Original scientific paper

INFLUENCE OF PHYSICAL ACTIVITY ON DEGREE OF DEPRESSION, ANXIETY AND STRESS IN STUDENTS OF UNIVERSITY OF BELGRADE - FACULTY OF MEDICINE[1]

Uroš Lazarević[2]
Medical Faculty, University of Belgrade, Serbia

Dragana Drljačić[3]
College of Sports and Health, Belgrade, Serbia

Miloš Bojović
College of Sports and Health, Belgrade, Serbia

Srđan Milosavljević
College of Sports and Health, Belgrade, Serbia

Abstract: Mental health problems have become increasingly present among students. Therefore, the aim of this study was to examine the influence of physical activity (PA) on the manifestation of the symptoms of depression, anxiety and stress (DAS) in medical students. The sample of examinees included 89 students (59 female [F] and 30 male [M] students), from the first to the sixth year of studies at the Faculty of Medicine, University of Belgrade, aged $22 \pm 3,3$. The measuring instruments were a short version of the Depression, Anxiety and Stress Scale (DASS-21) and a short form of the International Physical Activity Questionnaire (IPAQ). The obtained results indicate that average scores fall into the category of normal degree of depression and anxiety, and a moderate degree of stress, whereby F show higher scores on the anxiety scale ($x^2 = 8.36$, $p = 0.004$). Different scores were noted among students of different years of study on the depression scale ($F = 2.515$, $p = 0.036$), as well the anxiety scale ($F = 3.594$, $p = 0.005$), but not on the stress scale ($F = 1.55$, $p = 0.183$). Total PA was assessed as moderate (median [interval] = 2613 [462-11931] MET-min/week), whereby M significantly more frequently engage in high intensity activities ($x^2 = 7.69$, $p = 0.006$). The research also recorded a small positive correlation between sedentary activities and stress symptoms in F ($ro = 0.282$, $p = 0.030$), while small negative correlation was noted in M between moderate PA and depression symptoms ($ro = -0.279$, $p = 0.033$). The research results indicate that total PA and the degree of DAS in examined students is at a satisfactory level.

Keywords: *IPAQ, DASS-21, metabolic equivalent, neurotic disorders, mood*

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[2] Uroš Lazarević attends specialist studies at the Faculty of Medicine, University of Belgrade.
[3] ✉ dragana.drljacic@vss.edu.rs

INTRODUCTION

Physical activity is any skeletal muscle movement that requires energy consumption (WHO, 2010), i.e. body movement produced by the musculoskeletal system that results in energy consumption above the threshold that the body consumes at rest (Caspersen et al., 1985). It includes various activities on a daily basis (from housework to recreational and physical exercise) (Pedišić, 2004; Stojanović et al., 2013). In the last few decades, numerous scientific studies have examined the relationship between physical activity and health, as well as the effects of physical exercise on certain organ systems (Kohl et al., 2013).

The extent of the impact of physical activity on health has turned out to be large enough that researchers, even with relatively rough measurement techniques, have been able to consistently document the strong association of physical exercise with health benefits (Siscovick et al., 1985; Sylvia et al., 2014). It has been proved that there is an evident link between regular physical activity and a reduction in the incidence of certain diseases, such as coronary heart disease (Oguma & Shinoda-Tagawa, 2004), diabetes (LaMonte et al., 2005), hypertension (Diaz & Shimbo, 2013), arthritis (Shih et al., 2006), osteoporosis (Castrogiovanni et al., 2016), colon cancer (Wolin et al., 2009), depression (Dinas et al., 2011), obesity (Chin et al., 2016) etc. There is also evidence that regular physical activity leads to the improvement of certain bodily processes of physically active people, such as carbohydrate and fat metabolism, hemocoagulation processes, immune system function, improving cognitive function and mental health in general (Kohl et al., 2013).

