The Correlation of Kinesiology Activities and Students' Anxiety, Depression and Stress Self-Evaluation

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Abstract **- Physical activity has positive effects on different elements of one's physical and mental health. Lack of physical activity and extremely sedentary lifestyle without much movement may enhance experience of negative emotions.**

The objective of this paper is to determine whether the self-evaluation of depression, anxiety and stress conditions is in any way associated with exercising.

The research was conducted on a sample of 1000 undergraduate and graduate students. The questionnaires applied in evaluating the frequency and intensity of physical activity were *International Physical Activity Questionnaire* (IPAQ) Questionnaire of the former engagement in kinesiological activities (KINAKT), and in self-evaluation of negative emotional states applied DASS-21 with depression, anxiety and stress subscales.

The results show that 30 minutes of active movement at least once or several times a week can mitigate depression and anxiety. Intensive physical activity can mitigate depression, anxiety and stress, whilst moderate physical activity can mitigate depression. The results can be used in providing recommendations for the development of students' kinesiology activity programmes.

Keywords **- Physical activity, depression, anxiety, stress.**

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1. Introduction

Studying at the university is a period of transition to adulthood which includes assuming responsibilities, becoming more independent and freer, but at the same time encountering greater challenges. Such transition can have adverse impact on students' psychological well-being, as confirmed in research showing high prevalence of anxiety, depression and stress among members of this population [1], [2]. Compared to general population, the beginning of university education is often considered a stage of life filled with the highest levels of anxiety and psychological stress, which can be reflected on students' academic achievement and the quality of life [3], [4], [5].

Academic stress and mental health of students: The main sources of stress are exams, time management and huge amount of studying material, which can result in higher anxiety and symptoms of depression [6]. Also, stress due to adjusting to new social roles may additionally jeopardise students' mental health [7]. High stress levels are associated with increased cortisol secretion which, in the long run, may have negative impact on physiological processes and contribute to the development of anxiety and depression [8], [9]. Some research studies [10] have investigated the relationship among academic stress, anxiety, self-efficacy and burnout in students. The results have shown that high academic stress increases anxiety and burnout, whilst academic self-efficacy works as a factor of protection. A systematic review of references comprising 31 studies on students' mental health in Great Britain has led to the conclusion that the characteristics of mental strength are connected with lower risk of mental health problems [11]. These findings emphasize the importance of encouraging psychological resilience and providing support to student population in order to improve their mental health and academic achievements.

Prevalence of anxiety and depression among students: Meta-analyses and systematic reviews of references indicate significant prevalence of depression in student population. Research shows that one third of all students is subject to a high risk of developing symptoms of depression caused by factors relating to academic stress, adjustment to new life conditions and social and economic pressure [12], [13]. A large international study conducted on 14,000 students in 8 countries has shown that 35% of respondents meet diagnostic criteria for at least one mental disorder [14].

Anxiety is common among students and is characterised by persistent worrying, intrusive thoughts and negative anticipation of future events. The study conducted on 88,000 American students showed that 63.4% had experienced significant anxiety throughout the previous year [15]. In a more recent estimate of health condition from 2022, one in three students (34.60%) reported that he/she was diagnosed with an anxiety disorder, such as general anxiety disorder, social anxiety disorder, panic disorder or specific phobia, whilst 35.10% of students stated that anxiety was the disruptive factor in their academic achievements [16]. Some researchers [17] have stated that the prevalence of anxiety in student population during COVID-19 pandemic ranges from 23% to 39%, depending on the country of research. However, meta-analyses conducted on European students have determined that the prevalence of anxiety actually ranges from 45% to 64% [18]. Similar research conducted in other countries also confirm these findings, for example, an Australian study showed that girls were especially affected, accounting for almost 75% of teenagers who experienced significant anxiety or depression symptoms [19]. A Croatian study aimed to investigate the occurrence of depression, anxiety and stress among medical students [20]. The research has shown that 25.7% of medical students experience depression disorders, 26.7% have significant anxiety disorders and 15% of respondents have significant symptoms of stress, with the symptoms of anxiety and stress being more expressed in female students. Earlier research on medical students indicated an average prevalence of 28% for depression and 30% for anxiety [21], [22]. The risks described in these meta-analyses were younger age, female gender and poor social support.

