the studies themselves, there was wide divergence in sample sizes, the representativeness of the sample, and the methodologies employed. Further research needed to systematically investigate each trait using more representative samples and more robust methodologies (such as utilizing longitudinal studies). Studies where more traits were investigated simultaneously found that the combination of traits explains a greater amount of variance than when examined separately. Personality and addiction are such complex constructs that it would be the best to examine such relationships from as many perspectives (both theoretical and methodological) as it is possible. There may well be a set of predisposing personality variables but at present, we cannot draw a specific profile of an exercise addict's personality.

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Conflicts of Interest. None to declare.

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SITUATIONAL EFFICIENCY PARAMETERS OF SUCCESSFUL AND UNSUCCESSFUL ICE HOCKEY TEAMS AT IIHF WORLD CHAMPIONSHIP DIVISION I B

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ABSTRACT

Background. Performance indicators, which consist of a selection or combination of action variables, can be used to define performance in invasion games. These performance indicators should relate to successful performance. The same principles of match analysis can be used in all invasive games, and typical performance indicators can also be easily translated from one sport to another. The purpose of this study was to determine differences in situational efficiency parameters that differentiate ice hockey teams according to outcome. Sample of entities consisted of 15 games played on IIHF World Championship Division I B.

Methods. Situational efficiency variables that affected final outcome were comprised of 11 parameters. Differences between successful and unsuccessful teams were detected using Mann-Whitney *U*-test for nonparametric variables. Significant value was set at $p \leq .05$.

Results. Results showed overall statistical differences in situational parameters between winner and defeated teams. The best variables that differed teams were assists and shots on goal ($Z = 3.94$, $p > .000$ and $Z = -3.40$, $p > .001$), while on the other hand saves by goalie ($Z = 3.26$, $p > .001$) represented defeated teams.

Conclusion. On the basis of obtained results we suggest that winning teams had greater team play which leads to better passing play and shooting on goal.

Keywords: team sport, notational analysis, final outcome.

INTRODUCTION

Ice hockey is very intense, intermittent and the fastest team sport that requires a wide variety of motor skills as well as high level of fitness to compete at elite level (Quinney, 2005). By the games classification, Read and Edwards (1992) introduced three game categories: net and wall games, invasion games and striking/fielding games. The invasive games can further be divided into goal throwing, try scoring and goal striking games. As well as soccer, ice hockey is a typical goal striking game, too. Performance indicators, which consist of a selection or combination of action variables, can be used to define performance in invasion games. These performance indicators should relate to successful performance. The same principles of match analysis can be used in all invasive

games, and typical performance indicators can also be easily translated from one sport to another. Based on previous research, some factors, such as passing, tackling, shots, goals, time in possession, field position, set pieces contributing to success or improved performance in invasive games, can be introduced. (Huhhes & Bartlett, 2002).

Within the game, players' quality, teamwork and tactics primary determine the team's efficiency and competitive success (Trninić et al., 2000). By analyzing situational efficiency indicators it is possible to derive model values of team efficiency and individual player performance in defense and offense, as well as a comparison of players and teams, which is important for more efficient programming of the preparation process (Milanović, 1997).

Situational parameters become one of the most important and objective factors determining overall efficiency in the game, especially in team sports. Hunter and O'Donoghue (2001) compared successful and unsuccessful rugby teams in 1999 World Cup. Their study found two of eleven variables related to winning teams.

In his research, Thomas (2006) analysed the Harvard ice hockey team and made the argument that hockey could be described as a continuous time semi-Markov process. Thomas separated the game of ice hockey into 19 distinct states including: offensive team with the puck in defensive zone, defensive team with the puck in the offensive zone, faceoff at center ice, defensive takeaway, among others.

Moskowitz and Wertheim (2012) disagreed with that statement. They studied multiple sports, including hockey, and tried to determine if teams who were ranked as a top defensive team won championships more often than those who were ranked as a top offensive team. In every sport they tried to establish if there were just as many offensive teams winning as there were defensive teams winning.

Molik et al. (2012) found significant differences between disability groups in the anthropometric measures of training equency, height, and sledge length, but there was no strong evidence to support disability group differences in game efficiency parameters. The results may confirm the lack of a need for classification in sledge hockey or they may be evidence that a classification system is needed as the lower functioning disabilities are not being represented in the sport.

Given the diversity of invasion team sports, many assessment tools have been developed in an attempt to measure aptitude to, or performance in, a variety of team sports. Nadeau, Godbout, and Richard (2008) modified Team Sport Assessment Procedure (TSAP) for ice hockey. It consists of 10 explained constants that three well educated specialists need to mark. These constants made it possible to avoid unreasonable distortions of efficiency index values due to low numbers of ball or puck losses (Grehaigne, Godbout, & Bouthier, 1997; Nadeau et al., 2008).

Nowadays, best efficiency parameters are given by NHL and KHL statistics. They go in deep spheres of hockey so that you can get information about time spent on the ice, how many shoots the player performed in attacking situations, how

many hits, blocks, penalties there were in defensive situations.

The standard situational efficiency indicators used in this study provided a precise quality description of the team play. The **aim** of this study was to determine which situational parameters differed between winning and defeated teams in Ice Hockey World Championship Division IB. We anticipate significant differences in some situational parameters between winning and defeated teams. We considered scored goals in each period and their difference, number of assists, minutes of penalty, total time playing power play, total time playing shorthanded, face-offs won and lost, total shots on goal and saves.

METHODS

Subjects. The study was conducted on the sample of 6 hockey teams (15 games, 30 opponents) playing in the 2016 IIHF World Championship Division I B. Teams were Croatia, Estonia, Great Britain, Lithuania, Romania and Ukraine.

Variables. The variables that represent situational efficiency comprised 11 standard indicators in ice hockey game. These indicators were standardized by the International Ice Hockey Federation (IIHF). All results were downloaded from official IIHF website.

Variables Scored Goals in 1st Period (GOL_1P) *Scored Goals in 2nd Period* (GOL_2P) and *Scored Goals in 3rd Period* (GOL_3P) represent scored goals in period by each team. There is a slight difference between periods. Variable *Assist* represents number of assists as a result of good teamwork and usually leads to good opportunities to score, goal. Teams that have lots of assists besides scoring show excellent teamwork. Variable *Points* shows relations between scored goals and teamwork. More individual plays make points even to scored goals and more teamwork makes points tree times larger than scored goals. Variable *Penalty Minutes* (PIM) represent minutes of penalty that team gets for violating the rules. That leads to play shorthanded or play with man (or two men) advantage (Power play). Variable *Power Play Time* (PPT) represents total time that team plays power play. There can be huge differences between obtained penalties and served penalties (10, 20 and 25 min (misconduct and match penalties) if penalty does not count or obtained penalty at the end of last period). Variable *Power Play Goals* (PPG) represents goals scored with man advantage. It is a very good indicator of

team play. Variables *Face-off +* (FO+) and *Face-off -* (FO-) represent a get or loose puck position on face-offs. Variable *Shots on Goal* (SOG) represents shots that it has been saved by goalie or scored. Variable *Saves by Goalie* (SVS) represents number of saves that goalie makes. It does not count shots that hit the post or miss goal frame. Variable *Win/Loose* (W(1)/L(0)) represents discriminant variable that differs winning and losing teams in the game.

