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PHYSICAL EXERCISE, MENTAL HEALTH, QUALITY OF LIFE IN HIGHER EDUCATION– SYSTEMATIC REVIEW

EXERCÍCIO FÍSICO, SAÚDE MENTAL, QUALIDADE DE VIDA NO ENSINO SUPERIOR – REVISÃO SISTEMÁTICA

Isabel Simões Dias[1,2,3], Miguel Jacinto[1,4], Maria Odília Abreu[†1,2], & Marta Fonseca[1,2,3]

[1]School of Education and Social Sciences, Polytechnic of Leiria, Leiria, Portugal
[2]Life Quality Research Centre (CIEQV), Rio Maior, Portugal
[3]Centre for Studies in Education and Innovation (CI&DEI), Leiria, Portugal.
[4]Research Center in Sport, Health, and Human Development (CIDESD), Covilhã, Portugal

Abstract: This systematic review aims to evaluate the relationship between physical activity (PA)/physical exercise (PE)/sport, mental health (MH) and quality of life perception (QoL) of students enrolled in higher education. The databases used for the articles selection were Pubmed, Web of Science, Scopus and SPORTDiscus and descriptors were "university student", "university student", "higher education student", "physical activity", "sports", "exercise", "training", "depressive mood", "stress", "anxiety", and "quality of life". Following the process provided by the PRISMA flow diagram, 37 articles were selected and, of these, 16 met the inclusion criteria for the study. In this systematic review the beneficial effects of the practice of PA/PE/sport on MH and on the QoL perception was registered. In the studies include in this systematic review anxiety, depression, and stress were lower in individuals who practiced PA/PE/sport and the greater their practice, the lower the symptoms of such comorbidities. At the same time there was also a significant correlation between PA/PE/sport and MH. On the other hand, higher levels of PA/PE/sport were also related to better QoL perception. This evidence reveals the relationship between PA/PE/sport with MH and the QoL perception of students enrolled in higher education. It is important to follow the World Health Organization (2020) recommendations for PA/PE/sport practice to further healthy lifestyles in students enrolled in higher education and to promote their MH and QoL perception.

Keywords: Anxiety, Depression, Higher education students, Quality of life, Physical exercise

Resumo: Esta revisão sistemática tem como objetivo avaliar a relação entre atividade física (AF)/exercício físico (EF)/desporto, saúde mental (SM) e percepção de qualidade de vida (QV) de estudantes matriculados no ensino superior. As bases de dados utilizadas para a seleção dos artigos foram Pubmed, Web of Science, Scopus e SPORTDiscus e os descritores foram "*university student*", "*university student*", "*higher education student*", "*physical activity*", "*sports*", "*exercise*", "treino", "humor depressivo", "stress", "ansiedade" e "qualidade de vida". Seguindo os procedimentos metodológicos do fluxograma PRISMA, foram selecionados 37 artigos e, destes, 16 atenderam aos critérios de inclusão do estudo. Nesta revisão sistemática foram registados efeitos benéficos da prática de AF/EF/desporto na SM e na percepção da QV. Nos estudos incluídos nesta revisão sistemática a ansiedade, a depressão e o stress foram menores nos indivíduos que praticavam AF/EF/desporto e, quanto maior a sua prática, menores os sintomas dessas comorbidades. Ao mesmo tempo, houve

[†]Autor de Correspondência: Maria Odília Abreu (odilia.abreu@ipleiria.pt)
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também uma correlação significativa entre AF/EF/desporto e SM. Por outro lado, níveis mais elevados de AF/EF/desporto também foram relacionados à melhor percepção de QV. Essas evidências revelam a relação entre AF/EF/desporto com a SM e a percepção de QV dos estudantes matriculados no ensino superior. É importante seguir as recomendações da Organização Mundial da Saúde (2020) para a prática de AF/EF/desporto para promover estilos de vida saudáveis nos estudantes matriculados no ensino superior e promover a sua perceção de SM e QV.

Palavras-Chave: Ansiedade, Depressão, Estudantes do ensino superior, Qualidade de vida, Exercício físico

Mental health (MH) is a concept that encompasses, among other variables, perceived self-efficacy, subjective well-being, competence, autonomy, intergenerational dependence and self-actualization of the individual's intellectual and emotional potential (World Health Organization - WHO, 2002). It is a general term to refer to psychological, mental, cognitive, and affective factors that promote or hind an individual's functioning. MH can be affected by mental disorders (in its cognitive, emotional or behavioural dimension) that can be explained by a combination of biological, psychological and social factors (American Psychiatric Association, 2013; WHO, 2002).

MH problems are prevalent in the general population all over the world (Reneses et al., 2015), having increased significantly in recent decades (Knapstad et al., 2021). Today, they represent one of the greatest public health concerns in the world (Storrie et al., 2010; WHO, 2014). According to the WHO, it is estimated that 10% to 20% of adolescents around the world, at any time of their lives, may have had some type of mental illness, with a peak occurrence up to the age of 25 years (Kessler et al., 2007). These numbers increase when we analyze only young people enrolled in higher education (Cvetkovski, et al., 2012; Stallman, 2010). According to the University Student Mental Health Survey (2018) one in five students have had MH problems, regardless of the years of enrolment. These MH problems in students enrolled in higher education are visible in the high levels of stress, anxiety and depression (Bayram & Bilgel, 2008; Bahhawi et al., 2018; Beiter et al., 2015; Eisenberg et al., 2013; Fernández-Rodríguez et al., 2019; Hussain et al., 2013; Ibrahim et al., 2013; Liu et al., 2019; Potrebny et al., 2017; Ramón-Arbués et al., 2020).

These MH issues affect their quality-of-life perception (QoL) (Gao et al., 2018; Islam, 2019; Sanil et al., 2018), that is, the meaning their perception of their position in life, in the context, culture and value system in which they are inserted, considering their objectives, expectations, standards and concerns (WHOQOL GROUP, 1994; 1998). Student with MH problems or poor QoL are associated with higher health care expenditure and poor school performance (Rimyall et al., 2021). In more severe cases, these MH problems associated with a poor QoL give rise to self-injurious and suicidal behaviours (Davis et al., 2020). On the other hand, there are several studies that show that better QoL of students is associated with better academic performance (Degoy & Berra, 2018; Molnár et al., 2020; Sundén, 2019).

The physical activity practice (PA), physical exercise (PE) or sport plays an important role in preventing the onset of cardiovascular or metabolic diseases (Coombes et al., 2015; Lee et al., 2012). PA, PE and sport are terms that describe different concepts. PA is defined as any body movement produced by skeletal muscle that result in energy expenditure. Energy expenditure can be measured in Kilocalorie. PE include a systematic planning of PA, with a defined structure and repetition, with a view to maintaining or improving one or more component of physical fitness, namely strength, cardiorespiratory, balance and flexibility capacity (Caspersen et al., 1985). There are several sport definitions, and they all have something in common: they all concern any type of PA or PE that result from a competition (Sutula, 2018).

In recent decades, PA/PE or sports practices have been associated with benefits in MH (Chekroud et al., 2018; Galper et al., 2006; Harvey et al., 2010), namely in reduction of depression, anxiety and stress (Cooney et al., 2013; Ensari et al., 2015; Fox, 1999; Gordon et al., 2018; Grasdalsmoen et al.,

2020; Guszkowska, 2004; Jacinto et al., 2021; Kvam et al., 2016; Morres et al., 2019; Neves et al., 2014; Scully et al., 1998) and a better perception of QoL (Pucci et al., 2012).

Considering the obvious association between PA, PE and sport, MH, and the QoL perception in the general population, studies with students enrolled in higher education are rare. Knowing that school performance is an indicator of success in the future, it is important to know all the variables that can harm this success, in order to define effective intervention strategies. Today's students are tomorrow's future professionals, and the development of the world always depends on future generations. Thus, the aim of this study is to assess the relationship between PA/PE/sport, MH (stress, depression, and anxiety) and QoL perception of young people enrolled in higher education.

METHOD

Search strategy

The review was carried out in accordance with PRISMA protocol (Moher et al., 2009, 2015; Page et al., 2021) and the methods suggested by Bento (2014). The protocol was registered in the PROSPERO, with the number CRD42021286398. In the present study, the PICOS strategy (Methley et al., 2014; Nang et al., 2015) was defined according to the items: i) "P" (Patients) corresponded to participants enrolled in higher education, aged between 17 and 36 years, of any gender, race and ethnicity; ii) "I" (Intervention) corresponded to any PA, exercise and sport program, regardless of the duration of the intervention or the application of a questionnaire, in a cross-sectional study; III) "C" (Comparison) corresponded to the comparison before and after the intervention; iv) "O" (Outcome) corresponded to mood, depression, stress, anxiety, panic or phobia, as the first or second variable under study; v) "S" (Study Design) corresponded to intervention studies, randomized controlled trials (RCT's) or not RCT's, pilot studies or cross-sectional studies.

Inclusion/exclusion criteria

The inclusion criteria were studies with participants enrolled in higher education, aged between 17 and 36 years, of any gender, race and ethnicity; and studies that included any Physical activity, exercise and sport program, regardless of the duration of the intervention or the application of a questionnaire, in a cross-sectional study.

Study selection

A total of 200 studies were identified through a search carried out in the four databases. In a first phase, which included the reading of titles and abstracts, as well as the elimination of duplicate articles, 37 articles potentially relevant to the study were identified. Considering the defined eligibility criteria, after the complete reading of the articles, a sample of 16 articles was constituted for its full analysis (Figure 1).

Table 1 presents the characteristics of the studies included in the systematic review. From the sixteen studies included in this systematic review, seven are from the Asian continent (Almhdawi et al., 2021; Chellaiyan et al., 2018; Fukui et al., 2021; Hossen et al., 2020; Kayani et al., 2020; Li et al., 2015; Mak et al., 2018), four are from the European continent (Carpi et al. 2021; Herbert et al. 2020; Marschin & Herbert 2021; Ruotolo et al. 2021), four from the American continent (Brandão

Pinto de Castro et al., 2017; Dinzeo et al., 2014; Miguel et al., 2021; Yorks et al., 2017) and one study belongs to a Eurasian country (Ozkul, 2021).