Considering that there is a clear positive impact of physical activity in the prevention and reduction of physical illness, we are witnessing increased interest in its contribution and in preserving and alleviating the problems of mental illnesses. The positive effects of physical activity on mental health have been shown in a large number of studies (Erić, 2015; Goodwin, 2003). In one of them, which included over 8,000 respondents, findings were obtained that indicate that regular physical activity significantly reduces the risk of depression and anxiety disorders (De Moor et al., 2006). Also, intervention studies show that even one-time physical activity leads to a reduction in symptoms of depression, anxiety and stress immediately after the end of physical activity (Stonerock et al., 2015; Strickland & Smith, 2014).

The World Health Organization estimates that depression, anxiety and stress are the main causes of reduced quality of life and shortened life expectancy today (Ostojić et al., 2009). Due to the increasing incidence of serious mental illnesses, there is a fear of an increase in the number of people suffering from chronic or recurrent, mild to moderate symptoms of these illnesses. We are already witnessing an increased occurrence of mental problems in the general public, which can be characterized as mild depression, low self-esteem, high stress and anxiety, and poor coping with the difficulties and problems of everyday life. The reduction of the presence of physical activity in institutions and the promotion of physical activity as a culture of living also contribute to these phenomena (Fox et al., 2000).

Mental health problems are becoming more common among students as well. Research has shown that almost half of university students show moderate levels of stress-related mental health problems, including anxiety and depression (Regehr et al., 2013). After becoming academic citizens, students face an increased scope of academic obligations and responsibilities, and thus a number of psychological and psychosocial challenges associated with their personal development and independence. In this regard, the studies of medicine are among the most challenging in the world, including in our country. The university life of medical students during medical training implies great commitment and responsibility in terms of performing academic tasks and caring for patients and their families. A large number of hours spent in lectures and clinical practice, an environment that is often not ideal for learning, lack of sleep as well as factors that interfere with daily personal life, are common during this period (Moutinho et al., 2017). All of these factors affect the mental and emotional status of students (Latas et al., 2010) and, in the absence of activities that improve quality of life, can contribute to the development of physical, mental, and emotional problems.

Research has shown that medical students belong to a population in which the phenomena of pre-examination anxiety are particularly prevalent (Latas et al., 2010). There are many publications on the topic of pre-examination anxiety, but the literature on the impact of physical activity on the symptoms of depression, anxiety and stress in a healthy student population, according to the authors of this paper, is scarce. For this reason, the aim of this study was to examine the impact of physical activity on the manifestation of symptoms of depression, anxiety and stress of students of medicine.

METHOD

Examinee sample

The research included 89 male and female students (F= 59 and M = 30) attending the first to the sixth year of studies of the Faculty of Medicine, University of Belgrade (1st year, N = 10; 2nd year, N = 23; 3rd year, N = 9; 4th year, N = 23; 5th year, N = 7 and 6th year, N = 17), of average age 22 ± 3.3 years, covering ages from 19 to 35. Relevant data concerning socio-demographic variables (age, sex, year of study) and clinical characteristics of the examinees were collected using a semi-structured questionnaire, and then used as criteria for the inclusion of examinees into the research. The presence of any kind of psychiatric diagnosis and/or the use of psychopharmaceuticals represented the main criteria for elimination from further research.

The research was conducted in September 2019, as a cross-sectional study, and it was approved by the Ethical Committee of the Faculty of Medicine in Belgrade.

Measuring instruments

To measure the degree of depression, anxiety, and stress, a short version of the Depression, Anxiety, and Stress Scale (DASS-21) consisting of 21 items was used (Lovibond & Lovibond, 1995). DASS-21 includes three subscales, with seven items each (depression scale, e.g. *I felt life was meaningless*; anxiety scale, e.g. *I felt close to panic*; stress scale, e.g. *I was annoyed when something interrupted me in what I do*). The Depression Scale assesses dysphoria, hopelessness, devaluation of life, self-regulation, and lack of interest / involvement in events, anhedonia and inertia. The anxiety scale assesses autonomic nervous system reactions, skeletal muscle reactions, situational anxiety, and the subjective experience of anxiety affect. The stress scale is sensitive to levels of chronic nonspecific arousal. It assesses the difficulties in relaxation, nervous excitement and easily triggered anxiety and impatience.