Table 1. Description of variables

GOL_1P	Scored goals 1. period
GOL_2P	Scored goals 2. period
GOL_3P	Scored goals 3. period
ASSIST	Number of assists
POINTS	Number of points
PIM	Penalty minutes
PPT	Power play time
PPG	Power play goals
FO+	face-off +
FO-	face-off -
SOG	Shots on goal
SVS	Saves by goalie
W(1)/L(0)	Discrimination Var Win/Loose

Data analysis. Data was analyzed using Statistica 12.0 software for Windows. For all parameters, arithmetic mean and standard deviation were calculated. Kolmogorov-Smirnov test was used to determine whether the variables were normally distributed (maxD and *p* value). Group

differences between variables were analyzed using Man-Whitney *U*-test. To determine parameters which differentiated teams according outcome, discriminant analysis was performed.

RESULTS

Most of the variables in sport are binominal. Thomas (2007) and Ryder (2014) suggest that goal scoring in hockey follows a Poisson distribution. This results in looking at competing Poisson processes when trying to predict the outcome of the games. Ryder (2014) shows that by breaking down the scoring in hockey into short time intervals, one can accurately predict goals, except in the last two minutes when scoring is greatly increased due to the occasional strategy of pulling the goalie for an extra attacker when a team is down by one or two goals.

Goals scored in each period differ in the second period and that tells us that the second period was critical for winning/defeated teams. Some teams had scored to 6 goals in that period to gain advantage in result. So, from this point of view, the second period is the most important for coaches to prepare their teams. Assist for winning teams represent good passing game, which leads to better team game. PIM of 13.00 ± 8.73 shows rather aggressive play by winning teams. PPG of 1.13 ± 10.6 and PPT of 7.33 ± 3.51 minutes did not have such influence on the final result. In consideration of won and lost face-off, it does not have statistical difference and influence on gaining puck possession and start of attack. SOG was rather high and that was probably

Table 2. Basic descriptive situational efficiency parameters of winning teams

Predictors	N	Winning teams					
			SD	Min	Max	maxD	<i>p</i> -value
GOL_1P	15	1.47	0.92	0	3	0.33	<i>p</i> < .10
GOL_2P	15	2.07	1.71	0	6	0.18	<i>p</i> > .20
GOL_3P	15	1.47	1.46	0	5	0.18	<i>p</i> > .20
ASSIST	15	7.53	3.76	2	16	0.12	<i>p</i> > .20
PIM	15	13.00	8.73	4	35	0.19	<i>p</i> > .20
PPG	15	1.13	1.06	0	3	0.22	<i>p</i> > .20
PPT	15	7.33	3.51	2.26	16.00	0.15	<i>p</i> > .20
FO+	15	35.20	8.60	22	52	0.15	<i>p</i> > .20
FO-	15	30.33	7.62	19	46	0.16	<i>p</i> > .20
SOG	15	36.33	8.92	23	58	0.16	<i>p</i> > .20
SVS	15	21.07	7.16	10	32	0.15	<i>p</i> > .20
Critical D						0.304	

the result of good passing and team play showed by assist. As we see, results in Table 2 showed that variable GOL_1P did not have normal distribution by the K-S test criteria.

Results in Table 3 showed that defeated teams on the other hand had low scoring by each period of play. With low scoring, variable Assist cannot be high. In comparison to winning teams, they all had the same PPT (7.12 ± 2.65), but defeated teams did not score so much PPG (0.33 ± 0.49) that will help them in the final result. Like we mentioned earlier, face-off did not statistically differ between winning and defeated teams. Defeated teams had 23.13 ± 8.11 shots on goal. With high percentage of saves and not so many shots on net, goalies can easily accomplish their goals.

Kolmogorov-Smirnov test show that variables GOL_2P, GOL_3P, ASSISIT and PPG were not normally distributed. In that manner we cannot use *t*-test for independent samples, so we used Mann Whitney test to identify differences between winners and defeated teams.

Results in Table 4 show descriptive parameters of analyzed situational variables. Presenting results, winning teams scored more goals in each period, had more Assists, Power Play Goals and Shots on Goal. The only thing that defeated teams had better is number of Saves by Goalie. Both teams had almost the same power play time, but better teams had statistically greater PPG.

Teams differ at most in Assist during the game. The more goals the team scores, the more assists

Predictors	N	Defeated teams					
			SD	Min	Max	maxD	p-value
GOL_1P	15	0.60	0.63	0	2	0.29	$p < .15$
GOL_2P	15	0.53	0.64	0	2	0.33	$p < .10$
GOL_3P	15	0.33	0.62	0	2	0.44	$p < .01$
ASSIST	15	2.07	2.09	0	8	0.31	$p < .10$
PIM	15	15.87	14.94	4	60	0.23	$p > .20$
PPG	15	0.33	0.49	0	1	0.42	$p < .01$
PPT	15	7.12	2.65	2	13	0.26	$p > .20$
FO+	15	30.33	7.62	19	46	0.16	$p > .20$
FO-	15	35.20	8.60	22	52	0.15	$p > .20$
SOG	15	23.13	8.11	10	33	0.22	$p > .20$
SVS	15	31.40	7.44	21	52	0.20	$p > .20$
Critical D						0.304	

Table 3. Basic descriptive situational efficiency parameters of defeated teams

Predictors	N	Win ()	Def ()	Z	p*
GOL_1P	15	1.47 ± 0.92	0.60 ± 0.63	-2.49	.013
GOL_2P	15	2.07 ± 2.07	0.53 ± 0.64	-2.70	.007
GOL_3P	15	1.47 ± 1.46	0.33 ± 0.62	-2.28	.023
ASSIST	15	7.53 ± 3.76	2.07 ± 2.09	-3.94	.000
PIM	15	13.0 ± 8.73	15.87 ± 14.94	0.17	.868
PPG	15	1.13 ± 1.06	0.33 ± 0.49	-2.05	.040
PPT	15	7.33 ± 3.51	7.12 ± 2.65	-0.25	.803
FO+	15	35.20 ± 8.60	30.33 ± 7.62	-1.27	.206
FO-	15	30.33 ± 7.62	35.20 ± 8.60	1.27	.206
SOG	15	36.33 ± 8.92	23.13 ± 8.11	-3.40	.001
SVS	15	21.07 ± 7.16	31.40 ± 7.44	3.26	.001

Table 4. Differences between winning and defeated teams (Mann-Whitney test results)

can they get, but only if they have good team play. Next parameter that the teams differ in is SOG. It is normal that the more shots you take, the more likely will you score more goals. In this case winning teams had 36.33 ± 8.92 against defeated teams 23.13 ± 8.11 . It is more than 10 shots per game and it is easy to expect more goals scored.

The only thing that defeated teams had was SVS. It is normal for the team that it takes more shots on goal, and goalies have to save more. If goalies have problems to save shots, it results in a greater score difference. In that kind of situation we must take into consideration the save percentage, so that we can get a picture of a goalie performance.

Teams did not statistically differ in face-offs. Liardi and Carron (2011) found that face-off success was not related to home team wins ($p > .05$). All the results of face-offs were around 50%.

DISCUSSION

The aim of this study was to determine a group of significant situational parameters that differentiated winning and losing teams on Ice Hockey World Championship Division IB in Zagreb. Results in Table 4 showed that statistical differences between winning and defeated teams were established in goals scored, assists, Power Play Goals, Shots on goal and Saves by Goalie when significance was set at .05.