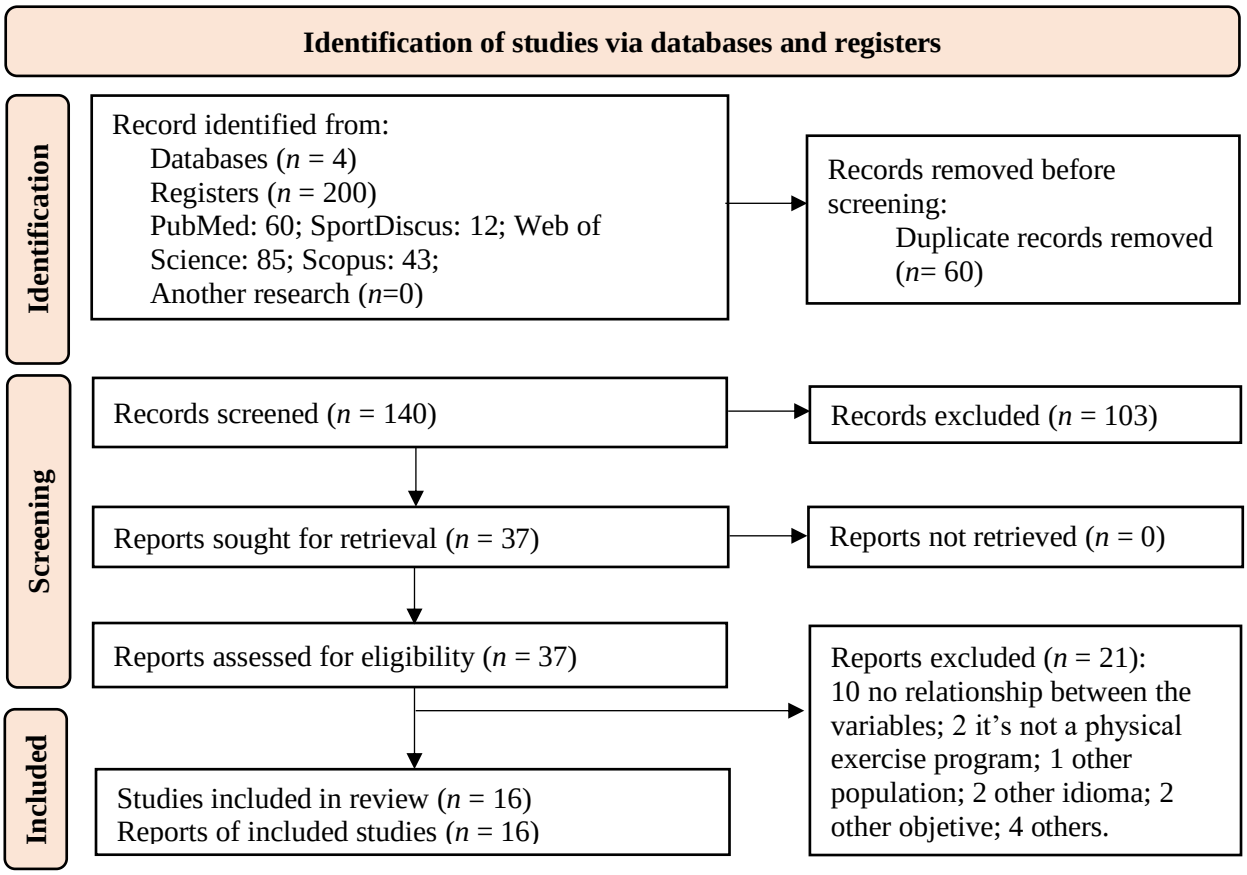

Figure 1. PRISMA flow diagram illustrating each phase of the search and selecting process.

Ten studies used a cross-sectional methodology (Almhdawi et al., 2021; Brandão Pinto de Castro et al., 2017; Carpi et al. 2021; Chellaiyan et al, 2018; Hossen et al., 2020; Kayani et al., 2020; Mak et al., 2018; Miguel et al., 2021; Ozkul, 2021; Ruotolo et al. 2021). Five studies used an experimental metholodology, with three being randomized controlled trials (Fukui et al., 2021; Herbert et al., 2020; Li et al., 2015) and two not (Marschin & Herbert 2021; Yorks et al., 2017). We can also see that one study concerns the validation of a questionnaire (Dinzeo et al., 2014).

The results of this systematic review show that PA/PE/sport practiced of young people enrolled in higher education are correlated with the MH and QoL perception. This main result of this study can be presented as followed (Figure 2):

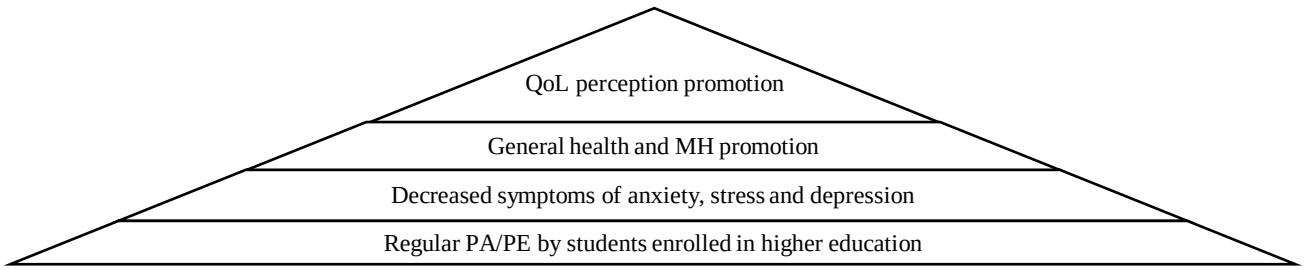

Figure 2. Study results summary

Table 1. Characteristics of the studies included in the systematic review.

Author, year, Country	Aims	Sample	Study Design	Assessment	Results
Almhdawi et al. (2021) Jordania	Study the undergraduate healthcare university students' health-related QoL's perception and its predictors during COVID-19.	*N*= 485; 20.6 ± 2y. Jordan university students.	Cross-Sectional.	*Medical Outcomes Study Short Form - SF-12; Depression Anxiety Stress Scale* (DASS 21); *International Physical Activity Questionnaire – short form* - IPAQ-SF; *Neck Disability Index (NDI).*	PA level was associated with health related QoL level (β = 1.81 [*IC* 95% 0.32 a 3.30], *p*<0.05).
Carpi et al. (2021) Italy	Study the levels of psychological well-being, stress and quality of life in students.	*N*= 407; Average age: 19.72y. Students from Medical course at Sapienza University of Rome.	Cross-Sectional.	*Short Form 12: Psychological General Well-Being Index Perceived Stress Scale.*	Regular physical exercise was associated with lower psychological distress (β = -0.62 [*IC* 95% 0.34 a 0.86], *p*<0.05)
Castro et al. (2017) Brazil	Assess specific factors related to lifestyle and QoL in undergraduates	*N*= 103. Undergraduate students of the Physical Education course at the State University of Rio de Janeiro.	Cross-Sectional.	*Individual Lifestyle Profile*	PA correlated with stress symptoms (*r*=0.226; *p*<0.05).
Chellaiyan et al. (2018) India	Study the physical inactivity prevalence among students and its association with anxiety, stress and depression.	*N*= 507. Students from the Faculty of Medicine of India.	Cross-Sectional.	Socio-demographic profile and anthropometry of the study participants. *International Physical Activity Questionnaire (IPAQ); Perceived Stress Scale (PSS); Generalised Anxiety Disorder 7 (GAD-7)*; *Beck Depression Inventory (BDI).*	Significant association between depression and sedentary behaviour (*p*=0.049).
Dinzeo et al., (2014) United States of America	Describe the development and preliminary evaluation of one questionnaire.	*N*= 377; 18-25y (20.14 ± 1.73y). Students from a university in the northeast of the United States of America.	Feasibility, validation, and preliminary examination of the questionnaire.	*Lifestyle and Habits Questionnaire*; *QoL Inventory; Stress Scale.*	Physical health and exercise were the best predicted of QoL´s perception (*r* =0.434, *p* <0.001).
Fukui et al., (2021) Japan	PA improvement among college students.	*N*= 125; 21.6 ± 2.9y. Randomized group: intervention (stay-at-home exercise – trunk, upper extremity and lower	Randomized controlled trial study.	*Short Form-8 (SF-8)* *5-item World Health Organization Well-Being Index (WHO-5)*	Significant interaction for the general health subscale of health related QoL (F=9.52), subjective well-being (*F*=6.70), and psychological stress