Stress as a development background for anxiety and depression in student population: According to research conducted by [23], general anxiety is widely spread among students around the world. Since anxiety can seriously affect students' social functioning, their academic achievement and even physical health, identifying the risk factors and clarifying the mechanism of interaction is necessary to facilitate development of adequate strategies and interventions.

Authors emphasize that stress is one of important risk factors leading to anxiety. It occurs as a response to external demands which exceed the capabilities of an individual to cope with them. When reacting, the body activates the hypothalamic-pituitary-adrenal (HPA) axis, which leads to increased cortisol secretion [24]. High cortisol levels are associated with prefrontal cortex dysfunction and increased activity of the amygdala, contributing to the feeling of anxiety and symptoms of depression [8]. Long-term activation of the HPA axis is associated with increased depression and anxiety disorders, reduced cognitive flexibility and difficulties in decision-making process [9]. Researchers focus more and more on the stressors students encounter and the tackling strategies they adopt. The stressors students encounter are differently categorised in various studies, but several main sources of stress have been identified in student population. Stressors relating to students can be divided into academic, financial, interpersonal and existential [25]. Academic stress, especially the pressure caused by exams and expectations, reduce motivation and increase the risk of burnout, often resulting in quitting studies [26], [27], [28] and negatively impacting the students' mental health [29]. A study was conducted a research in the Netherlands studying perceived stress in different life domains, on a sample of 2,196 students [30]. The results have shown that lack of social support additionally exacerbates their response to stress. The research has demonstrated that foreign and exchange students more intensively experience social changes and cultural and educational differences, which may impact their stress levels. Similar results were obtained by [31] and [32].

Physical activity and training acting as protective factors: Mental wellbeing is closely connected to one's lifestyle. A healthy lifestyle has positive impact on a person's mental state [33], [34], [29]. Research show that certain lifestyle characteristics may mitigate the risk of developing depression among students [35]. The results obtained in many studies demonstrate that a healthy sleep, together with regular physical activity and social support associate with more seldomly occurring symptoms of depression [14], [36]. A longitudinal Spanish research which monitored 1,292 students throughout one year, has concluded that exactly these factors were associated with lower prospects for developing depression [12]. Physical activity has been recognised as one of the most efficient way in reducing the symptoms of anxiety, depression and stress among students [37]. Positive effects of physical training are explained by neurobiological mechanisms, which include increased secretion of endorphin, serotonin and dopamine [38], [39].

Additionally, a regular physical activity improves the HPA axis function by reducing negative impacts caused by stress [40]. It also impacts a person's emotional state by reducing perceived stress and increasing resilience to emotional challenges [41]. Students who practice moderate or intensive physical exercises show lower levels of anxiety and depression [37]. Even a simple walk demonstrated significant protective effect, especially in male students [42]. The referred studies clearly show that any physical activity has a safeguard effect on physical and mental health and plays an important role in preserving emotional stability of a person, when he/she is exposed to increased mental stress [43].

Physical activity's effect safeguard mechanisms: The mechanism through which physical activity affects the alleviation of negative emotions is often associated with levels of physical resilience and coping styles employed in dealing with negative emotions [44]. Highly psychologically resilient individuals are more likely to embrace positive tackling strategies and are more proactive in their management of negative emotions [45], [44]. Research shows that persons who exercise on a regular basis are mentally more resilient, develop more adaptive emotional responses to environmental changes, thus improving their tackling skills and contributing to emotional recovery [46]. Most of the studies have confirmed positive impact of regular physical activity on mitigating anxiety, depression and stress [43], [44], [47], [48], [49]. The authors emphasize the importance of active lifestyle for improving mental wellbeing of students, by highlighting the need to promote physical activity as a mental health strategy.

Despite its recognised advantages, physical activity has often been neglected by students. They report seldom physical movement(s), mostly due to lack of time, motivation and inaccessibility of sport facilities [50]. Many studies indicate that insufficient physical activity among students is to be associated with negative outcomes on their physical and mental health [51], [52].