Many studies in performance analysis compare the collective results of two or more randomly selected winning or losing teams. This is done in order to try to identify performance features that distinguish winning and losing sides. This type of study tries to find general rules for a particular sport, e.g. the long ball game is not as effective as a passing game in soccer. However, Jones (2008) suggests that combining results in this way may mask any individual team performance and that can then mean that inherent weaknesses and strengths of individual teams may not be identified. In effect combining the performance of lots of teams may produce a general pattern that does not actually hold true for any team.

According to Roith and Magel (2014), goals against have a larger magnitude than goals scored. This would lead us to believe that it is more important for the team that is striving to make the postseason to keep their opponents from scoring an abundance of goals.

Presented results showed that the biggest differences were in assists. This means that winning teams had better team play that resulted in better passing play to more shots on goal and scoring chances. On the other hand, defeated teams had more saves, and final result depended on the quality of goalkeeping and how many goals the goalie could not save.

Also, winning teams differed in scoring goals in each period. The first period represented motivation at the start of a match. The second period represented plays on tactics showed in the first period, and the third period represented team's conditioning fitness (level of endurance). Statistical analysis shows that a very important part of a game is the second period in which the teams that score more have greater probability to win the game.

Some teams try to focus more on face-offs. According to Liardi and Carron (2011), the home team wins 3.01% more games when it achieves greater than 50% for the face-offs. On the other hand, the team must have more face-offs won in offensive zone that leads to advantage on shots on goal. In this study, winning teams didn't have significantly more face-offs than defeated teams.

Power Play Goals had also statistical significance, but that did not make such difference between teams. On team statistics, teams that had the biggest percentage of Power Play ended on 4th and 5th place. It is good that teams have better special team play (power play, penalty kill), but it is better to have developed penalty kill to get fewer goals.

This kind of data did not show us deeply what was going on the ice. Some of mistakes are covered by better tactics or by good saves by goalie. For better information we must use notational analysis that is an objective way of recording performance, so that critical events in that performance can be quantified in a consistent and reliable manner (Milanović, Jukić, Vuleta, Gregov, & Sporiš, 2008). The use of systematic observation instruments provides researchers with a method of collecting behavioral data on both the coach and the athlete. These data can be analyzed and processed in a variety of ways to provide a descriptive profile that can be used for giving both the athlete and the coach feedback about their actions. This implies that without feedback there will be no change in performance. The athlete will have no idea that there is an alternative or a better way. However,

it has been identified that coaches are only able to recall 30-50% of key performance factors they witnessed, even with special training in observation (Franks & Miller, 1991)

Hughes and Franks (2004) indicated 4 main usages of notational analysis: *analysis of movement, technical analysis, tactical analysis and development of database and modeling*. Sports biomechanics is concerned with fine detail about individual sports techniques in comparison to notational analysis which is more concerned with gross movements or movement patterns in games or teams. Furthermore, notational analysts are typically more concerned with strategic and tactical issues in sport than with technique analysis. However, both emphasize the development of systematic techniques of observation and have 'key events' as important features of their theoretical foundations.

In Lee's (2011) study, players' attitudes towards video showed that using video analysis was surprisingly positive. Players seemed to be quite responsive to using video analysis for player development, and its use with special teams, the same as the coaches. The younger players seemed to want to use video analysis for all aspects of the game, which is a positive sign but cannot always be a wise thing. With the older players it is seen that the use of video is not a major focus in the individual game preparation, but serves as a team viewing resource. The higher the level, the less the athlete needs to see when it comes to the basic things such as player development skills, skating and "1 on 1" and "2 on 1". The video time is set to go over systems, power play, penalty kill, special teams and faceoff plays. In rare cases a player or a coach would want to focus on an individual effort.

Advances in both computer and video technology can make this observation process more efficient and also provide the coach with audio-visual feedback about their interactions with athletes. The next phase of solving these problems in their entirety is translating the use of these objective observation systems into practice.

CONCLUSION

Our results indicate that that winning and defeated teams differed in situational efficiency parameters at the world championship. Teams differed the most in Assists and Shots on Goal (more probability of scoring). This tells us that coaches need more to prepare their teams mentally to play better team play that will lead to more scoring chances. Ice hockey consists of very complex technical-tactical structures, whereby you need to gain advance over the opponent. For more precise situational parameters it would be good to observe passing game and lost pucks (unforced), turnovers, rebounds, shots taken, blocked shots. All of those data can be found in NHL statistic. Therefore, in the future it will be recommended that teams have a specialized person for notational analysis. Notational analysis is used by coaches and sport scientists to gather objective data on gross movements or movement patterns in games or teams the performance of athletes (Bartlett, 2001). Tactics, technique, individual athlete movement and work-rate can all be analyzed, enabling coaches and athletes to learn more about performance and gain a competitive advantage. Systems for notational analysis are becoming increasingly sophisticated, reflecting the demands of coaches and scientists, as well as improvements in technology.

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ECONOMIC IMPACTS OF THE ORGANIZATION OF BIG SPORTS EVENTS BASED ON THE EXAMPLE OF THE EUROPEAN LASER SENIOR CHAMPIONSHIP 2014

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ABSTRACT

Background. Tourism and sport, apart from being a significant social phenomenon, are close to each other and interfere. In modern society, sport has become an important content during a tourist's stay in a destination, regardless of whether he/she is an active participant in competitive or recreational sports activities. Tourism industry has a share of 18.2% of GDP of the Republic of Croatia, but seasonality is one of the key problems. The modern tourist should be offered added value such as excursions, sports or musical events, cultural manifestations, etc. The stated values can be achieved with a proper destination management. Aim of the research was to demonstrate on the example of the organisation of a big sports event, how and to what extent a big sports event affects the increase of consumption in a destination.

Methods. The research employed a questionnaire survey.

Results. Guests, participants of the big sports event spent more than the average tourist in the destination on the annual level.

Conclusions. The organization of a big sports event has a number of positive consequences for the economy of a destination. In addition to the fact that guests and participants of big sports events spend more than an average tourist in a destination does per day, they want to learn about the history and culture and other attractions in a destination they visit or stay. The above mentioned has the effect of getting a positive impression that they will transfer to their families and friends who will also want to visit the destination. Also, the organization of a big sports event in the pre-season or post-season contributes to the extension of the tourist season, which is extremely important for the city of Split since tourism is still seasonally oriented despite the fact that it has a high 18.2% of the GDP (in 2016 and 17.2% in 2014).

Keywords: big sports event, consumption, income of the destination, sports tourism.

INTRODUCTION

When it comes to tourism, it can be said that tourism is a socio-economic phenomenon based on people's needs for a temporary change of their residence of work, rest and entertainment as well as possibilities to satisfy those needs. It is the key support of total long lasting Croatian developing strategy, and it is based on natural and transportation resources and human capital.

Tourism plays two main roles (Bartoluci & Škorić, 2009):

- a balance-of-payments stabilizer,

- a stabilizer of the national labour market.

Tourism has to help balance economic relation of the domestic economy with the international one. Furthermore, tourism can decrease the unemployment rate by employing new people in tourism sector. The economic crisis as well as a downward trend in the world and domestic market has increased the number of the unemployed in the Republic of Croatia in the period between 2005 and 2013. According to the Croatian Employment Service, the average unemployment rate in 2005 was 8.6%, and in 2013 it was 20.2% (Hrvatski

zavod za zapošljavanje – Godišnjak 2013, 2014). After 2013, a decrease in the number of unemployed was noted, which is a consequence of coming out of economic crisis.