Author, year, Country	Aims	Sample	Study Design	Assessment	Results
		extremity, for 8 week) and control. Students from a university in Hiroshima.		*Kessler Screening Scale for Psychological Distress (K6).*	(*F*=7.83) was detected (p<0.05) (positive effect on the MH). After intervention, MH variable increased (*d=2*) and WHO-5 scale score (*d*=0.96). The k-6 scale score decreased in the intervention group (*d*=1.94),
Herbert et al., (2020) Germany	Assess MH, well-being regular PA and explore the potential health benefits of short-term aerobic exercise on German university students.	*N*=185; 22.54 ± 2.93y. *N*= 30 aerobic exercise intervention group (6 weeks, 2x/week; 8-16 min/session; *N*= 10 laboratory pilot study group (2 weeks, 2x/week; 8-16 min/session);	Randomized controlled trial study.	*Beck Depression Inventory* *State-Trait Anxiety Inventory* *Positive and Negative Affect Schedule* *Stress and Coping Inventory* *WHOQOL-BREF* (*Global Physical Activity Questionnaire* *Eating Disorder Inventory*	Regular PA was negatively correlated with depression (*r*=-0,22. p<0.05), trait anxiety (*r*=-0.26, p<0.001), body dissatisfaction (*r*=-0.21, p<0.05) and perceived psychosomatic stress (*r*=-0.21, p<0.01) and positively correlated with QoL (*r*=0.27, p<0.001). Decreased depressive symptoms in the intervention group (p<0,005, *d*=0,62), perceived stress (p < 0,001, *d*=0,72), perceived stress due to uncertainty (p< 0,001, *d*=0,77) and symptoms anxiety (p> 0,1, *d*=0,17).
Hossen et al., (2020) Bangladesh	Assess the sports and exercises impact on mental and physical health among the university students.	*N*= 639; 18-26y. 6 university students in Bangladesh.	Cross-Sectional.	*General Anxiety Disorder-7* *Patient Health Questionnaire-9 (PHQ-9).*	Anxiety and depression were significantly lower in individuals who practiced PE (p<0.001).
Kayani et al., (2020) China	Assess the PA influence on academic anxiety	*N*=418; 18-36y. Pakistani university students.	Cross-Sectional.	*PA Questionnaire; Self-enhancement and self-protection strategies scale;Self-criticism* 6-item state and trait anxiety scale	Negative correlation between PA and anxiety (*r*=−0.281; p <0.01).
Li et al. (2015) China	Assess the effectiveness and safety of Baduanjin exercise on physical and MH of Fujian Traditional Chinese Medicine student.	*N*=222; 18-25y. Randomized groups: intervention group (*N*=101; 20.63 ± 1.03y) and control (*N*=105; 20.92 ± 1.15y) Intervention: beginning and ending posture exercise (12 weeks; 5 x week; 60 min/session).	Randomized controlled trial study.	*The Symptom Checklist-90;* *Perceived Stress Scale;* *General Self-efficacy Scale;* *Self-Esteem Scale;* *Profile of Mood States;* Mood and mindfulness (*POMS scale*): *WHOQOL-BREF*.	No significant changes in self-symptom intensity (p=0.713), stress (p=0.207), self-efficacy, self-esteem (p=0.278) (p=0.242), mood (p=0.682) and QoL (p=0.798).

Author, year, Country	Aims	Sample	Study Design	Assessment	Results
Mak et al., (2018) China	Assess the relationships between socio-economic status, health-promoting lifestyles and QoL among Chinese nursing students.	*N*=539; 21.7 ± 2.08y. Hong Kong university students.	Cross-Sectional.	*Health-Promoting Lifestyle Profile II (HPLP-II); Youth Risk Behavior Survey (YRBS); World Health Organization Quality of Life (WHOQOL)-BREF instrument*; Socio-economic status.	Positive association between QoL's perception and PA (p=0.018).
Marschin & Herbert, (2021) Germany	Study and compared the PA effects and cognitive intervention on MH among university students.	*N*=20; 22.54 ± 2.93y. Students from German universities. PA: endurance exercises, muscular strength, relaxation, and ballroom dance movements (1x week, 5 to 10 min).	Quasi-experimental study.	*Perceived Stress Scale-10; Stress and Coping Inventory; Positive and Negative Affect Schedule; WHOQOL-BREF; Global Physical Activity Questionnaire; Beck Depression Inventory-II; Eating Disorder Inventory-2; Physical Activity Readiness Questionnaire; Balanced Inventory of Desirable Responding; Reasons for Exercise Inventory; D2-R Test for Attention*.	Both interventions can reduce university students' perceived stress, mood, and QoL's perception across the term. The interaction effect of group × time on self-reported perceived stress, mood/affect and QoL was not significant.
Miguel et al., (2021) Brazil	Study associated factors with QoL's perception of Brazilian medical students.	*N*= 1350; 22.8 ± 3.46y.	Cross-Sectional.	*WHOQOL-BREF; VERAS-Q; Epworth Sleepiness Scale; Pittsburgh Sleep Quality Index; Beck Depression Inventory; Resilience Scale*; *State-Trait Anxiety Inventory; Interpersonal Reactivity Multidimensional Scale; Maslach Burnout Inventory; Dundee Ready Education Environment Measure*	Physical health (included PA) was the most important factor predicting QoL's perception.
Ozkul (2021) Turkey	Assess the QoL's perception, PA level, sleep quality, stress, anxiety, depression levels and the relationship between the QoL's perception and these factors	*N*=320; 20-22y. Physiotherapy students at Gazi university.	Cross-Sectional.	*Short Form-36 (SF-36); Short Form-International Physical Activity Questionnaire (IPAQ); Pittsburgh Sleep Quality Index (PSQI); 10 item Perceived Stress Scale (PSS); Hospital Anxiety and Depression Scale (HADS).*	Significative correlation between PA and general health (r=0.110; p <0.049) and MH (r=0.170; p <0.002).

Author, year, Country	Aims	Sample	Study Design	Assessment	Results
	among university students.				
Ruotolo et al., (2021) Italy	Assess the validity and the reliability of SF-12 Health Survey version 2 (SF-12v2) in QoL's perception Italian students.	*N*=583; 23.14 ± 5.1y.	Cross-Sectional.	*SF-12 Health Survey version 2 (SF-12v2).*	Positive association between PA and MH (*p*=0.007).
Yorks et al., (2017) United States of America	Assess the relationship between PE and stress and QoL's perception in a medical student (EUA)	*N*=69. Medical students at a university in the United States of America. Nonrandomized groups: Fitness class group (*N*= 25, group fitness class – 30 min, 1x week; 20-29y); Health-enhancement group (*N*= 29, PA alone or even with 2 partners, 2x week); control group (*N*=15) 12 weeks.	Nonrandomized, controlled study.	*Perceived Stress Scale* (PSS); *QoL Visual Analog Scales* (VASs).	Fitness class group decreased perceived stress (*p*=0.038) and increased physical QoL (*p*=0.007), mental (*p*=0.046) and emotional (*p*=0.004). Health-enhancement group improved mental QoL (*p*=0.023).

Main results on the link between Physical Activity/Physical Exercise/Sport, Mental Health and Physical Activity/Physical Exercise/Sport and Quality of Life

Carpi et al. (2021), Castro et al. (2017), Herbert et al. (2020), Hossen et al. (2020), Marschin and Herbert (2021) and Yorks et al. (2017) claim that PA/PE/sport is associated with a reduction in stress symptoms and that its impact on anxiety is also evident (Herbert et al., 2020; Hossen et al., 2020; Kayani et al., 2020). For Marchin and Herbert, (2021), there is an association between PA/PE/sport and mood. Chellaiyan et al. (2018) and Herbert et al. (2020) state that physical inactivity is associated with the prevalence of depressive symptoms (and its relationship with MH is direct) (Fukui et al., 2021; Herbert et al., 2020; Ozkul, 2021; Ruotolo et al., 2021; York set al., 2017).

Almhdawi et al. (2021), Yorks et al. (2017), Dinzeo et al. (2014), Mak et al. (2018), Herbert et al. (2020) and Marschin and Herbert (2021) studies reveals that higher PA levels were related to better QoL perception, with one study claiming that PA is the most important factor (Miguel et al., 2021).For studies that performed correlations with PA/PE/sport, we found MH weak in general (Ozkul, 2021), with stress (Castro et al., 2017; Herbert et al., 2020), weak with correlated with symptoms anxiety (Herbert et al., 2020; Kayani et al., 2020;) and depression (Herbert et al., 2020) and weak to moderate with QoL (Dinzeo et al., 2014; Herbert et al., 2020).

Li at al (2015) in an experimental study found no significant differences between the PA/PE and QoL. Naturally, due to the weight of the studies, we would like to give greater prominence to the ranmized controlled studies. In the study by Herbert et al. (2020) PE intervention resulted in a decrease in depressive symptoms with a medium effect size. Fukui et al. (2021) showed large effect sizes with the intervention to increase QoL and MH and decrease depressive symptoms. Li at al (2015) in an experimental study found no significant differences between the PA/PE/sport and QoL.

DISCUSSION

The present systematic review aimed to study the relationship between PA/PE/sport, and MH, namely stress, depression, anxiety and QoL perception, in young people (17 to 36 years old) enrolled in higher education.

Around the world, higher education students aren´t following the current PA recommendations (Irwin, 2004; Rhodes et al., 2017). The prevalence of sedentary lifestyles, namely low PA levels, is concerning health services once these behaviours increase individuals' risk of cardiovascular or metabolic disease (Dumith et al., 2011; Lee et al., 2012; Rhodes et al., 2017). Low PA levels are also associated with mental disorders (Biddle & Asare, 2011; Teychenne, Ball & Salmon, 2010a, 2010b) and are considered the fourth leading cause of death worldwide (Lee et al., 2012). On the other hand, PA practice promotes academic performance (Asigbee, Whitney & Peterson, 2018; de Bruijn et al., 2018; Zhang et al., 2019), so students enrolled in higher education can have scholar benefits if they assume a more active lifestyle.

Mental disorders (e.g. depression, anxiety) can significantly and negatively affect performance and motor control, working memory, concentration and injury risk (Stults-Kolehmainen and Sinha, 2014), important dimensions in academic terms, for health and for QoL perception.

The political and cultural reality differs from continent to continent, as well as economic inequality, especially in high and middle-income countries, therefore, PA levels can also differ between countries or continents (SFM et al., 2020). In socioeconomically and culturally underdeveloped countries, the scarce PA prevalence in adolescents/students is real (Arat & Wong, 2017; Cihan, Bozdağ & VAR, 2018; Dinc et al., 2015; Rhodes et al., 2017; Khan et al., 2018; Gul et al., 2019; Uddin et al., 2020). In underdeveloped countries there are lack of resources, policies and

planning to promote PA and respond to the comorbidities caused by its low levels. In developed countries, PA levels are similarly insufficient, due to rapid urbanization and globalization in recent years (Hallal et al., 2012).