During the measurements, the examinees had the task to assess the degree to which they experienced each of these conditions in the last seven days on a four-point Likert-type scale (from 0 - not at all, to 3 - mostly or almost always) (Lovibond & Lovibond, 1995). Depression, anxiety, and stress (DAS) scores were calculated by summing the scores for the relevant items, with scores for each subscale ranging from 0 to 21. The criteria for determining DAS levels are shown in Table 1.

Table 1. *Assessment criteria for levels of depression, anxiety and stress*
(Lovibond & Lovibond, 1995)

Feeling	depression	anxiety	stress
normal	0-4	0-3	0-7
mild	5-6	4-5	8-9
moderate	7-10	6-7	10-12
strong	11-13	8-9	13-16
very strong	≥ 14	≥ 10	≥ 17

Legend: Columns show score intervals on the Depression, Anxiety and Stress Scale (DASS-21)

A short form of the International Physical Activity Questionnaire (IPAQ) was used to examine the level of physical activity (PA) (IPAQ Research Committee, 2005), which measures the frequency, duration and intensity of PA in the last seven days. This form of the IPAQ questionnaire is intended for health-related PA assessment in the population aged 15 to 69 and assesses PA levels through three types of activities: light PA, moderate and intense PA, and time spent in sedentary activities (sitting / lying down) (Hagströmer et al., 2006; Papathanasiou et al., 2009). The level of PA was estimated through the total energy consumption expressed in Metabolic Equivalents of Task. One metabolic equivalent (MET) represents the basal level of oxygen consumption and caloric expenditure associated with it (about 3.5 ml O2 / kg / min or 1 Kcal / kg / h) and corresponds to the level of resting metabolism (Ainsworth et al., 2000). The calculation of MET was done according to the Guidelines for Data Processing and Analysis of the International PA Questionnaire (IPAQ Research Committee, 2005). MET-min / week values < 600 were considered low energy consumption and corresponded to the category of light PA. Values from 601 to 3000 MET-min / week

corresponded to moderate PA, and values > 3000 MET-min / week to intensive PA (Craig et al., 2003). Furthermore, based on the cumulative IPAQ score, the examinees were classified into the group of active subjects (MET-min / week ≥ 3000) and the group of inactive subjects (MET-min / week ≥ 3000).

Statistical analysis

Basic descriptive indicators (frequencies and percentages for attribute features, i.e. SV ± SD, minimum and maximum for numerical features) were calculated for all variables. The normality of the distribution of numerical features was examined using the Shapiro-Wilk test, which showed the absence of a normal distribution for all monitored variables. In line with the results obtained for the purpose of examining differences in the degree of DAS in relation to sex, differences in types of PA in relation to sex, as well as differences in the degree of DAS in relation to the level of PA between respondents of the same sex and physically active and physically inactive students, the Kruskal-Wallis test was applied. Since the results of nonparametric statistics did not differ from the results obtained by parametric tests, to examine differences in the degree of DAS between respondents of different years of study, as well as differences in PA between respondents of different years of study, the paper presents results obtained by one-factor analysis of variance. In case of significance of the main factor, subsequent Fischer LSD tests were performed. Spearman's rank correlation coefficient was applied to examine the relationship between PA levels and DAS levels, by testing the correlation between individual IPAQ instrument subscales and DASS-21 subscales. According to Cohen's criteria, values from 0.10 to 0.29 were considered small, from 0.30 to 0.49 medium, and values from 0.50 to 1.00 were considered to indicate high correlation (Pallant, 2011). Statistical tests were calculated using SPSS 20.0 software (SPSS Inc, Chicago, IL), where the threshold of significance of statistical analyses was at the level of confidence $p = 0.05$.

RESULTS

Assessing the degree of DAS on the total sample yielded results that fall into the category of normal feeling on the scale of depression (median and interval, Med [interval] = 3 [0-20]) and anxiety (Med [interval] = 3 [0-17]) and a mild feeling on the stress scale (Med [interval] = 8 [1-20]). However, high maximum values were also recorded, for all three scales, which fall into the category of very strong feeling.