It is important to emphasize that tourism is the only economic activity, which continuously marks positive results even during the time of economic crisis. In 2013, the number of tourist arrivals increased by 5.1%, and the number of overnight stays by 3.3%. Such movement is the result of a positive trend of foreign tourist overnights, since in the last two years a downward trend has been marked in the number of domestic tourist overnights. The share of foreign tourists in the total number of arrivals was 88.1%, 92.1% of overnights if compared to 11.9% of arrivals and 7.9% of overnights of domestic tourists (Hrvatski turizam u brojkama, 2014).

The term sports-oriented travel is more commonly encountered on the tourist market (UNWTO, 2013). Tourism, sport and sport recreation interfere, which is reflected in their multifunctionality. Competitive sports tourism implies all travels for participation in certain sport competitions, from domestic to international ones. Participants of this form of sports tourism are athletes, coaches, auxiliary staff and viewers of sports events, especially the media (Bartoluci, Škorić, & Šindilj, 2013). Numerous sports events extend the offer of a certain destination, thus strengthening its competitiveness. When organising a sports event, the offer of activities connected to a certain event should be modified according to specific demands in order to gain quality (Beech & Chadwick, 2004). In the period between 7th and 14th June, 2014, the European Laser Senior Championship (the Championship) was held in Split. It was organised by the Sailing Club Split and more than 300 people participated in the Championship. The organization of a big sports event helps to attract a large number of tourists. By attracting a larger number of tourists, the consumption in the destination increases, resulting in an increase in the revenue of the destination.

Tourism in Croatia. The stated data show the importance of tourism industry for the economy of Croatia. Thus, analysing the data for the last couple of years, a continuous growth has been recorded in the number of tourist arrivals and overnights, and in tourist revenue. In 2013, tourist revenue was €7.18 billion, and it represented a share of 16.5% of GDP in the Republic of Croatia. There were 12.45

million of tourist arrivals. The year 2014 marked a rise of 600,000 of tourist arrivals if compared to the previous year. Tourist revenue amounted to €7.4 billion, while a tourism share represented 17.2% of GDP (Statistička analiza turističkog prometa u 2014. godini, 2015). In 2016, a tourism share was 18.2% of GDP. In the same year, there were 78 million overnights or 9% more than the previous year. Foreign tourist overnights marked a rise of 9.6%, and domestic tourist overnights marked a rise of 2.0%.

During 2013, Croatian tourism proved its market activity. The results of the tourist season were above every expectation. According to the figures, in the first ten months, 12.1 million tourists visited Croatia or 5% more if compared to the same period of the previous year, and it reached 71 million overnight stays, or 4% more than in 2012. An upward trend of tourist trade was marked in all Croatian counties, and Croatia in the first ten months achieved results better than expected. The total rise of the first ten months was mostly marked by foreign tourist arrivals, which amounted to 10.98 million or 6% more compared to the same period the year before, and a rise of 5% was reached in overnight stays with 65.1 million of overnight stays. Domestic tourists achieved the results similar to the previous year's results, with more than 1.1 million arrivals, they got the identical number of arrivals, whereas, a 2% decrease was noted in the number of overnights (Statistička analiza turističkog prometa u 2014. godini, 2015).

The average tourist consumption. In 2010, the Institute for Tourism conducted the research on tourist consumption in Croatia, which is relevant for the comparison of the results of participants in the European Laser Senior Championship (Stavovi i potrošnja turista u Hrvatskoj – TOMAS 2010).

According to the results of the mentioned research, the average expenditures of a tourist per day were €58 on the state level, and €55 on the level of Split-Dalmatia county (the County), whereas the average daily expenditures reached the amount of €121.1 throughout the area of Split. The average daily expenditure refers to accommodation service, food and costs of other services (shopping, sport and recreation, culture, entertainment, trips and similar).

The study of 2010 shows that 74% of average daily consumption refers to hospitality service and the rest represents the costs of other services.

Table 1. Tourists and overnights by counties (the period from January to October 2013)

	Tourists		Overnights	
	Total	Index 13/12	Total	Index 13/12
REPUBLIC OF CROATIA - TOTAL	12 132 165	105	71 252 456	104
	Tourists		Overnights	
	Total	Index 13/12	Total	Index 13/12
ISTRIA COUNTY	3 142 022	101	21 875 229	100
PRIMORJE-GORSKI KOTAR COUNTY	2 223 191	102	12 477 203	102
LIKA-SENJ COUNTY	480 136	105	1 927 418	107
ZADAR COUNTY	1 347 378	107	9 552 025	104
ŠIBENIK-KNIN COUNTY	815 752	107	5 346 590	107
SPLIT-DALMATIA COUNTY	2 149 462	110	12 705 855	108
DUBROVNIK-NERETVA COUNTY	1 264 143	109	6 155 700	107
CITY OF ZAGREB	710 081	115	1 212 436	112

Source: Tourist Board of the Split-Dalmatia County.

Talking about segments of average consumption, the following can be said:

- 49% of the average daily consumption represents accommodation service, which is €28.62 for accommodation service on the state level, and €26.95 on the County level, and €59.34 on the Split level;
- 9% of the average daily consumption refers to other food service within accommodation service, which is €5.27 on the state level, €4.95 on the County level and €10.90 on the Split level;
- 16% of the average daily consumption refers to other services of food and beverages outside accommodation service, which is €9.34 on the state level, €8.80 on the County level, and €19,38 on the Split level;
- 26% of the average daily consumption refers to costs of other services, which is €15.18 on the state level, €14.30 on the County level and €31.49 on the Split level.

Destination. When tourism is concerned, it is important to state that a modern tourist wants not only the sun and sea but also other facilities. He/she wants to learn about local culture, meet local people, national folklore, gastronomy, visit festivals, sport tournaments, museums, galleries, etc. By implementing the Tourism Development Strategy of the Republic of Croatia by 2020 (Strategija razvoja turizma Republike Hrvatske do 2020. godine, 2015), the Government of Croatia has pointed at disadvantages of destination management with the aim of satisfying the needs

of a modern guest. Managing a destination is an integrated process of managing the key elements of the tourism mix, marketing communication, mediation, and destination partnership. The basic intention is to increase the number of arrivals balancing tourism demand and offer. Tourist Boards are in charge of the destination management.

Tourism and Destination Management Organisation can be defined as a process of shaping, managing and developing tourism system, public offer and interest in a destination (Magaš, 2003). All developed tourist destinations search for new content in order to enrich their offer. There are two trends in the world. One leads to a trend of preserving historical monuments, culture and nature or authentic heritage. The other is directed toward newly formed attractions. However, as time passes, those attractions become part of physical, historical and cultural environment – they become “natural”. This process obscures the difference between them; therefore, it is difficult to differ between natural attraction with the elements of newly formed attraction and newly formed attraction that soon integrates in its natural environment (Butler & Pearce, 1995). Other attractions, such as sport competitions and music festivals have also developed.

A positive trend of branding and developing a destination is definitely the city of Split, which has lately transformed from a transitional into a tourist city. In order to keep guests more than just for sightseeing, within already existing events like the traditional Split Summer Festival, new events

have been created such as the Days of Diocletian, Summer Colours of Split, etc. Moreover, Split has become the host of the Ultra Europe Festival, a festival of electronic music for a minimum period of five years. Over 120,000 guests from more than 100 countries worldwide visit the festival in three days of its duration.

The European laser senior championship.

As stated in the title of this article, the aim of this work was to research social and economic impacts which the Championship had. In order to present the hypothesis H1, the relation of the statistical data on the average consumption of a tourist inside and outside the city of Split should take into consideration, as well as, the relation of the stated figures if compared to the average percentage for the County and the Republic of Croatia.