Having regard to all given findings, it is clear that encouraging active lifestyle among students is important for their mental wellbeing. Promoting available and flexible forms of physical activity may contribute to better mental health and fewer negative consequences associated with sedentary lifestyle. Mutual relationship between anxiety, depression and stress and levels of physical activity has not been sufficiently investigated in Croatian student population. This research aims at providing answers to the question as to which extend physical activity can work as a protective factor against negative emotional states of students.

It is to be expected that students practicing more physical exercises will demonstrate lower levels of anxiety, depression and stress, which would confirm the safeguarding role of physical activity in preserving mental health.

2. Methodology

The research was conducted at one Croatian university, with the approval of the University Ethics Committee. The objectives and findings are part of a doctoral thesis research conducted by the [53] and mentors and co-authors of this paper.

2.1. Respondents

The study was participated by N=1000 respondents, undergraduate and graduate students at one Croatian university aged 19 to 23 (M = 23.14, SD =3,20). Within the sample, N = 480 (48,0%) were male and N = 520 (52,0%) female. Their participation was voluntary and anonymous.

2.2. Measuring Instruments

a) The Depression, Anxiety and Stress Scale - 21 DASS-21 questionnaire [54] is used in self-evaluation of depression, anxiety and stress. The reliability of the survey expressed as Cronbach's alpha reliability coefficient is = 0.950 [55]. The reliability of sub-scales is: depression = 0.908, anxiety 0=0.854 and stress = 0.891 [53].

b) The questionnaire on evaluating kinesiology activities and involvement in sports: To self-evaluate physical activity of the respondents, the Croatian version of questions was used [56] *International Physical Activity Questionnaire* IPAQ-SF [57] together with the questionnaire of past engagement in kinesiology activities/sports (KINAKT) [58]. The reliability of KINAKT questionnaire expressed as Cronbach's alpha coefficient is α= 0.978 [53].

The International Physical Activity Questionnaires (IPAQ) estimated walking, moderate intensity activities and strenuous physical activities. A part of the KINAKT questionnaire which was used in this research allows, *inter alia*, to estimate the frequency of sport and recreational activity in the last week, on a scale of 0 to 4 times a week.

3. Results and Discussion

The results demonstrate application of the DASS-21 scale and KINAKT questionnaire, descriptive statistics, reliability estimate, mutual comparison and connections among variables.

3.1. Measuring Reliability of the Depression, Anxiety and Stress Scale, DASS-21

In order to determine the measuring reliability of DASS-21, the reliability of its subscales was calculated.

The results of DASS-21 questionnaire implementation and of the three self-evaluation sub-scales of this measuring instrument (the self-evaluation subscales for depression, anxiety and stress) are shown in the tables below.

Table 1, Table 2 and Table 3 present the arithmetic means, variances and correlations among items and the Cronbach's alpha coefficient of individual items.

Table 1. DASS-21 questionnaire results - depression self-evaluation sub-scale

	Arithmetic Mean	Variance	Correlations	Cronbach's α
I found it hard to calm down	6.44	24.210	.695	.874
I tended to overreact	6.47	23.859	.658	.878
I felt very nervous	6.15	22.896	.743	.868
I felt my restlessness building up	6.37	22.750	.785	.863
I found it difficult to relax	6.23	22.625	.750	.867
I could not stand anything disturbing me in what I was doing	6.34	25.521	.491	.897
Sometimes I was rather sensitive	6.20	23.058	.692	.874

Table 1 shows a Cronbach alpha reliability coefficient of certain DASS-21 items ranked from 0.863 to 0.897, and the Cronbach alpha of overall depression self-evaluation sub-scale being $\alpha = 0.891$.

Below is the presentation of results of the other DASS-21 sub-scale – the self-evaluation of anxiety including information on arithmetic means of respondents' answers, items' variance, correlation among items and the Cronbach's alpha reliability coefficient.