Picture 1 shows the basic descriptive indicators (Med and interval) of the degree of DAS and the results of comparisons in relation to gender, where it can be observed that all three types of symptoms are more pronounced in female subjects. However, significant differences were observed only in the symptoms of anxiety ($x2 = 8.36$, $p = 0.004$), but not in the symptoms of depression ($x2 = 0.94$, $p = 0.333$) and stress ($x2 = 2.54$, $p = 0.111$).

Picture 1. *Basic descriptive indicators (median and interval) of the degree of depression, anxiety and stress and the results of comparisons in relation to sex*
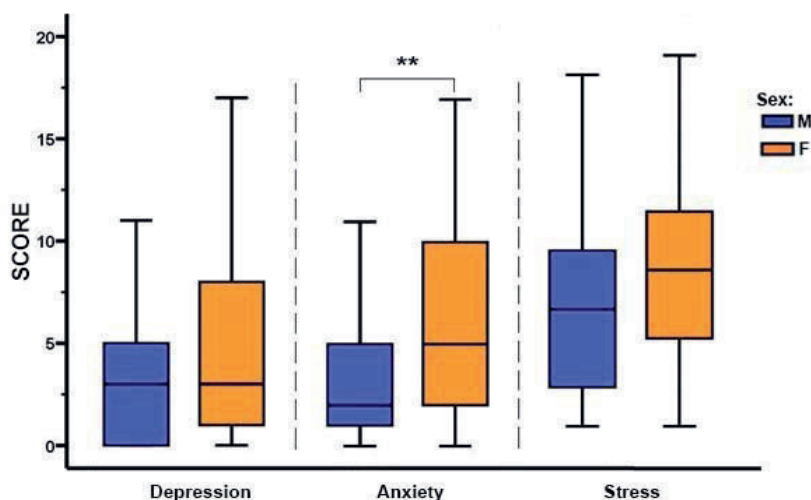
Legend: Rectangular diagrams represent the interquartile range, while the centre line represents the median. The symbol ** indicates differences between the sexes (M-male and F-female) significant at the level of p<0.01

Table 2 shows the basic descriptive indicators (Med and interval) of DAS degree, by years of study. On the scale of depression, the largest number of results is within the normal feeling of depression (score 0-4), except for the 1st and the 5th year, where it is within the moderate feeling of depression (7-10). Anxiety scores range from normal feeling (0-3) for the 3rd, 4th and 6th year, mild for the 5th, moderate (6-7) for the 1st and strong feeling of anxiety for the 2nd year of study. Stress scores range from normal feelings for the 3rd, 4th and 6th year (score 0-7), mild for the 2nd and 5th (score 8-9), to moderate feelings of stress (score 10-11) for the 1st year of study.

Table 2. *Basic descriptive indicators (median and interval) of the degree of depression, anxiety and stress, by years of study (I-VI)*

	I	II	III	IV	V	VI
Depression	7 (0-20)	3 (0-17)	3 (0-9)	1 (0-13)	7 (3-8)	3 (0-16)
Anxiety	7 (0-7)	8 (0-14)	2 (1-10)	2 (0-8)	5 (0-12)	3 (0-11)
Stress	10 (3-18)	9 (1-20)	7 (2-16)	6 (2-15)	9 (7-16)	7 (1-19)

The results of comparing the degree of DAS in relation to the year of study are shown in Picture 2. First-year students generally showed the highest degree of DAS in relation to students of other years of study, while the lowest degree was recorded in fourth-year students. One-factor analysis of variance revealed differences between students of different years of study in the degree of depression ($F_{5.88} = 2.515$, $p = 0.036$) and anxiety ($F_{5.88} = 3.594$, $p = 0.005$), but not in symptoms of stress ($F_{5.88} = 1.55$, $p = 0.183$). Depression symptoms are significantly more present in first-year students than in third-year students (average difference [AD] = 4.33, $p = 0.042$) and in fourth-year students (AD = 4.66, $p = 0.009$), while in students of the 2nd year, the symptoms of depression were more present than in the fourth year students (AD = 3.61, $p = 0.009$). First-year students also showed a higher degree of anxiety compared to colleagues attending the 4th (AD = 4.47, $p = 0.004$) and 6th year of study (AD = 3.42, $p = 0.036$). A higher degree of anxiety was also recorded among second-year students compared to fourth-year students (AD = 4.17, $p = 0.001$) and sixth-year students (AD = 3.12, $p = 0.018$).