The admission to higher education, the changes and challenges that this entails, may be associated with the emergence of comorbidities such as depression, anxiety, or the adoption of unhealthy lifestyles (Fernández Villa et al., 2013), namely a) stress during the academic phase; b) pressure resulting from external factors (e.g. exams); c) excessive workload; d) lack of leisure time; e) poor time management; f) competition; g) fear/concern about not meeting the parents' expectations; h) new relationships; i) change of residence; j) biological factors (e.g. age, sex); k) incorrect use of the internet; l) smoking; m) bad eating habits (including excessive alcohol consumption); n) lack of sleep or PA; o) low self-esteem; p) lack of a stable partner; q) financial charges (Balapala & India, 2017; Bangasser et al., 2010; Gao, Ping & Liu, 2020; Ibrahim et al., 2013; Kruisselbrink Flatt, 2013; Kumaraswamy, 2013; Silveira et al., 2011). The levels of anxiety and depression can lead to self-injurious and suicidal behaviours (Davis, Doyle & Nahar, 2020), making it urgent to value the MH of these subjects, who often do not seek psychological help for fear of exposing the situation or speaking in public about their concerns, emotions or life habits (Fernández-Rodríguez, Soto-López & Cuesta, 2019).

Physical activity, Physical Exercise, Sports and Mental Health

The results of this systematic review are corroborated by Khanzada et al. (2015) study, in which was concluded that students who took PA/PE or sports had a low level of depression and anxiety.

This positive association between PA/PE/sports and MH is also clear when depressive symptoms are analyzed, which are more evident in sedentary students (Chellaiyan et al., 2018). Herbert et al. (2020) study showed that the more PA was practiced, the fewer were the depressive symptoms. Currently, this relationship is recognized not as a preventive measure, but as a treatment (Bushman, 2019; Dunn & Jewell, 2010).

Anxiety and depression were significantly lower in individuals who practiced PE in Hossen et al. (2020) study, where athletes and non-athletes were compared. These study results are consistent with other studies carried out previously (Craft et al., 2007; Pourranjbar et al., 2010; Proctor & Boan-Lenzo, 2010; Weber et al., 2018), reinforcing the idea that the PA/PE/sports can be one of the reasons for lower levels of anxiety and depression among athletes. On the other hand, PA/PE/sport practice is not only associated with a decrease in symptoms of anxiety and depression, but also with better school performance, a fact that is clear in most of the literature (Asigbee, Whitney & Peterson, 2018; Barbosa et al., 2020; de Bruijn et al., 2018; McPherson et al., 2018; Zhang et al., 2019). For Hossen et al. (2020), these symptoms can be reduced with the creation of sports practices and/or adherence to extracurricular activities.

Regular PA/PE practice was also associated with stress decrease in different studies (e.g.: Carpi et al., 2021; Castro et al., 2017; Herbert et al., 2020a; Marschin & Herbert, 2021; Yorks et al., 2017). Jackson (2013) research report reveal that individuals who engage in aerobic activity for 20 to 30 minutes per week feel calmer than those who don´t and that this effect can last for several hours after exercise.

In addition to these results, higher levels of anxiety were found in females and depression in males (Brand et al., 2012; Chan et al., 2010). On this issue, the research is not accurate: there are studies that reveal higher anxiety scores in women, but do not find differences between gender on depression values (Jörngården et al., 2006) and other studies point out to female gender having high levels of anxiety and depression (Li et al., 2021). However, most of the research seems to point out that the female gender has higher levels of both variables (Alibrahim et al., 2010; Alosaimi et al., 2014; Hou et al., 2020; Oliva et al., 2018; Shehatah et al., 2010; White et al., 1999). Several factors may be

behind these results, as well as the different conclusions between the studies: the culture and the development of the country, the sample recruited characteristics (namely, convenience sample, greater number of one gender, professional situation, among others), current situation of the country/world (example COVID-19) or even the context.

The COVID-19 pandemic has worsened the university students´ MH. However, Fukui et al. (2021), when implementing an online PE program during the pandemic for students enrolled in higher education found out that the pandemic had had a positive impact on the MH of the students.

PE practice, namely aerobic, has been associated with MH (stress, depression and anxiety) and QoL perception (Jackson, 2013). Herbert et al. (2020) argueargues that short-term practice should be recommended for MH promotion. Such results are corroborated by Ozkul (2021), Yorks et al. (2017) and Ruotolo et al. (2021) studies since they show a significant correlation between PA/PE, general health and MH.

Physical activity, Physical Exercise, Sports and Quality of Life

This systematic review results show the impact of PA/PE/sports on QoL perception. Almhdawi et al. (2021), Yorks et al. (2017), Dinzeo et al. (2014), Mak et al. (2018) and Herbert et al. (2020) studies bring out that higher PA levels were related to better QoL perception, with one study claiming that PA is the most important factor (Miguel et al., 2021). These results are in agreement with Anokye et al. (2012), namely when we spoke about the population of various age groups or different clinical conditions.

PA/PE/sport have a direct impact on brain development, namely in the frontal and temporal area, due to the cortical activity they provoke. PA/PE/sport increase metabolism, oxygenation, blood flow, state of excitability and brain derived neurotrophic factor, affecting brain plasticity, stimulating the production of angiogenesis, neurotrophies, synaptogenesis and the release of endorphins (Corbett et al., 2013; Dishman & O'Connor, 2009; Harber & Sutton, 1984; Ringenbach et al., 2016; Vogt et al., 2012). These data may explain the relationship between MH, QoL perception and the significance of regular PA/PE/sport practice. In addition to physiological mechanisms, other factors may explain this relationship, namely psychological (e.g., distraction or mental time out, mastery and self-efficacy) or inflammatory mechanisms (e.g., link between the immune system and nervous system) (Mikkelsen et al., 2017).

Li et al. (2015) didn´t find any differences between the study groups about stress and QoL perception. The author justifies this fact with the participants characteristics (e.g., time to regular PA/PE practice or other sports activities). It is noteworthy that not even students from Sports Science put into practice what they learn during the course, such as healthy eating, regular practice of PE or healthy sleep habits (Brandão Pinto de Castro et al., 2017).

To sum up, this systematic review results show that PA/PE or sport practices are correlated with MH, promoting the QoL perception of young people enrolled in higher education.

PA/PE and/or sports have a direct impact on brain development, namely in the frontal and temporal area, due to cortical activity they incite. They increase metabolism, oxygenation, blood flow, excitability state and brain-derived neurotrophic factor, affecting brain plasticity, stimulating the production of angiogenesis, neurotrophins, synaptogenesis and the release of endorphins (Corbett et al., 2013; Dishman & O'Connor, 2009; Harber & Sutton, 1984; Ringenbach et al., 2016; Vogt et al., 2012), evidence that may justify the results found regarding the relationship between PA/PE/sport and MH and PA/PE/sport and QoL.

Limitations and future recommendations

There is a scarcity of intervention studies (experimental methodology, namely randomized controlled trials) that present PE programs or analyze PE programs impact on stress, depression, anxiety and QoL perception. This is a fundamental topic to continue the study of the relationship of the variables of interest. Due to the diversity of studies included in the presented systematic review, it limits to presentation and discussion of results. Even so, this is intended to be the first survey of the state of the art for suture studies.

At the same time, some studies included in this systematic review have some limitations, which may limit the magnitude of the results. Future studies should take into account the following limitations: i) non-representative sample of the entire young university population, institution, country or world (Almhdawi et al., 2021; Carpi et al., 2021; Dinzeo et al., 2014; Herbert et al., 2020; Hossen et al., 2020; Kayani et al., 2020; Li et al., 2015; Marschin & Miguel, 2021; Ozkul, 2021; Yorks et al., 2017), or sample convenience (Kayani et al., 2020); ii) use of assessment instruments that raised some difficulties in understanding the terminology (Hossen et al., 2020); iii) distance between data collection points (Hossen et al., 2020); iv) difficulty in collecting data, due to the university workload (Hossen et al., 2020); v) interviewer bias (Hossen et al., 2020); vi) response bias (Dinzeo et al., 2014; Kayani et al., 2020; Li et al., 2015; Mak et al., 2018); vii) absence of data prior to the COVID-19 pandemic; viii) difficulty to submit the assessment methodology (Almhdawi et al., 2021); ix) cross-sectional methodology (Brandão Pinto de Castro et al., 2017; Carpi et al., 2021; Mak et al., 2018; Miguel et al., 2021); x) unrepresentative data (Chellaiyan et al., 2018); xi) bias in sample selection (Dinzeo et al., 2014); xii) Hawthorne effect (Fukui et al., 2021); xii) COVID-19 pandemic situation (Fukui et al., 2021); xiii) high dropout rate (Fukui et al., 2021); xiv) unblinded participants and instructors/non-randomized study randomized (Li et al., 2015; Marschin & Herbert 2021; Yorks et al., 2017).

Physical inactivity is seen as a public health problem (Ozkul, 2021). Since higher education students tend to adopt sedentary lifestyles (Grasdalsmoen et al., 2019; Guthold et al., 2018), it is necessary to promote students physical activity in order to achieve the WHO recommendations (2020) and promote their MH and QoL perception through intervention strategies to enhance PA/PE/MH and QoL perception. It is important to encourage students to achieve PA recommendations, namely 150 to 300 minutes of moderate PA, or 75 to 150 minutes of vigorous PA per week (WHO, 2020), preferably in group or social activities (Yorks et al., 2017). Likewise, it is still necessary to identify the risk behaviours of the target population (Bore et al., 2016; Carpi et al., 2021; Dyrbye et al., 2006).

The Exercise is Medicine is an initiative of the American College of Sports Medicine (ACSM) that aims to highlight the importance of physical assessment and exercise prescription as diseases prevention and treatment. Calls on higher education institutions to promote PA as a vital sign of health or as “medicine” and encourages teaching and non-teaching staff (including students) to work together to improve the university campus health and well-being through steps: a) to include the PA/PE programs as a fundamental part of the daily routine (institutional paradigm shift); b) to provide the necessary tools for the development of healthy habits; 3) PA assessment and prescription, through health and fitness professionals (ACSM, 2019; Thompson et al., 2020). Another more extreme measure, which may have the opposite effect to what is intended, is the PA inclusion at academic cycles curriculum (Petruzzello & Box, 2020).