H1 = Championship participants have higher expenses than the average expenditures of a tourist on the Split level

H1.1 = Championship participants have higher expenses than the average expenditures of a tourist on the Split-Dalmatia County level

H1.2 = Championship participants have higher expenses than the average expenditures of a tourist on the level of the Republic of Croatia

It is assumed that Championship participants want to explore the city as well as surrounding destinations more, thus the following hypothesis was formed:

H2 = Championship participants wish to find out more about history and culture, and other sights of a destination where they stay.

Moreover, it is assumed that Championship participants spend less on souvenirs, tourist attractions and the similar than an average guest who visits Split, the County or Croatia, therefore, the following hypotheses have been formed:

H3 = Championship participants have lower expenses than the average expenditures of a guest on the Split level for other services (souvenirs, tourist attraction tours and similar)

H3.1. = Championship participants have lower expenses than the average expenditures of a guest on the County level for other services (souvenirs, tourist attraction tours and similar)

H3.2. = Championship participants have lower expenses than the average expenditures of a guest on the state level for other services (souvenirs, tourist attraction tours and similar)

METHODS

The empirical research was conducted during the Championship on the chosen group of participants. The surveyed group included competitors, coaches, clubs and organisation representatives, sponsors and spectators. The research was conducted employing a questionnaire, which was composed of 17 questions divided into two parts. In the first part, respondents were supposed to answer the questions about their gender, age, country of origin, their role in the Championship, their average monthly income. The second part of the questionnaire was composed of questions concerning their visit to Split, whether it was their first visit to Split, if they had information about it prior to their arrival, where they stayed, whether they planned to visit other cultural events, manifestations and similar, the costs of their stay and the amount they planned to spend on other hospitality services, souvenirs, trips, tourist attractions and the similar during their stay in Split.

RESULTS

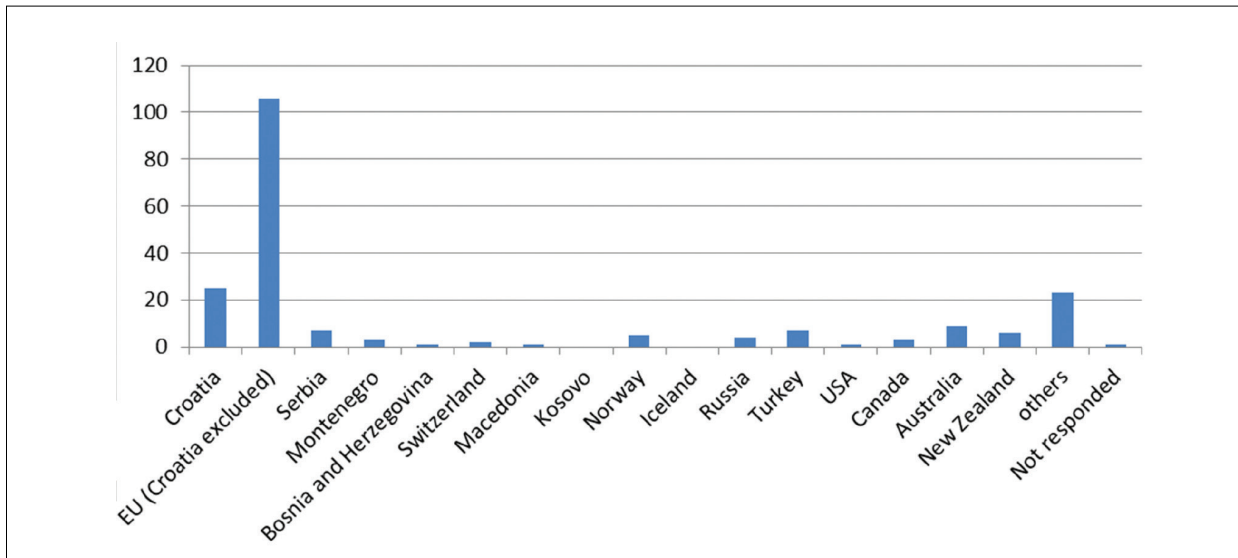
In total, 204 questionnaires were correctly completed. If analysed according to gender, 65% of respondents were men (133), whereas 35% of them were women (71). The majority of respondents, more precisely 51.97% or 106, were from countries that are part of the European Union (Croatia excluded); 12.25% of the total number of respondents were from Croatia.

If the total number of respondents is considered, 150 of them were competitors and they represented a 73.52 % segment. There were 29 coaches, or 14.22%, 11 associates from organisations (5.39%), three sponsors (1.47%), six spectators (2.94%), whereas 5 respondents did not state their status.

If we consider the economic aspect of the Championship, the questionnaire had a particular number of economic questions.

When asked who paid for accommodation service, 71 respondents (34.80%) answered that travel and accommodation expenses were covered by their main club or organisation; 29 respondents (14.22%) answered that expenses were covered by the sponsors, whereas 59 respondents claimed that travel and accommodation expenses were paid by themselves. As far as other respondents were concerned, 24 of them had more sources

Figure 1. The number of competitors by countries



Note. Composed by the authors according to the results of research.

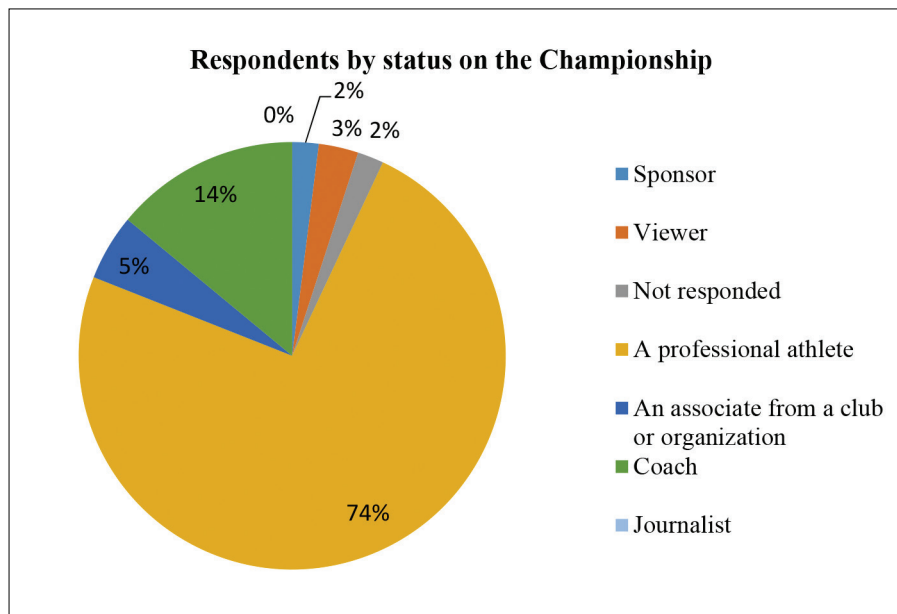


Figure 2. Respondents by status on the Championship

Note. Composed by the authors according to the results of research.