Picture 2. *Basic descriptive indicators (SV ± SD) of the degree of depression, anxiety and stress and comparison results in relation to the year of study*
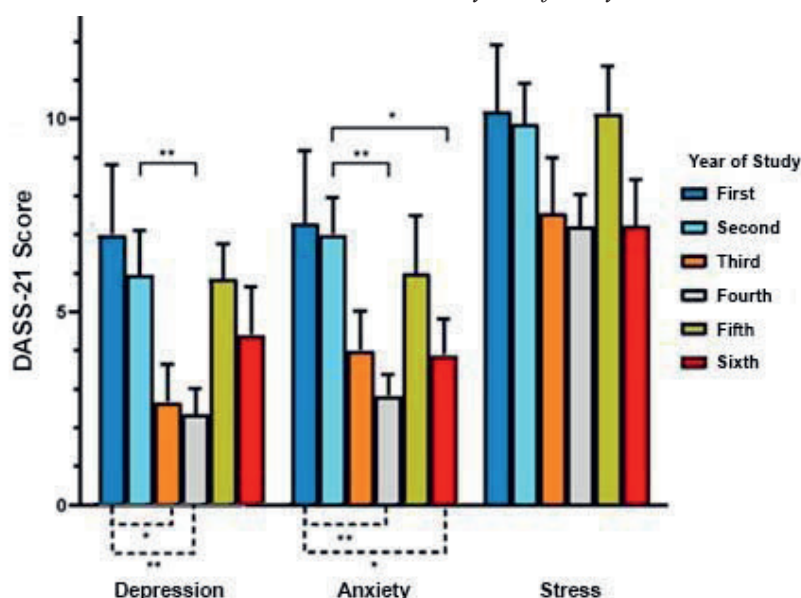

Legend: DASS-21 Score - the value of the score on the scale of depression, anxiety and stress, the symbol * indicates differences between groups significant at the level of $p<0.05$, and the symbol ** differences significant at the level of $p<0.01$

Estimation of PA levels at the sample level yielded values that fall into the category of moderate total PA (Med [interval]) = 2613 ([462-11931] MET-min / week), with sedentary activities, Med [interval] = 408 [75- 780]

MET-min / week; light PA, Med [interval]) = 1386 [132-4851] MET-min / week; moderate, Med [interval]) = 240 [0-3600] MET-min / week and intense, Med [interval]) = 0 [0-6720] MET-min / week.

Picture 3 shows the basic descriptive indicators (Med and interval) of different types of PA in the last seven days, and the results of comparisons in relation to gender. It can be noticed that male respondents scored higher on the IPAQ scale compared to their female counterparts, but these differences are significant only in the case of intense physical activity ($x2 = 7.69$, $p = 0.006$), but not in other types of activities, as well as on the cumulative IPAQ score.