Considering the relevance of the relationship between PA/PE/sports practices, MH (namely, stress, depression and anxiety) and QoL perception, in a future study we intend to understand de mediation/moderation relationships between these variables.

Although the literature points out to the high prevalence of comorbidities in higher education students (that worsened with the COVID-19 pandemic), the present systematic review showed that PA/PE/sports are correlated with MH (namely, stress, depression and anxiety) of young adults enrolled in higher education and QoL perception.

Higher education institutions need to pay special attention to the young higher education student's mental health. With government entities, higher education systems could define MH policies and create primary and secondary prevention measures. They could, for instance, i) develop more and better support services, adequate to the target population, to detect and treat students' psychiatric disorders and ii) include regular PA/PE/sport practice in their campus day-to-day life, rather than focusing only on academic average. Multidisciplinary interventions are essential for MH and well-being promotion, preventing school dropout and promoting QoL perception.

To have effective interventions, it is necessary to understand which students are at risk of developing mental disorders and design time-efficient PE programs, allowing them to exercise, even if they have a busy workday (Herbert et al. 2020).

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ORCID

Isabel Simões Dias https://orcid.org/0000- 0001-5522-3760
Miguel Jacinto https://orcid.org/0000-0002-1727-3537
Maria Odília Abreu https://orcid.org/0000-0002-5771-6080
Marta Fonseca https://orcid.org/0000-0001-9400-2573

AUTHOR'S CONTRIBUTION

Isabel Simões Dias: double check of the bibliographic research and evaluation of the methodological quality of the articles; supervised the construction and writing of the work and carried out a thorough review of it.

Miguel Jacinto: conception, research and writing of the manuscript.

Maria Odília Abreu: responsible for the double check of the bibliographic research and evaluation of the methodological quality of the articles; collaborated in the construction of the article and carried out a thorough review, having approved the final version.

Marta Fonseca: responsible for the double check of the bibliographic research and evaluation of the methodological quality of the articles; collaborated in the construction of the article and carried out a thorough review, having approved the final version.

REFERÊNCIAS

Alibrahim, O.A., Al-Sadat, N., & Elawad, N.A.M. (2010). Gender and risk of depression in Saudi Arabia, a systematic review and meta-analysis. *Journal of Public Health in Africa*, *1*(1), e7. https://doi.org/10.4081/jphia.2010.e7

Almhdawi, K. A., Alazrai, A., Obeidat, D., Altarifi, A. A., Oteir, A. O., Aljammal, A. H., Arabiat, A. A., Alrabbaie, H., Jaber, H., & Almousa, K. M. (2021). Healthcare students' mental and physical well-being during the COVID-19 lockdown and distance learning. *Work (Reading, Mass.), 70*(1), 3–10. https://doi.org/10.3233/WOR-205309

Alosaimi, F.D., Al-Sultan, O.A., Alghamdi, Q.A., Almohaimeed, I.K., & Alqannaset, S.I. (2014). Gender-specific differences in depression and anxiety symptoms and help-seeking behavior among gastroenterology patients in Riyadh, Saudi Arabia. *Neurosciences, 19*(3), 203–209.

American College of Sports Medicine (2019). Exercise is Medicine On Campus action guide. https://www.exerciseismedicine.org/assets/page_documents/EIM%20on%20Campus%20action%20guide.pdf.

American Psychiatric Association (2013). *Diagnostic and statistical manual of mental disorders* (5.ª ed.). American Psychiatric Association.

Anokye, N.K. Trueman, P., Green, C., Pavey, T.G., & Taylor, R.S. (2012). Physical activity and health related quality of life. *BMC Public Health, 12*(1), 624. https://doi.org/10.1186/1471-2458-12-624

Arat, G., & Wong, P.W.-C. (2017). The relationship between physical activity and mental health among adolescents in six middle-income countries: A cross-sectional study. *Child & Youth Services, 38*(3), 180–195. https://doi.org/10.1080/0145935X.2017.1297202

Asigbee, F.M., Whitney, S.D., & Peterson, C.E. (2018). The Link Between Nutrition and Physical Activity in Increasing Academic Achievement. *The Journal of School Health, 88*(6), 407–415. https://doi.org/10.1111/josh.12625

Bahhawi, T.A., Bahhawi, Albasheer, O.B., Makeen, A.M., Arishi, A.M., Hakami, O.M., Maashi, S.M., Al-Khairat, H.K., Alganmy, O.M., Sahal, Y.A., Sharif, A.A., & Mahfouz, M.S. (2018). Depression, anxiety, and stress and their association with khat use: a cross-sectional study among Jazan University students, Saudi Arabia. *Neuropsychiatric Disease and Treatment, 14*, 2755–2761. https://doi.org/10.2147/NDT.S182744

Balapala, K., & India, D. (2017). Depression, Anxiety, and Stress among Health Science Students belonging to Non-affluent Families: A University-based Study. *International Journal of Scientific Study, 4*(12), 99–102.

Bangasser, D.A., Curtis, A., Reyes, B.A.S, Bethea, T.T., Parastatidis, I., Ischiropoulos, H., Van Bockstaele, E.J., & Valentino, R.J. (2010). Sex differences in corticotropin-releasing factor receptor signaling and trafficking: potential role in female vulnerability to stress-related psychopathology. *Molecular Psychiatry, 15*(9), 877, 896–904. https://doi.org/10.1038/mp.2010.66

Barbosa, A., Whiting, S., Simmonds, P., Moreno, R.S., Mendes, R., & Breda, J. (2020). Physical Activity and Academic Achievement: An Umbrella Review. *International Journal of Environmental Research and Public Health, 17*(16), 5972. https://doi.org/10.3390/ijerph17165972

Bayram, N., & Bilgel, N. (2008). The prevalence and socio-demographic correlations of depression, anxiety and stress among a group of university students. *Social Psychiatry and Psychiatric Epidemiology, 43*(8), 667–672. https://doi.org/10.1007/s00127-008-0345-x

Beiter, R. Nash, R., McCrady, M., Rhoades, D., Linscomb, M., Clarahan, M., & Sammut, S. (2015). The prevalence and correlates of depression, anxiety, and stress in a sample of college students. *Journal of Affective Disorders, 173*, 90–96. https://doi.org/10.1016/j.jad.2014.10.054

Bento, T. (2014). Revisões sistemáticas em desporto e saúde: Orientações para o planeamento, elaboração, redação e avaliação. *Motricidade, 10*(2), 107–123. https://doi.org/10.6063/motricidade.10(2).3699

Biddle, S.J.H., & Asare, M. (2011). Physical activity and mental health in children and adolescents: a review of reviews. *British Journal of Sports Medicine*, *45*(11), 886–895. https://doi.org/10.1136/bjsports-2011-090185

Bore, M., Kelly, B., & Nair, B. (2016). Potential predictors of psychological distress and well-being in medical students: a cross-sectional pilot study, *Advances in Medical Education and Practice*, *7*, 125–135. https://doi.org/10.2147/AMEP.S96802

Brand, R., Wolff, W., & Hoyer, J. (2012). Psychological Symptoms and Chronic Mood in Representative Samples of Elite Student-Athletes, Deselected Student-Athletes and Comparison Students. *School Mental Health*, *5*, 166–174. https://doi.org/10.1007/s12310-012-9095-8

Brandão Pinto de Castro, J. de Souza Vale, R.G., de Aguiar, R.S., & Mattos, R.S. (2017). Perfil do estilo de vida de universitários de Educação Física da cidade do Rio de Janeiro. *Revista Brasileira de Ciência e Movimento*, *25*, 73–83. https://doi.org/10.18511/rbcm.v25i2.6234

de Bruijn, A.G.M., Hartman, E., Kostons, D., Visscher, C., & Bosker, R. J. (2018). Exploring the relations among physical fitness, executive functioning, and low academic achievement. *Journal of Experimental Child Psychology*, *167*, 204–221. https://doi.org/10.1016/j.jecp.2017.10.010

Bushman, B.A. (2019). Physical Activity and Depression. *ACSM's Health & Fitness Journal*, *23*(5), 9–14. https://doi.org/10.1249/FIT.0000000000000498

Carpi, M., Milanese, A., Cattaruzza, M.S., Ferrara, C., Liuccio, M., & Vestri, A. (2021) Well-being, Perceived Stress and Their Relations with Health-Relevant Behaviours Among Italian Medical Students: a Cross-Sectional Study at Sapienza University of Rome. *Trends in Psychology*, *30*, 425–441. https://doi.org/10.1007/s43076-021-00114-x

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health-related research. *Public Health Reports*, *100*(2), 126–131

Chan, Y., Leung, D.Y.P., Fong, D.Y.T., Leung, C., & Lee, A.M. (2010). Psychometric evaluation of the Hospital Anxiety and Depression Scale in a large community sample of adolescents in Hong Kong. *Quality of Life Research: An International Journal of Quality-of-Life Aspects of Treatment, Care and Rehabilitation*, *19*(6), 865–873. https://doi.org/10.1007/s11136-010-9645-1

Chekroud, S.R., Gueorguieva, R., Zheutlin, A.b., Paulus, M., Krumholz, H.M., Krystal, J.H., & Chekroud, A.M. (2018). Association between physical exercise and mental health in 1·2 million individuals in the USA between 2011 and 2015: a cross-sectional study. *The Lancet. Psychiatry*, *5*(9), 739–746. https://doi.org/10.1016/S2215-0366(18)30227-X

Chellaiyan, V., Ali, F.L., & Maruthappapandian, J. (2018). Association between Sedentary Behaviour and Depression, Stress and Anxiety among Medical School Students in Chennai, India. *Journal of Clinical and Diagnostic Research*, *12*. https://doi.org/10.7860/JCDR/2018/37129.12216

Cihan, B.B., Bozdağ, B., & Var, L. (2018). Examination of Physical Activity and Life Quality Levels of University Students in Terms of Related Factors. *Journal of Education and Learning*, *8*, 120. https://doi.org/10.5539/jel.v8n1p120