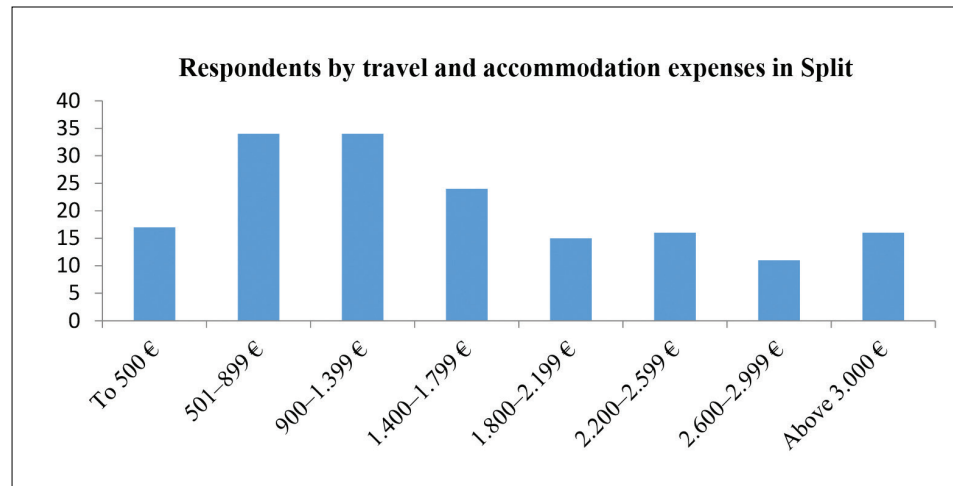
of financing their travel and accommodation expenses. Thus, five of them paid for their expenses partially by themselves and partially by clubs and organisations, whereas sponsors and the parent body clubs and organisations paid the travel expenses of others. Twenty-one respondents did not answer the above stated question.

When asked about the amount of travel and accommodation expenses in Split, the majority, 34 of them or 16.67% responded that the costs were between €501 and 899. The same number of respondents answered that the total amount of

expenses ranged between €900 and 1399; 11.97% of respondents or 24 of them said their expenses were from €1400 to 1799. Travel and accommodation expenses amounted to €500 for 17 respondents. It is important to say that respondents from Split and the County did not have to reply to this particular question.

According to the results of the research, 37.25% of respondents or 76 of them paid up to €30 per day for hospitality service, accommodation service excluded, that is, for food within and outside accommodation service; 25.98%, or 53 respondents

Figure 3. Respondents by travel and accommodation expenses in Split



Note. Composed by the authors according to the results of research.

spent from €31 to 50, whereas 14.22% spent from €51 to 70 per day. The rest of the respondents or 5.88%, or 12 of them spent between €71 and 90 per day and the same segment of respondents portrays the average daily consumption from €91 to 110. Six respondents answered that their average daily consumption was above €111, whereas, 16 respondents did not answer the question.

If we consider only the respondents who answered the survey question, it can be said that food expenses within and outside accommodation service for 40.43% of respondents amounted to €30 per day. Other respondents had expenses higher than €31.

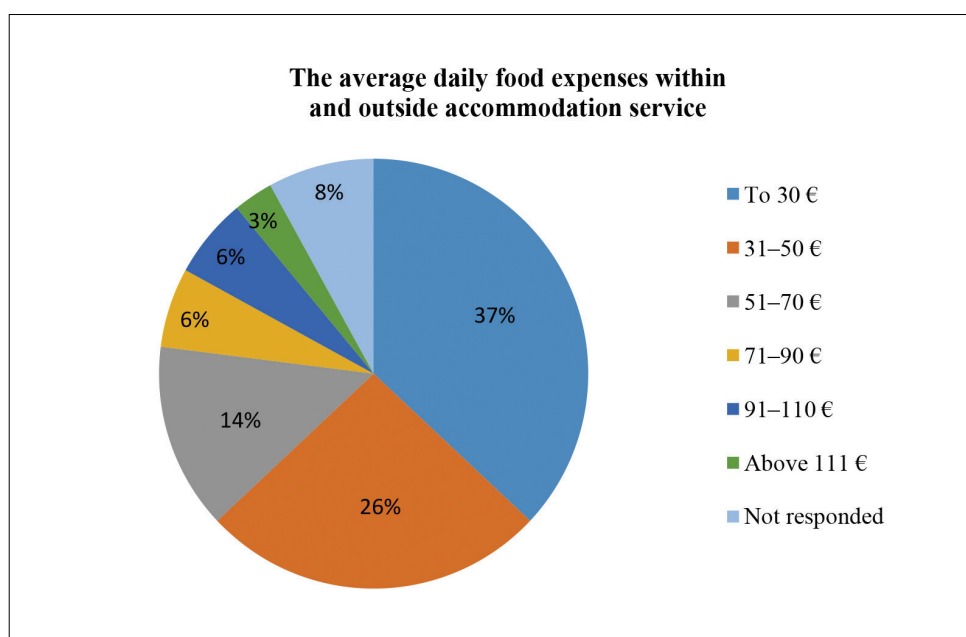
Since an average guest in Split spends €30 for food service on a daily basis, we can confirm

the hypothesis that Championship participants had higher food expenses within and outside accommodation service than the average tourist consumption on the Split level for food within and outside accommodation service.

The average daily consumption for food within and outside accommodation service was €13.75 on the County level, and €14.61 on the state level. Thus, this proves the hypothesis that Championship participants had higher food expenses within and outside accommodation service than the average tourist consumption on food within and outside accommodation service on the County level, or on the level of Croatia.

The participants were asked if they planned to visit other cultural sites such as Diocletian's

Figure 4. The average daily food expenses within and outside accommodation service



Note. Composed by the authors according to the results of research.

Palace or some museums, whether they planned to visit Marjan hill on the west side of Split, sport sites such as the stadium, do shopping, go to a one-day trip, try local gastronomy. Interestingly, none of the respondents circled that option. Based on the previously said, it can be also confirmed that Championship participants wanted to visit historical and cultural sites of the destination where they stayed.

It is important to note a new study on the consumption of tourists in the Republic of Croatia, the results of which were published in 2016 (Tomas, 2016.). The results can be compared with the results of the research. According to this research, the average tourist consumption was €66.36 per day. Average daily cost of accommodation was €36.22; 75% of the survey respondents had a stated or higher cost of accommodation per day. The average daily consumption for food within and outside accommodation service was €12.18. By comparing this data with the results of the research, it can be said that Championship participants had higher food expenses within and outside accommodation service in 2014 than the average tourist consumption for food within and outside accommodation service on country level in 2016 which is an important indicator of the importance of organizing this championship.

Financial implication of the championship.

In total, 273 competitors, 62 coaches and eight referees participated in the Championship. If club representatives, journalists and competitors' families are added, the number of 400 Championship participants will be reached. According to the data, 10% of the Championship participants were from Split and the surroundings, therefore, it can be concluded that 360 participants had accommodation in Split. The average number of overnight stays per participant is 12 days. Taking into consideration that the sojourn tax in Split is HRK 7 per day per tourist (The Sojourn Tax Act, 2014), the Tourist Board of the city of Split collected HRK 30.240 during the Championship (assuming that all 360 participants were registered). Taking into consideration the survey results, it can be summed up that the participants, who were not from Split and the surroundings, spent at least €22.680 per day only for food within and outside accommodation service. Considering the average number of overnight stays, which is 12 per participant, it is concluded that the Championship

participants spent on food within and outside accommodation service, and on hospitality service more than €272.000. The average travel expenses to Split and daily accommodation per participant amounted to €1.581 for 12 days (the average stay of the Championship participants). Based on the above said, it can be concluded that the Championship participants with the average stay of 12 days, paid €569.160 for travel and accommodation expenses. Considering the consumption of Championship participants who did not have organised accommodation on the area of Split, it can be concluded that the total consumption of all participants was more than €1.000.000.