Table 2. DASS-21 questionnaire results - anxiety self-evaluation sub-scale

	Arithmetic Mean	Variance	Correlations	Cronbach's α
Dry mouth	4.12	19.305	.451	.856
Trouble breathing (rapid breathing, shortness of breath at rest)	4.44	18.934	.600	.837
Tremor (e.g. of hands)	4.40	18.320	.606	.835
I was concerned about situations in which I might panic or feel embarrassed	3.83	17.141	.606	.836
I felt close to a panic attack	4.22	17.048	.713	.818
I was aware of how my heart works when at rest (skipping, rapid heartbeat)	4.26	17.612	.655	.828
I was scared for no particular reason	4.32	17.474	.701	.821

Table 2 shows the rank of Cronbach alpha reliability coefficient of certain DASS-21 anxiety sub-scale items from α=0.818 to α=0.856, and the Cronbach alpha of the anxiety self-evaluation sub-scale α= 0,854. These data indicate sufficiently high reliability of the sub-scale and its items.

Furthermore, the results of DASS-21 stress sub-scale including data on arithmetic means of respondents' answers, items' variance, correlation among items and the Cronbach's alpha reliability coefficient are given in Table 3.

Table 3. DASS-21 questionnaire results – stress self-evaluation sub-scale

	Arithmetic Mean	Variance	Correlations	Cronbach's α
I was unable to experience any positive feeling	5.41	25.045	.743	.893
Starting the activity was difficult for me	4.84	26.652	.479	.920
I felt like I had nothing to look forward to	5.28	23.203	.838	.881
I was low-spirited and sad	5.01	24.252	.726	.894
I could not be fascinated by anything	5.41	24.269	.791	.888
I felt like a worthless person	5.27	23.546	.764	.890
I felt like life had no sense	5.32	23.716	.749	.892

Data shown in Table 3 indicate a range of Cronbach alpha reliability coefficient of certain stress self-evaluation sub-scale items in DASS-21 from 0.881do 0.894, and the Cronbach alpha of overall stress self-evaluation sub-scale being α = 0,908.

The reliability of DASS-21 sub-scales ranges from α=0.854 for the anxiety sub-scale, through α=0.891 for depression to the highest, stress self-evaluation scale, at α=0.908. The results show that the DASS-21 depression, anxiety and stress scale questionnaire has high overall reliability expressed as a Cronbach alpha coefficient, that the three sub-classes have satisfactory reliability measures and that applying DASS-21 enables reliable self-evaluation of depression, anxiety and stress.

A mere application of DASS-21 questionnaire shows that almost half of the students demonstrate mild, moderate or increased outcome values related to depression and stress [59]. These results can be compared to research conducted by [18] showing 45% to 64% anxiety prevalence among student population and that 35% students experience mental disorders [14].

3.2. A KINAKT Questionnaire Analysis of Overall Physical Activity during the Previous Week which Lasted Longer Than 30 Minutes

In the KINAKT questionnaire, the respondents were, *inter alia*, asked how many times they had practiced any physical activity which lasted more than 30 minutes in the previous week. These data are shown in Figure1.

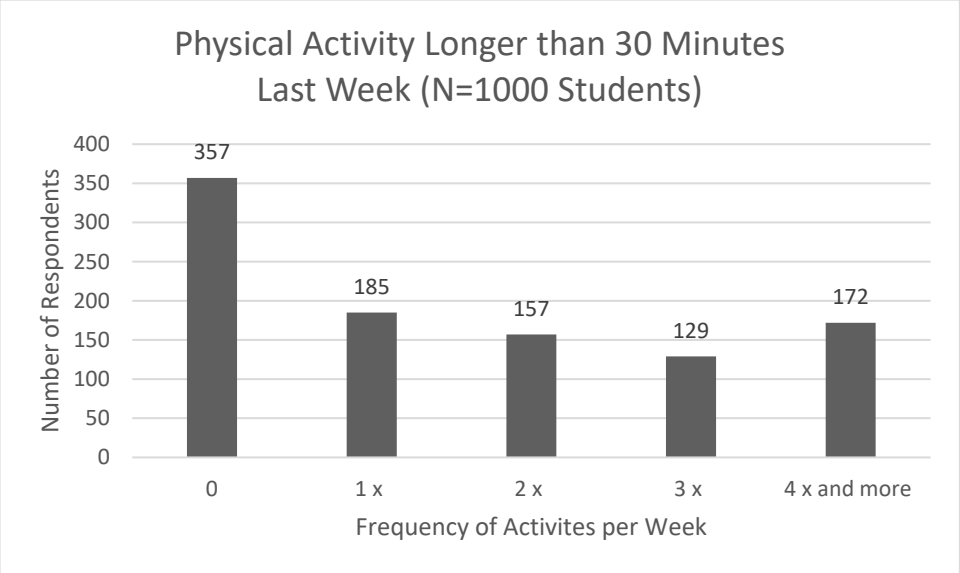

Figure 1. The frequency of physical activities lasting longer than 30 minutes last week