Coombes, J.S., Law, J., Lancashire, B., & Fassett, R.G. (2015). Exercise is Medicine: curbing the burden of chronic disease and physical inactivity, *Asia-Pacific Journal of Public Health*, *27*(2), NP600-605. https://doi.org/10.1177/1010539513481492

Cooney, G. M., Dwan, K., Greig, C. A., Lawlor, D. A., Rimer, J., Waugh, F. R., McMurdo, M., & Mead, G. E. (2013). Exercise for depression. *The Cochrane Database of Systematic Reviews*, *9*, CD004366. https://doi.org/10.1002/14651858.CD004366.pub6

Corbett, D.B., Peer, K.S., & Ridgel, A.L. (2013). Biomechanical muscle stimulation and active-assisted cycling improves active range of motion in individuals with Parkinson's disease. *NeuroRehabilitation*, *33*(2), 313–322. https://doi.org/10.3233/NRE-130961

Craft, L.L., Freund, K.M., Culpepper, L., & Perna, F.M. (2007). Intervention study of exercise for depressive symptoms in women. *Journal of Women's Health*, *16*(10), 1499–1509. https://doi.org/10.1089/jwh.2007.0483

Cvetkovski, S., Reavley, N.J., & Jorm, A.F. (2012). The prevalence and correlates of psychological distress in Australian tertiary students compared to their community peers. *The Australian and New Zealand Journal of Psychiatry*, *46*(5), 457–467. https://doi.org/10.1177/0004867411435290

Davis, R.E., Doyle, N.A., & Nahar, V.K. (2020). Association between prescription opioid misuse and dimensions of suicidality among college students. *Psychiatry Research*, *287*, 112469. https://doi.org/10.1016/j.psychres.2019.07.002

Degoy, E., & Berra, S. (2018). Differences in health-related quality of life by academic performance in children of the city of Cordoba-Argentina. *Quality of Life Research*, *27*, 1463-1471. https://doi.org/10.1007/s11136-018-1849-9

Dinc, G., Sozmen, K., Ergor, G., Sakarya, S., Yardim, N., & Unal, B. (2015). Leisure Time Physical Activity Level in Turkish Population, Turkey 2012: Kaan Sözmen. *European Journal of Public Health*, *25*(suppl_3). https://doi.org/10.1093/eurpub/ckv175.231

Dinzeo, T.J., Thayasivam, U., & Sledjeski, E.M. (2014a). The Development of the Lifestyle and Habits Questionnaire-Brief Version: Relationship to Quality of Life and Stress in College Students. *Prevention Science*, *15*(1), 103–114. https://doi.org/10.1007/s11121-013-0370-1

Dishman, R.K., & O'Connor, P. J. (2009). Lessons in exercise neurobiology: The case of endorphins. *Mental Health and Physical Activity*, *2*(1), 4–9. https://doi.org/10.1016/j.mhpa.2009.01.002

Downs, S.H., & Black, N. (1998). The feasibility of creating a checklist for the assessment of the methodological quality both of randomised and non-randomised studies of health care interventions. *Journal of Epidemiology and Community Health*, *52*(6), 377–384. https://doi.org/10.1136/jech.52.6.377

Dumith, S.C., Hallal, P.C., Reis, R.S., & Kohl, H.W. (2011). Worldwide prevalence of physical inactivity and its association with human development index in 76 countries. *Preventive Medicine*, *53*(1–2), 24–28. https://doi.org/10.1016/j.ypmed.2011.02.017

Dunn, A.L., & Jewell, J.S. (2010). The effect of exercise on mental health. *Current Sports Medicine Reports*, *9*(4), 202–207. https://doi.org/10.1249/JSR.0b013e3181e7d9af

Dyrbye, L.N., Thomas, M.R., & Shanafelt, T.D. (2006). Systematic review of depression, anxiety, and other indicators of psychological distress among U.S. and Canadian medical students. *Academic Medicine: Journal of the Association of American Medical Colleges*, *81*(4), 354–373. https://doi.org/10.1097/00001888-200604000-00009

Eisenberg, D., Hunt, J., & Speer, N. (2013). Mental health in American colleges and universities: variation across student subgroups and across campuses. *The Journal of Nervous and Mental Disease*, *201*(1), 60–67. https://doi.org/10.1097/NMD.0b013e31827ab077

Elmer, T., Mepham, K., & Stadtfeld, C. (2020). Students under lockdown: Comparisons of students' social networks and mental health before and during the COVID-19 crisis in Switzerland. *PLOS ONE*, 15(7), e0236337. https://doi.org/10.1371/journal.pone.0236337

Ensari, I., Greenlee, T.A., Motl, R.W., & Petruzzello, S.J., (2015). Meta-analysis of acute exercise effects on state anxiety: an update of randomized controlled trials over the past 25 years. *Depression and Anxiety*, *32*(8), 624–634. https://doi.org/10.1002/da.22370

Fernández Villa, T, Ojeda, J.A., Pérez, C.A., Cavanillas, A.B., Carral, J.M.C., Álvarez, R.C., Rodríguez, M.D., Mejías, E.J., Moleón, J.J.J., Díaz, J.L., Campos, R.M, de la Torre, A.J.T., Juan, LF.V., & Sánchez, V.M., (2013). Proyecto UNIHCOS: cohorte dinámica de estudiantes universitarios para el estudio del consumo de drogas y otras adicciones. *Revista Española de Salud Pública*, *87*(6), 575–585. https://doi.org/10.4321/S1135-57272013000600003

Fernández-Rodríguez, C., Soto-López, T., & Cuesta, M. (2019). Needs and demands for psychological care in university students. *Psicothema*, *31*(4), 414–421. https://doi.org/10.7334/psicothema2019.78

Fox, K.R. (1999).The influence of physical activity on mental well-being. *Public Health Nutrition*, *2*(3a), 411–418. https://doi.org/10.1017/S1368980099000567

Fukui, K., Suzuki, Y., Kaneda, K, Kuroda, S., Komiya, M., Maeda, N., & Urabe, Y. (2021). Do "Stay-at-Home Exercise" Videos Induce Behavioral Changes in College Students? A Randomized Controlled Trial. *Sustainability*, *13*(21), 11600. https://doi.org/10.3390/su132111600

Galper, D.I., Trivedi, M.H., Barlow, C.E., Dunn, A.L., & Kampert, J.B. (2006). Inverse association between physical inactivity and mental health in men and women. *Medicine and Science in Sports and Exercise*, *38*(1), 173–178. https://doi.org/10.1249/01.mss.0000180883.32116.28

Gao, T., Xiang, Y., Zhang, H., Gao, J., Kong, Y., Hu, Y., & Mei, S. (2018). Prevalence and Correlates of Suicidal Behaviors among College Students in Northeastern China: a Cross-Sectional Study. *Psychiatric Quarterly*, *89*(2), 359–370. https://doi.org/10.1007/s11126-017-9540-9

Gao, W., Ping, S., & Liu, X. (2020). Gender differences in depression, anxiety, and stress among college students: A longitudinal study from China. *Journal of Affective Disorders*, *263*, 292–300. https://doi.org/10.1016/j.jad.2019.11.121

Gordon, B.R., McDowell, C.P., Hallgren, M., Meyer, J.D., Lyons, M., & Herring, M.P. (2018). Association of Efficacy of Resistance Exercise Training With Depressive Symptoms: Meta-analysis and Meta-regression Analysis of Randomized Clinical Trials. *JAMA psychiatry*, *75*(6), 566–576. https://doi.org/10.1001/jamapsychiatry.2018.0572

Grasdalsmoen, M., Eriksen, H.R., Lønning, K.J., & Sivertsen, B. (2019). Physical exercise and body-mass index in young adults: a national survey of Norwegian university students. *BMC public health*, *19*(1), 1354. https://doi.org/10.1186/s12889-019-7650-z

Grasdalsmoen, M., Eriksen, H.R., Lønning, K.J., & Sivertsen, B. (2020). Physical exercise, mental health problems, and suicide attempts in university students. *BMC Psychiatry*, *20*(1), 175. https://doi.org/10.1186/s12888-020-02583-3

Gul, Y., Jokhio, G.A., & Bibi, T. (2019). Measuring the differences of neighbourhood environment and physical activity in gated and non-gated neighbourhoods in Karachi, Pakistan. *Journal of Urban Design*, *24*(3), 494–513. https://doi.org/10.1080/13574809.2018.1468216

Guszkowska, M. (2004). Effects of exercise on anxiety, depression and mood. *Psychiatria Polska*, *38*(4), 611–620

Guthold, R., Stevens, G.A., Riley, L.M., & Bull, F.C. (2018). Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1·9 million participants. *The Lancet Global Health*, *6*(10), e1077–e1086. https://doi.org/10.1016/S2214-109X(18)30357-7

Hallal, P.C., Andersen, L.B., Bull, F.C., Guthold, R, Haskell, W., & Ekelund, U. (2012). Global physical activity levels: surveillance progress, pitfalls, and prospects. *The Lancet*, *380*(9838), 247–257. https://doi.org/10.1016/S0140-6736(12)60646-1

Harber, V.J., & Sutton, J.R. (1984). Endorphins and exercise. *Sports Medicine* (Auckland, N.Z.), *1*(2), 154–171. https://doi.org/10.2165/00007256-198401020-00004

Harvey, S.B., Hotopf, M., Overland, S., & Mykletun, A. (2010). Physical activity and common mental disorders. *The British Journal of Psychiatry: The Journal of Mental Science*, *197*(5), 357–364. https://doi.org/10.1192/bjp.bp.109.075176

Herbert, C., Meixner, F., Wiebking, C., & Gilg, V., (2020) 'Regular Physical Activity, Short-Term Exercise, Mental Health, and Well-Being Among University Students: The Results of an Online and a Laboratory Study. *Frontiers in Psychology*, *11*, 509. https://doi.org/10.3389/fpsyg.2020.00509

Hishan, S., Jaiprakash, H., Ramakrishnan, S., Mohanraj, J., Shanker, J., & Keong, L. (2018). Prevalence and Socio-Demographic Association of Depression, Anxiety and Stress Among University Students. *International Journal of Engineering & Technology*, *7*, 688. https://doi.org/10.14419/ijet.v7i2.29.13998