Also, comparing the results of the survey in 2014 with the results of average tourist spending in the Republic of Croatia (published in 2016) it can be concluded that the participants of the competition in 2014 had an average higher cost than the average tourist costs were published in 2016.

CONCLUSION

According to Beech and Chadwick (2004), in the world economy, sport has a share of 3% of the total GDP, whereas in the European Union its share is 1.5%. The impact of sport on the economy development of Croatia cannot be exactly stated since there are no reliable statistical reports. However, it is notable that sport, especially big sports events, generates high economic impact in Croatia. Unfortunately, tourism industry in Croatia is still highly seasonally oriented. Therefore, any manifestation, such as the European Sailing Championship in Split in preseason or postseason, influences the increase of the tourist offer beside the main tourist season. Participants of such competitions generally spend more than an average tourist in a destination. The results of the research have shown that during the Championship in Split participants spent more than €1,000,000, travel expenses included. Although, to a lesser extent, due to a tight schedule, participants of sport competitions still spend some time to visit a city, its culture and tradition. On their way back home, Championship participants will share their impressions with their relatives and friends, thus promoting hospitality of the city of Split, natural beauties and rich heritage, which should result that at least some of them wish to visit Split what they eventually do.

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THE EFFECTS OF DIET, PHYSICAL ACTIVITY AND SOCIAL FACTORS ON STRESS PERCEIVED BY STUDENTS

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ABSTRACT

Background. General health status of students is becoming worse due to an intensive lifestyle: a difficult job or study routine, improper diet, and low physical activity (Poteliūnienė, 2010). One of the common problems among students is stress. Stressful situations on a daily basis have been found to be associated with a worse physical and psychological status, harmful habits or personal relationships with friends (Dusselier, Dunn, Wang, Shelley, & Whalen, 2005; Leppink, Odlaug, Lust, Christenson, & Grant, 2016).

Methods. According to the following questionnaires, dietary habits and some social peculiarities (Grabauskas, Zaborskis, Klumbienė, Petkevičienė, & Žemaitienė, 2004), physical activity (Aadahl & Jørgensen, 2003) and perceived stress (Konduri, Gupchup, Borrego, & Worley-Louis, 2006) by female and male students were determined. The data obtained were processed using mathematical statistical methods. The relationships between qualitative determinants were evaluated by chi square (χ^2) criterion. A value at $p < .05$ was considered significant. Statistical analysis was performed using SPSS (version 17.0) (*Statistical Package for Social Science 17.0 for Windows*) statistical software package.

Results. Male students (54.2%) who were following a dietary regime reported experiencing low level of stress, and those students (45.2%) who were not having a dietary regime perceived moderate level of stress. Married female students (80%) responded that they experienced low level of stress, moderate level of stress was indicated by 72.7% of females living with a partner and 40% of females who had a boyfriend, and 38.5% of single females reported having high level of stress.

Conclusions. Male students who were following a dietary regimen reported experiencing lower level of stress, and those students who were not having a dietary regimen responded that they perceived moderate level of stress. A dietary regimen and perceived stress did not differ among female students. Different levels of physical activity were not associated with stress experienced by female and male students ($p > .05$). Married female students did not perceive high level of stress; moderate level was reported by females living with a partner; high level of stress – by single students. Marital status and perceived stress did not differ in male students.

Keywords: physical activity, diet, social factors, stress.

INTRODUCTION

Frequently perceived stress is a common problem in students, especially in those who started their studies after school. Stressful situations on a daily basis are associated with worse academic performance, physical health and mental status (Leppink et al., 2016). Most commonly stress manifests through chronic diseases, depression,

anxiety, and sleeping disorders. Harmful habits, personal relationships, disagreement with university or college management are associated with stress (Dusselier et al., 2005). According to scientific research, the main stressors are a heavy study workload, sleeping disorders, and social activity (Talib & Zia-ur-Rehman, 2012).

The aim of the study was to analyse the effects of diet, physical activity, harmful habits and some social factors on stress perceived by students.

The object of the study was the effects of diet, physical activity, harmful habits and social factors on stress perceived by students.

METHODS

The research sample included 118 respondents: 52 female and 66 male students. They were the 2nd – 3rd-year students of physiotherapy of the Lithuanian Sports University. Mean age of females was 20.77 ± 2.29 years, and that of males – 21.03 ± 2.63 years.

The study was performed following the Declaration of Helsinki concerning the ethical guidelines for human research. The study was started in November, 2016, and finished in January, 2017. The further sequence included the selection of subjects, familiarization, aim, and methods of the study.

Methods included a *Questionnaire survey*. Using the questionnaires, the following variables were determined: diet patterns, harmful habits and certain social factors (Grabauskas ir kt., 2004), physical activity (Aadahl et al., 2003), perceived stress (Konduri et al., 2006). The overall questionnaire consisted of 23 questions. Anthropometric measurements such as age, body mass and height comprised 1–2 questions, the other questions evaluated as follows: 4–7 – social factors, 8–14 – diet patterns, 15–21 – harmful habits, 22 – the frequency of physical activity and 23 – the frequency of perceived stress.

Statistical analysis. The obtained data were processed using mathematical statistical methods.

The relationships between qualitative determinants were evaluated by chi square (χ^2) criterion. The Student-*t* test was used for the calculation and assessment of means. Factor analysis, principal component analysis and a Varimax rotation were used for the main groups of food. Five dietary factors, which were later transformed into the groups “skipping meals rarely“, “skipping meals sometimes“, and “ skipping meals often“, were developed. A value of $p < .05$ was considered significant. Statistical analysis was performed using SPSS 17.0 for Windows statistical software package.

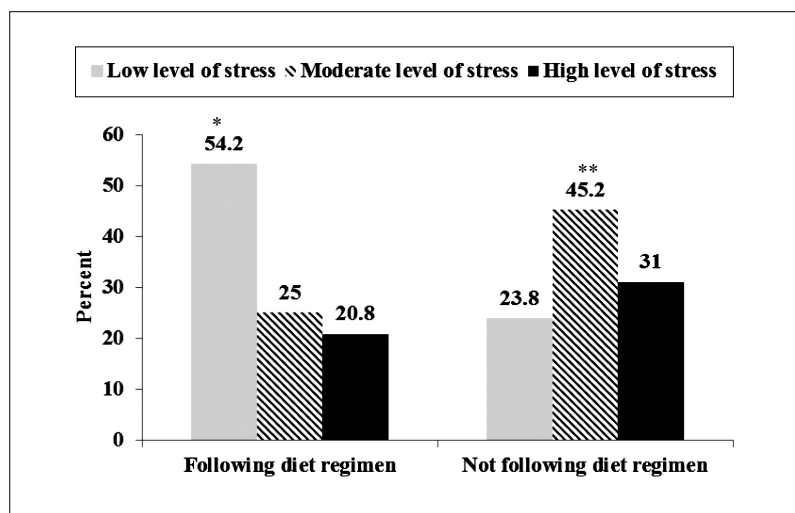
RESULTS

The majority of male students (54.2%) who were following a dietary regime experienced low level of stress, and students (45.2%) without dietary regime reported having moderate levels of stress. The results were statistically significant (Figure 1).

Levels of stress experienced by female students were similar in the groups of sufficient, moderate and insufficient physical activity suggesting that in all groups there were females who reported having high, moderate and low levels of stress (Figure 2). High levels of stress were pointed out by 22% of females with sufficient physical activity, by 25% – with moderate physical activity, and by 47% of students who had insufficient physical activity. The results were not statistically significant.