Respondents' answers summarised in Figure 1 highlight that the week before around one third of the respondents did not practice any physical activity for longer than 30 minutes (N=357; or 35.7%). Respondents who practiced a physical activity longer than 30 minutes once a week comprise N=185 (18.5%), twice a week N=157 (15.7%), three times a week N=128 (12.9%) and more than 4 times a week N=172 (17.2%). These results indicate a relatively low frequency of regular physical activity of students. According to the entire KINAKT questionnaire, 27.3 % of students did not practice any physical activity in the last month and almost half of the respondents (49.3%) in the last week spent their time sitting 4 to 8 hours a day [53], [60]. The results of rather scarce physical activity of students have also been confirmed by other researchers [52], [51].

3.3. The Kruskal-Wallis Test by Ranks Used in Comparing Participation in Physical Activity which Lasted at Least 30 Minutes in the Last Month

Table 4 shows a comparison of DASS-21 questionnaire self-evaluation results and their sub-scales of depression, anxiety and stress in students with physical activity which lasted longer than 30 minutes during the last week, conducted using KINAKT questionnaire item. Physical activity was evaluated by categories of not at all (0), once a week (1), two times a week (2), three times a week (3) and four and more times a week (4).

Table 4. The Kruskal-Wallis test by ranks used in comparing participation in physical activity which lasted less than 30 minutes in the last month

	How many times last week did you practice any sport & recreational activity which lasted less than 30 minutes?	N	Ranks' arithmetic mean	Kruskal-Wallis *H*	p
Depression	Zero	357	528.11	14.415	**.006**
	Once	185	530.00		
	2 times	157	482.47		
	3 times	129	488.14		
	4 or more times	172	437.18		
	Total	1000			
Anxiety	Zero	357	528.40	18.422	**.001**
	Once	185	540.76		
	2 times	157	481.27		
	3 times	129	482.14		
	4 or more times	172	430.60		
	Total	1000			
Stress	Zero	357	527.16	7.675	.104
	Once	185	497.15		
	2 times	157	499.73		
	3 times	129	494.99		
	4 or more times	172	453.62		
	Total	1000			

According to the results obtained by the non-parametric Kruskal-Wallis test (Table 4) used for comparing independent variables of DASS-21 questionnaire for subscales of depression, anxiety and stress with independent variables of KINAKT questionnaire for physical activity within the last week ranging 0, 1, 2, 3 and 4 and more times, it was determined that there was a statistically significant difference in DASS-21 results on the depression and anxiety sub-scales, in relation to practicing physical activities. Students who, in the last week, once or more than once/multiple times practiced a physical activity longer than 30 minutes estimated themselves as being less depressed (H=14.415, p=0.006) and less anxious (H=18.422, p=0.001). There is no statistically significant difference in relation to the level of stress with students who practice physical activities more or less often during one week (H=7.675, p=104). Based on these results it can be concluded that a more often physical activity practiced for longer than 30 minutes a week is a good way of reducing depression and anxiety.

A more often physical activity practiced for 30 minutes a week is not related to stress reduction. It could be explained this in a way that students who practice physical activities more often may have less time available to study, which increases their stress level. The result may be applied as a recommendation for students who experience anxiety and depression, by suggesting them to practice physical activity for at least 30 minutes per week.

3.4. The Correlation of Overall Physical Activity Evaluated by the International Physical Activity Questionnaire – (IPAQ-SF) and Self-Evaluation of Depression, Anxiety and Stress Evaluated by the Depression Anxiety and Stress Scale 21 (DASS-21)

In order to determine the correlation of physical activity variables estimated by the IPAQ and the variables of depression, anxiety and stress self-evaluation based on the answers provided by the respondents participating in DASS-21 questionnaire, the Spearman's rank correlation coefficient was applied. The results are shown in Table 5.