Hossen, M., Karmakar, P., Das, A., Rahman, A., & Chakma, M. (2020). Association of Sport and Exercise with Health Condition and Academic Performance: A Cross-sectional Study among the University Students in Bangladesh. *Turkish Journal of Sports Medicine*, *55*. https://doi.org/10.5152/tjsm.2020.187

Hou, F., Bi, F., Jiao, R., Luo, D., & Song, K., (2020). Gender differences of depression and anxiety among social media users during the COVID-19 outbreak in China:a cross-sectional study. *BMC Public Health*, *20*(1), 1648. https://doi.org/10.1186/s12889-020-09738-7

Hussain, R., Guppy, M., Robertson, S., & Temple, T. (2013). Physical and mental health perspectives of first year undergraduate rural university students. *BMC Public Health*, *13*(1), 848. https://doi.org/10.1186/1471-2458-13-848

Ibrahim, A.K., Kelly, S.J., Adams, C.E., & Glazebrook, C. (2013). A systematic review of studies of depression prevalence in university students. *Journal of Psychiatric Research*, *47*(3), 391–400. https://doi.org/10.1016/j.jpsychires.2012.11.015

Irwin, J.D. (2004). Prevalence of university students' sufficient physical activity: a systematic review. *Perceptual and Motor Skills*, *98*(3 Pt 1), 927–943. https://doi.org/10.2466/pms.98.3.927-943

Islam, M.A. (2019) Psychosocial Factors associated with Health Related Quality of Life among University Students. Thesis. University of Dhaka. Available at: http://repository.library.du.ac.bd:8080/xmlui/xmlui/handle/123456789/990

Jacinto, M., Frontini, R., Matos, R., & Antunes, R. (2021). Effects of Exercise Programs on Anxiety in Individuals with Disabilities: A Systematic Review with a Meta-Analysis. *Healthcare (Basel, Switzerland)*, *9*(8), 1047. https://doi.org/10.3390/healthcare9081047

Jackson, E.M. (2013). STRESS RELIEF: The Role of Exercise in Stress Management. *ACSM's Health & Fitness Journal*, *17*(3), 14–19. https://doi.org/10.1249/FIT.0b013e31828cb1c9

Jörngården, A., Wettergen, L., & von Essen, L. (2006). Measuring health-related quality of life in adolescents and young adults: Swedish normative data for the SF-36 and the HADS, and the influence of age, gender, and method of administration. *Health and Quality of Life Outcomes*, *4*, 91. https://doi.org/10.1186/1477-7525-4-91

Kayani, S., Wang, J., Biasutti, M., Sánchez, M.L.Z., Kiyani, T., & Kayani, S. (2020). Mechanism Between Physical Activity and Academic Anxiety: Evidence from Pakistan. *Sustainability*, *12*(9), 3595. https://doi.org/10.3390/su12093595

Kessler, R.C., Amminger, G.P., Aguilar-Gaxiola, S., Alonso, J., Lee, S., & Ustün, T.B., (2007). Age of onset of mental disorders: A review of recent literature. *Current opinion in psychiatry*, *20*(4), 359–364. https://doi.org/10.1097/YCO.0b013e32816ebc8c

Khan, A., Kadir, M.A., Choudhury, S.R., Ashraf, F., Rahman, M., Ahmed, K.R., Saif-Ur-Rahman, K.M., Parvin, S., & Uddin, R. (2018). Results from Bangladesh's 2018 Report Card on Physical Activity for Children and Youth. *Journal of Physical Activity and Health*, *15*(s2), S318–S319. https://doi.org/10.1123/jpah.2018-0419

Khanzada, F.J., Soomro, N., & Khan, S.Z. (2015). Association of Physical Exercise on Anxiety and Depression Amongst Adults. *Journal of the College of Physicians and Surgeons-Pakistan: JCPSP*, *25*(7), 546–548. https://doi.org/07.2015/JCPSP.546548

Knapstad, M., Sivertsen, B., Knudsen, A.K., Smith, O.R.F., Aarø, L.E., Lønning, K.J., & Skogen, K.C, (2021). Trends in self-reported psychological distress among college and university students from 2010 to 2018. *Psychological Medicine*, *51*(3), 470–478. https://doi.org/10.1017/S0033291719003350

Kruisselbrink Flatt, A. (2013). A Suffering Generation: Six Factors Contributing to the Mental Health Crisis in North American Higher Education. *College Quarterly*, *16*(1). Available at https://eric.ed.gov/?id=EJ1016492

Kumaraswamy, N. (2013). Academic Stress, Anxiety and Depression amongCollege Students- A Brief Review. *International Review of Social Sciences and Humanities*, *5*(1), 135–143.

Kvam, S. Kleppe, C.L., Nordhus, I.H., & Hovland, A., (2016). Exercise as a treatment for depression: A meta-analysis. *Journal of Affective Disorders*, *202*, 67–86. https://doi.org/10.1016/j.jad.2016.03.063

Lee, I., Shiroma, E.J., Lobelo, F., Puska, P. Blair, S.N., & Katzmarzyk, P.T. (2012). Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *The Lancet*, *380*(9838), 219–229. https://doi.org/10.1016/S0140-6736(12)61031-9

Li, M., Fang, Q., Li, J., Zheng, X., Tao, J., Yan, X., Lin, Q., Lan, X., Chen, B., Zheng, G., & Chen, L. (2015). The Effect of Chinese Traditional Exercise-Baduanjin on Physical and Psychological Well-Being of College Students: A Randomized Controlled Trial. *PLoS ONE*, *10*(7). https://doi.org/10.1371/journal.pone.0130544

Li, Y., Li, J., Yang, Z., Zhang, J., Dong, L., Wang, F., & Zhang, J. (2021). Gender Differences in Anxiety, Depression, and Nursing Needs Among Isolated Coronavirus Disease 2019 Patients. *Frontiers in Psychology*, *12*, 2068. https://doi.org/10.3389/fpsyg.2021.615909

Liu, X., Ping, S., & Gao, W. (2019). Changes in Undergraduate Students' Psychological Well-Being as They Experience University Life. *International Journal of Environmental Research and Public Health*, *16*(16), 2864. https://doi.org/10.3390/ijerph16162864

Mak, Y.W., Kao, A.H.F, Tam, L.W.Y., Tse, V.W.C, Tse, D.T.H., & Leung, D.Y.P. (2018). Health-promoting lifestyle and quality of life among Chinese nursing students. *Primary Health Care Research & Development*, *19*(6), 629–636. https://doi:10.1017/S1463423618000208

Marschin, V., & Herbert, C. (2021). A Short, Multimodal Activity Break Incorporated Into the Learning Context During the Covid-19 Pandemic: Effects of Physical Activity and Positive Expressive Writing on University Students' Mental Health—Results and Recommendations From a Pilot Study. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.645492

McPherson, A., Mackay, L., Kunkel, J., & Duncan, S. (2018). Physical activity, cognition and academic performance: an analysis of mediating and confounding relationships in primary school children. *BMC Public Health*, *18*(1), 936. https://doi.org/10.1186/s12889-018-5863-1

Methley, A.M., Campbell, S., Chew-Graham, C., McNally, R., & Cheraghi-Sohi, S. (2014). PICO, PICOS and SPIDER: a comparison study of specificity and sensitivity in three search tools for qualitative systematic reviews. *BMC Health Services Research*, *14*(1), 579. https://doi.org/10.1186/s12913-014-0579-0

Miguel, A. Q. C., Tempski, P., Kobayasi, R., Mayer, F. B., & Milton, A. (2021). Predictive factors of quality of life among medical students: results from a multicentric study. *BMC psychology*, *9*(1), 36. https://doi.org/10.1186/s40359-021-00534-5

Mikkelsen, K., Stojanovska, L., Polenakovic, M. Bosevski, M., & Apostolopoulos, V. (2017) Exercise and mental health. *Maturitas*, *106*, 48–56. https://doi.org/10.1016/j.maturitas.2017.09.003

Moher, D., Liberati, A., Tetzlaff, J., Altman, D., & PRISMA Group (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *Public Library of Science Medicine*, *6*(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097

Moher, D., Shamseer, D., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., Shekelle, P, Stewart, L., & PRISMA-P Group (2015). Preferred reporting items for systematic review and meta-analysis

protocols (PRISMA-P) 2015 statement. *Systematic Reviews, 4*, 1. https://doi.org/10.1186/2046-4053-4-1

Molnár, É.D., Kovács, D., & Bartyik, K. (2020). Comparison of Quality of Life and Learning Success of Adolescents Surviving Cancer and Their Classmates. *Journal of Cancer Education*, *35*, 352–358. https://doi.org/10.1007/s13187-019-1472-7

Morres, J.D., Hatzigeorgiadis, A., Stathi, A., Comoutos, N., Arpin-Cribbie, C., Krommidas, C., & Theodorakis, Y. (2019). Aerobic exercise for adult patients with major depressive disorder in mental health services: A systematic review and meta-analysis. *Depression and Anxiety*, *36*(1), 39–53. https://doi.org/10.1002/da.22842

Charn Nang, C., Piano, B., Lewis, A., Lycett, K., & Woodhouse, M. (2015). Using The PICOS Model To Design And Conduct A Systematic Search: A Speech Pathology Case Study. *undefined*, *51*.

Neves, M.K.M.D., Loots, J.M., & van Niekerk, R.L. (2014). The effect of various physical exercise modes on perceived psychological stress. *South African Journal of Sports Medicine*, *26*(4), 104–108.