Picture 3. *Basic descriptive indicators (median and interval) of different types of physical activity (PA), total PA and results of comparisons in relation to gender*
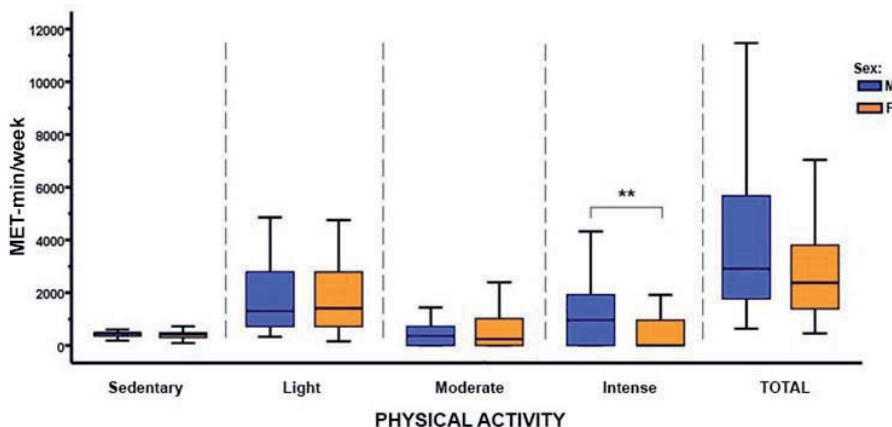
Legend: MET-min / week - metabolic equivalent, M - male, F - female. Rectangular diagrams represent the interquartile range, while the centre line represents the median. The symbol ** indicates differences that are significant at the level of $p < 0.01$

Table 3 shows the basic descriptive indicators (Med and interval) of different types of PA (sedentary, light, moderate and intensive) and total PA according to years of study. It can be noticed that students of the 3rd, 5th and 6th year of study achieved a large total energy consumption during one week (MET-min / week ≥ 3000), in contrast to students of the 1st, 2nd and 4th year, whose values of MET-min / week were < 3000 and belong to the category of moderate energy consumption. The highest energy consumption was achieved by students of the 3rd and 5th year (MET-min / week = 3732), while the least active were first-year students (MET-min / week = 1527). Comparing the results at the PA level, in relation to the year of study, no differences were observed between the groups (F values ranged from $F_{5.88} = 0.416$ to $F_{5.88} = 1.676$).

Table 3. *Basic descriptive indicators (median and interval) of different types of physical activity (PA) as well as total PA in the last seven days, presented in metabolic equivalents (MET-min / week), by years of study (1st-6th)*

	1st	2nd	3rd
Sedentary	435 (75-600)	420 (150-780)	360 (300-600)
Light	1056 (330-4851)	1386 (132-4752)	1386 (132-4752)
Moderate	240 (0-3360)	0 (0-1800)	0 (0-3360)
Intense	0 (0-6480)	0 (0-1920)	480 (0-4320)
Total	1527 (462-11931)	1911 (693-6432)	3732 (1386-10878)
	4th	**5th**	**6th**
Sedentary	420 (90-720)	360 (180-720)	480 (120-540)
Light	1386 (297-4851)	2720 (495-3465)	1155 (198-4158)
Moderate	240 (0-3360)	480 (0-3360)	480 (0-3600)
Intense	320 (0-3840)	960 (0-4320)	960 (0-6720)
Total	2892 (462-9891)	3732 (933-10452)	3108 (594-11466)

Comparing the results between physically active and physically inactive subjects in the DAS degree, a trend was observed that all three types of symptoms were more pronounced in physically inactive male students, as well as in physically inactive female students (with the exception of depression). However, significant differences that would confirm this finding were not noted.

Finally, examining the association between PA and DAS symptoms in the total sample, no significant correlation was observed between the cumulative IPAQ score and symptoms of depression (ro = -0.049, p = 0.649), anxiety (ro = -0.130, p = 0.224) and stress (ro = -0.018, p = 0.865). Analysing the results by gender, there was a small positive correlation between sedentary activities and stress symptoms in women (ro = 0.282, p = 0.030), while in men there was a small negative correlation between moderate physical activity and symptoms of depression (ro = -0.279, p = 0.033).

DISCUSSION

The effectiveness of physical activity (PA) in the reduction of mental illness is close to the effects of traditional treatment - psychotherapy (Paluska & Schwenk, 2000). Exercising PA does not necessarily require financial investments, and an individual can practice it independently with appropriate instructions. Many other non-drug treatments (e.g., cognitive behavioural therapy) are not readily available to the general population (for economic or other reasons), which is another advantage of PA. It is also common knowledge that treatment needs for mental illness can never be fully met by health professionals alone.