*Table 5. Spearman's rank correlation coefficient (Spearman's rho**) IPAQ and DASS.21*

KINAKT (Physical Activity Level)		**DASS-21** Depression	**DASS-21** Anxiety	**DASS-21** Stress
HIGH Physical Activity	r	-.097**	-.112**	-.107**
	p	.003	.001	.001
	N	940	940	940
MODERATE Physical Activity	r	-.078*	.004	-.028
	p	.019	.911	.402
	N	914	914	914
LOW / Insufficient Physical Activity - walking	r	-.011	.073*	.038
	p	.748	.030	.255
	N	879	879	879
Total Physical Activity	r	-.088**	-.036	-.055
	p	.005	.257	.080
	N	1000	1000	1000
Total sitting per week	r	.069*	-.021	.039
	p	.044	.547	.256
	N	863	863	863

***. Significant correlation at 0.01*
**. Significant correlation at 0.05*

Based on correlations shown in Table 5, very low statistically significant negative correlations have been reported in DASS-21 self-evaluation sub-scale between depression and high physical activity (r= -0.097, p<0.01), moderate activity(r=-0.078, , p<0.05) and total physical activity (r=-=.088, p<0.01), with the correlation of DASS-21 sub-scale depression self-evaluation and total weekly period of sitting being positive (r=.069, p<0.05).

Low statistically significant negative correlation has been reported with DASS-21 anxiety variable and high physical activity (r= -0.112, p<0.01), and low statistically significant positive correlation occurred between the DASS-21 anxiety variable and low or insufficient physical activity, i.e. walking (r=.073, p<0.05). On the DASS-21 scale stress is negatively correlated with high level of physical activity (r=-0.107, p<0.01).

These results can be compared with research conducted by [37], which also demonstrate that physical activity is a symptom of students' anxiety, depression and stress. An additional confirmation that physical activity reduces the negative effects of stress is provided by one of the recent studies [40].

To conclude, it is likely that high levels of physical activity can mitigate the feeling of depression, anxiety and stress, just like moderate and overall (high, moderate and low) physical activity, can mitigate depression. On the other hand, more sitting can increase the self-perception of depression. Although these correlations are statistically significant, when interpreting data what has to be taken into consideration are their rather low values.

4. Conclusion

Practising physical activities is important in preserving physical and mental health. The level of mental health can, *inter alia*, be estimated by applying the questionnaires whose sub-scales encompass its various aspects, such as self-evaluation of depression, anxiety and stress. The self-evaluation of students' health conducted by the DASS-21 questionnaire provides reliable results expressed as Cronbach alpha reliability coefficient.

Since any physical activity is an important element in preserving physical health the research also focused on estimating the intensity of students' practicing physical activities. The results obtained on a sample of N=100 students at one Croatian university have shown that the week before over one third of all students (35.7%) did not practice any physical activity lasting longer than 30 minutes. Comparison of the results obtained by the KINAKT and DASS-21 questionnaires has shown the existing correlation between the intensity of physical activity and the self-evaluation of depression, anxiety and stress; since research has also shown that depression and anxiety may be reduced with 30 minutes of physical activity in a week, physical activity as a measure of prevention to mitigate those negative emotional conditions is to be recommended.

The results have shown that moderate physical activity estimated by IPAQ can contribute to mitigating depression (DASS-21), whilst more frequent resting periods and sitting increase it. The DASS-21 questionnaire applied in this research has shown that high level of physical activity may mitigate depression, anxiety and stress (DASS-21).

The correlation of variables calculated with Spearman's rank correlation coefficients applied between physical activity and self-evaluation of negative emotional states is statistically significant and rather low, which is a limitation factor in interpretation of obtained results.

Another limitation can be the methodological one, represented by the very sample of students who have enrolled in different programmes of study. Therefore, it would be good if the research could additionally include more students from different universities and colleges.

The follow-up research should include expanding and implementation on high-school population of students and comparison of the existing results with the outcomes of other measuring instruments implemented on mental health and physical activity estimate. A more intensive informing and encouraging students to practice physical activities, by implementing programmes of moderate physical activities can be beneficial for mental health preservation. Further research plans take into consideration the implementation of parallel measuring instruments intended for self-evaluation of emotional states in correlation with physical activity.

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