Oliva, F., Nibbio, G., Vizzuso, P., Sodano, A.J., Ostacoli, L., Carletto, S., & Piccia, R.L. (2018). Gender Differences in Anxiety and Depression before and after Alcohol Detoxification: Anxiety and Depression as Gender-Related Predictors of Relapse. *European Addiction Research*, *24*, 163–172. https://doi.org/10.1159/000490046

Ozkul, C.O. (2021). Quality of life and related factors in university students during the coronavirus disease 2019 pandemic. *Journal of Exercise Therapy and Rehabilitation*, *7*(3), 267–276

Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J.M., Hróbjartsson, A., Lalu, M.M., Li, T., Loder, E.W., Mayo-Wilson, … Moher, D. (2021) 'The PRISMA 2020 statement: an updated guideline for reporting systematic reviews', *BMJ*, *372*(71). https://doi.org/10.1136/bmj.n71.

Petruzzello, S.J., & Box, A.G. (2020). The Kids Are Alright—Right? Physical Activity and Mental Health in College Students. *Kinesiology Review*, *9*(4), 279–286. https://doi.org/10.1123/kr.2020-0039

Potrebny, T., Wiium, N., & Lundegård, M.M.-I. (2017). Temporal trends in adolescents' self-reported psychosomatic health complaints from 1980-2016: A systematic review and meta-analysis. *Public Library of Science ONE*, *12*(11), e0188374. https://doi:10.1371/journal.pone.0188374

Pourranjbar, M., Poursoltani, H., Khodadadi, M.R., & Ghorbanzadeh, B. (2010). A Comparative Study on General Health Status of Athlete and Nonathlete Students in Kerman University of Medical Sciences. *Archives Of Applied Science Research*, 2012, 623–631.

Proctor, S. & Boan-Lenzo, C. (2010). Prevalence of Depressive Symptoms in Male Intercollegiate Student-Athletes and Nonathletes. *Journal of clinical sport psychology*, *4*, 204–220. https://doi.org/10.1123/jcsp.4.3.204

Pucci, G. C., Rech, C. R., Fermino, R. C., & Reis, R. S. (2012). Association between physical activity and quality of life in adults. *Revista de saúde publica*, *46*(1), 166–179. https://doi.org/10.1590/s0034-89102012000100021

Ramón-Arbués, E., Gea-Caballero, V., Granada-López, J.M., Juárez-Vela, R., Pellicer-García, B., & Antón-Solanas, E. (2020). The Prevalence of Depression, Anxiety and Stress and Their Associated Factors in College Students. *International Journal of Environmental Research and Public Health*, *17*(19), 7001. https://doi.org/10.3390/ijerph17197001.

Reneses, B., Garrido, S., Navalón, A., Martín, O., Ramos, I., Fuentes, M., Moreno, J., & López-Ibor, J., (2015). Psychiatric morbidity and predisposing factors in a primary care population in Madrid. *The International Journal of Social Psychiatry*, *61*(3), 275–286. https://doi.org/10.1177/0020764014542815

Rhodes, R., Janssen, I., Bredin, S., Warburton, D., & Bauman, A. (2017). Physical activity: Health impact, prevalence, correlates and interventions. *Psychology & Health*, *32*(8), 942–975. https://doi.org/10.1080/08870446.2017.1325486

Rimvall, M. K., Wolf, R. T., Olsen, E. M., Skovgaard, A. M., Clemmensen, L., Oxholm, A. S., Verhulst, F., Rask, C. U., van Os, J., & Jeppesen, P. (2021). Healthcare Costs, School Performance, and Health-related Quality of Life in Adolescence Following Psychotic Experiences in Preadolescence: A Longitudinal Cohort Study. *Schizophrenia bulletin*, *47*(3), 682–691. https://doi.org/10.1093/schbul/sbaa175

Ringenbach. S., Holzapfel, S., Mulvey, G., Jimenez, A., Benson, A., & Richter, M. (2016). The effects of assisted cycling therapy (ACT) and voluntary cycling on reaction time and measures of executive function in adolescents with Down syndrome. *Journal of intellectual disability research*, *60*(11), 1073–1085. https://doi.org/10.1111/jir.12275

Ruotolo, I., Berardi, A., Sellitto, G., Panuccio, F., Polimeni, A., Valente, D., & Galeoto, G. (2021). Criterion Validity and Reliability of SF-12 Health Survey Version 2 (SF-12v2) in a Student Population during COVID-19 Pandemic: A Cross-Sectional Study. *Depression Research and Treatment, 2021*, 6624378. https://doi.org/10.1155/2021/6624378

Scully. D., Kremer, J., Meade, M., Graham, R., & Dudgeon, K. (1998). Physical exercise and psychological well-being: a critical review. *British Journal of Sports Medicine*, *32*(2), 111–120.

SFM, C., Van Cauwenberg, J., Maenhout, L., Cardon, G., Lambert, E.V., & Van Dyck, D. (2020). Inequality in physical activity, global trends by income inequality and gender in adults. *International Journal of Behavioral Nutrition and Physical Activity*, *17*(1), 142. https://doi.org/10.1186/s12966-020-01039-x

Shehatah, A., Rabie, M.A., & Al-Shahry, A. (2010). Prevalence and correlates of depressive disorders in elderly with type 2 diabetes in primary health care settings. *Journal of Affective Disorders*, *123*(1–3). 197–201. https://doi:10.1016/j.jad.2009.09.002

Silveira, C., Norton, A., Brandão, I., & Roma Torres, A. (2011). Saúde Mental em Estudantes do Ensino Superior: Experiência da Consulta de Psiquiatria do Centro Hospitalar São João. *Acta Med Portuguesa*, *24*(S2), 247–256

Stallman, H. (2010). Psychological distress in university students: A comparison with general population data. *Australian Psychologist*, *45*. https://doi.org/10.1080/00050067.2010.482109

Storrie, K., Ahern, K., & Tuckett, A. (2010). A systematic review: Students with mental health problems-a growing problem. *International Journal of Nursing Practice*, *16*(1), 1–6. https://doi.org/10.1111/j.1440-172X.2009.01813.x

Stults-Kolehmainen, M.A., & Sinha, R. (2014). The effects of stress on physical activity and exercise. *Sports Medicine* (Auckland, N.Z.), *44*(1), 81–121. https://doi.org/10.1007/s40279-013-0090-5

Sundén, S. (2019). *Perceptions of Academic Success and Quality of Life Issues Among Undergraduate University Students* (Tese, Concordia University – Portland).

Sutula, V.O. (2018). General Definition of the Concept Sports. *Journal of Physical Fitness, Medicine & Treatment in Sports*, *4*(4), 555644. https://doi.org/10.19080/jpfmts.2018.04.555644

Teychenne, M., Ball, K., & Salmon, J. (2010a). Physical activity, sedentary behavior and depression among disadvantaged women. *Health Education Research*, *25*(4), 632–644. https://doi.org/10.1093/her/cyq008

Teychenne, M., Ball, K., & Salmon, J. (2010b). Sedentary behavior and depression among adults: a review. *International Journal of Behavioral Medicine*, *17*(4), 246–254. https://doi.org/10.1007/s12529-010-9075-z

Thompson, W., Sallis, R., Joy, E., Jaworski, C., Stuhr, R., & Trilk, J. (2020). Exercise Is Medicine. *American Journal of Lifestyle Medicine*, *14*(5), 511–523. https://doi.org/10.1177/1559827620912192.

Uddin, R., Hasan, M., Saif-Ur-Rahman, K.M., Mandic, S., & Khan, A. (2020). Physical activity and sedentary behaviour in Bangladesh: a systematic scoping review. *Public Health, 179*, 147–159. https://doi.org/10.1016/j.puhe.2019.10.006

University Student Mental Health Survey (2018). A Large Scale Study into the Prevalence of Student Mental Illness within UK Universities. Available at https://uploads-ssl.webflow.com/561110743bc7e45e78292140/5c7d4b5d314d163fecdc3706_Mental%20Health%20Report%202018.pdf (Accessed: 20 November 2021).

Vogt, T., Schneider, S., Abel, V., Anneken, V., & Strüder, H. (2012). Exercise, mood and cognitive performance in intellectual disability - a neurophysiological approach. *Behavioural Brain Research, 226*(2), 473–480. https://doi.org/10.1016/j.bbr.2011.10.015

Weber, S., Puta, C., Lesinski, M., Gabriel, B., Steidten, T., Bär, K., Herbsleb, M., Granacher, U., & Holger, G (2018). Symptoms of Anxiety and Depression in Young Athletes Using the Hospital Anxiety and Depression Scale. *Frontiers in Physiology, 9*, 182. https://doi.org/10.3389/fphys.2018.00182

White, D., Leach, C., Sims, R., Atkinson, M., & Cottrell, D. (1999). Validation of the Hospital Anxiety and Depression Scale for use with adolescents. *The British Journal of Psychiatry: The Journal of Mental Science, 175*, 452–454. https://doi.org/10.1192/bjp.175.5.452

WHOQOL (1998). The World Health Organization quality of life assessment (WHOQOL): Development and general psychometric properties. *Social Science & Medicine*, *46*(12), 1569–1585. https://doi.org/10.1016/s0277-9536(98)00009-4

WHOQOL GROUP (1994). Development of the WHOQOL: Rationale and Current Status. *International Journal of Mental Health*, *23*(3), 24–56. https://doi.org/10.1080/00207411.1994.11449286

World Health Organization (2001) *The World Health Report. Mental Health: New Understanding, New Hope.* World Health Organization. Available at: https://apps.who.int/iris/handle/10665/42390.

World Health Organization (2014). *The global burden of disease: 2004 update.* WHO

World Health Organization (2020) *Guidelines on physical activity and sedentary behaviour.* WHO

Yorks, D.M., Frothingham, C.A., & Schuenke, M.D. (2017). Effects of Group Fitness Classes on Stress and Quality of Life of Medical Students. *The Journal of the American Osteopathic Association*, *117*(11), e17–e25. https://doi.org/10.7556/jaoa.2017.140

Zhang, Y., Niu, L., Zhang, D., Ip, P., Ho, F., Jiang, Y., Sun, W., Zhu, Q., & Jiang, F. (2019). Social-Emotional Functioning Explains the Effects of Physical Activity on Academic Performance among Chinese Primary School Students: A Mediation Analysis. *The Journal of Pediatrics, 208*, 74–80. https://doi.org/10.1016/j.jpeds.2018.11.045