The results of the study showed that 45% of male students with sufficient physical activity, 40.9% – with moderate physical activity, and 28.6% of males who had insufficient physical activity reported experiencing moderate levels of stress. There were no significant differences (Figure 3).

Figure1. Dietary regime and levels of stress perceived by male students



Note. $\chi^2 = 6.264$, $df = 2$, $p < .05$;

* $p < .05$ comparing males who were following a dietary regime and experienced moderate and high levels of stress;

** $p < .05$ comparing males who were not following a dietary regime and experienced moderate and high levels of stress.

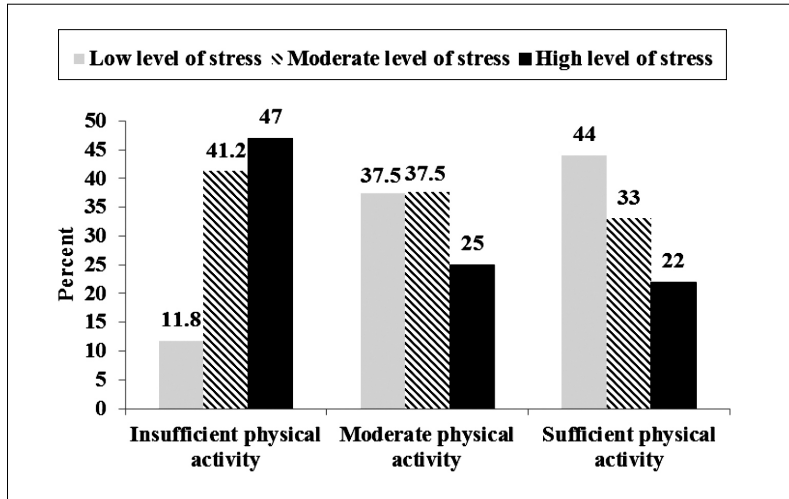


Figure 2. Physical activity and levels of stress perceived by female students

Note. $\chi^2 = 5.421, df = 4, p > .05$.

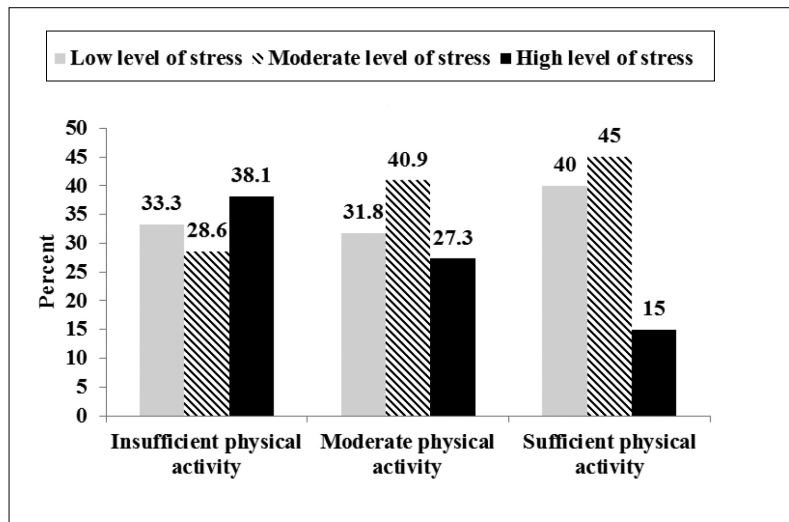


Figure 3. Physical activity and levels of stress perceived by male students

Note. $\chi^2 = 3.046, df = 4, p > .05$.

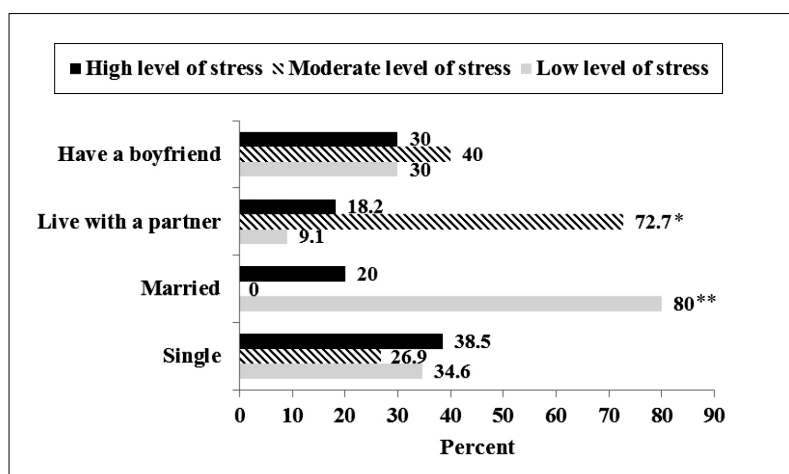


Figure 4. Marital status and levels of stress experienced by female students

Notes. $\chi^2 = 13.066, df = 6, p < .05$;
 * $p < .05$ comparing with females living with a partner and perceiving low and high levels of stress;
 ** $p < .05$ comparing with married females who perceived high level of stress.

The majority of married female students (80%) responded that they experienced low levels of stress, moderate level of stress was pointed out by 72.7% of females living with a partner and 40% of

females who had a boyfriend, and 38.5% of single females reported having high levels of stress. The results were statistically significant (Figure 4).

DISCUSSION

General health status of students is becoming worse due to an intensive lifestyle: difficult job or study routines, poor sleep quality, not regular meals, low physical activity, and harmful habits (Poteliūnienė, 2010). In order to maintain proper physical health, it is recommended to have a healthy diet, sufficient amount of rest and sleep, as well as regular exercises (Standage et al., 2012). The analysis of our results about diet regime and perceived stress showed that 42.1% of female students who followed a diet regime perceived low level of stress, and 36.4% of students without diet regime experienced high and moderate levels of stress ($p < .05$). The majority of male students (54.2%) who followed a diet regime perceived low level of stress, and moderate levels of stress more frequently were reported by students (45.2%) who did not have diet regime. According to Zvolinskaia, Kimitsidi, and Aleksandrov (2014), one of the common problems among students is improper diet, and Tavolacci, Ladner, Grigioni, Richard, and Villet (2013) argue that stress perceived by students is associated with diet habits.

The main environmental stressors may be linked to academic, non-university, family or relationships with friends (Yusoff, Rahim, Baba, Ismail, & Pa, 2013). According to our results, the majority of married women (80%) perceived low levels of stress, moderate levels of stress were reported by students living with partners (72.7%) and having a boyfriend (40%), and high levels of stress were experienced by single students

(38.5%) ($p < .05$). Among males, moderate levels of stress were pointed out by married (66.7%), having a girlfriend (47.4%) and single students (43.3%). Students (50%) who lived with a partner most frequently experienced high levels of stress. According to Karkockienė (2011), the most common stressors were relationships with a family or friends, financial problems and a heavy study load.

CONCLUSIONS

1. Male students who followed a diet regime perceived lower level of stress compared with moderate stress experienced by students without a diet regime. Diet regime and perceived stress among female students did not differ. Significant differences in eating breakfast, having a snack, intake of food and perceived stress among male and female students were not found.
2. Different physical activity was not associated with stress perceived both by female and male students ($p > .05$).
3. High level of stress was not perceived by married female students, moderate levels – by females living with a partner, high level of stress – by single students. Marital state and stress experienced by male students did not differ. Considering gender, the associations between average mark, subjective study evaluation, incomes and perceived stress were not determined.

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