Recognizing the importance of the connection of PA with health has led to great interest in assessing PA-related behaviours. Earlier research that studied the level of PA in the student population showed that it depends on the type of faculty (Malčić, 2018). Given that medical studies place high demands on students in terms of volume of material and daily obligations, this can be reflected in the symptoms of depression, anxiety and stress (DAS) even in students who do not have a psychiatric diagnosis.

This study showed a normal degree of depression and anxiety and a mild degree of stress in students of the Faculty of Medicine, University of Belgrade, with some students experiencing high values of DAS variables that indicate a strong feeling. The results obtained are partly in line with a study conducted among students of Brazilian universities, which recorded higher scores on the DASS-21 scale, with some groups of students reporting high levels of anxiety and stress (Moutinho et al., 2017). Further analysis showed that students, depending on the year of study, generally show a normal to moderate feeling of depression, a normal to strong feeling of anxiety and a normal to moderate feeling of stress. These results deviate in part from the results of recent research studies in the world, which indicate that students are a risk population for the development of mental illness. In the United States, a study was conducted on 67,000 students, and its findings indicate that mental health problems are common in the student population (Liu et al., 2019). Namely, the results showed that one in four students was treated for a mental health disorder, that a fifth of students were thinking about suicide, that 9% of students had attempted suicide, and almost 20% had experienced self-harm. One of the reasons why the findings of this DAS study differ from the results of the previous studies probably lies in the different criteria for inclusion of respondents in the study, which in the case of this study implied the absence of psychiatric diagnosis and taking psychopharmaceuticals, which probably resulted in relatively low scores on the DASS-21 scale.

The results of this research indicate that female students, compared to male students, show higher scores in the degree of DAS, with significantly more pronounced symptoms of anxiety. This finding is in line with previous research in the field of anxiety in students of medicine. In a study that analysed the pre-examination anxiety of medical students, it was shown that female students are more anxious (Latas et al., 2010). Some authors explain this difference by saying that female respondents are more willing to admit their anxiety than males, and it is possible that females are generally more anxious than males.

Although the results of this study indicate that the respondents are not under high stress and severe depressive and anxiety problems, if the DAS indicators are observed between the respondents of different years of study, there are differences in the values of these indicators. This is most noticeable with first-year students, which can be explained by the big changes and new challenges that they face. In the literature, among other things, irregular sleep patterns, fluctuations in close relationships and feelings of pressure caused by academic demands are cited as the main obstacles to students' mental health (Kadison & DiGeronimo, 2004), which is probably most pronounced in first-year students.

The assessment of the level of PA indicates that the total PA of the examined students belongs to the category of moderate, with students practicing light PA (walking) the most, and intense the least. At the same time, differences between students of different years of study were not noticed. When it comes to differences between sexes, male students practiced intensive PAs significantly more than female students.

Furthermore, a study that analysed the association between sedentary lifestyle and psychological disorders (Hamer et al., 2014) showed that moderate PA was associated with a lower chance of depression in women, while intense to moderate PA was associated with a higher risk of depression in men. Similar findings emerged from the study by Wang et al. (2019) in which the association between depression and PA largely depended on the intensity of PA and respondents' sex. Lower incidence, shorter duration, and moderate PA were associated with a lower risk of depression in women. On the other hand, in men who used PA with a higher frequency, duration and intensity, the risk of depression was higher. In this regard, the findings of this study are partly consistent with the findings of previous studies. Namely, assessing the relationship between PA levels and DAS levels, only a small positive correlation was found between sedentary lifestyle and stress symptoms in female students, as well as a small negative correlation between moderate physical activity and depression symptoms.

CONCLUSION

Based on the findings of this study, it can be concluded that the level of physical activity, as well as the degree of depression, anxiety and stress of the examined students of the Faculty of Medicine, University of Belgrade is at a satisfactory level. The obtained results are partly in line with previous studies, and to confirm such findings in some future research should provide a larger and more homogeneous sample of respondents, with monitoring of PA levels and DAS indicators over time, all with the aim of developing different support systems for prevention and reduction of mental problems and difficulties.

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