



Sedentary Lifestyle and Beneficial Effects of Physical Activity on Psychiatric Disorders in a Population of Moroccan University Students: Psychophysiological Interpretation

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Abstract

Edited by: Sasho Stoleski
Citation: Ibour S, Boulhanna A, Hnini R, Chigr F, Najimi M. Sedentary Lifestyle and Beneficial Effects of Physical Activity on Psychiatric Disorders in a Population of Moroccan University Students: Psychophysiological Interpretation. Open-Access Maced J Med Sci. 2022 Jul 28; 10(E):1496-1504. https://doi.org/10.3889/oamjms.2022.8119
Keywords: Physical activity; Psychiatric disorders; University students; Morocco
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Received: 30-Nov-2021
Revised: 14-Jul-2022
Accepted: 18-Jul-2022
Copyright: © 2022 Said Ibour, Abdelmounaim Boulhanna, Rachid Hnini, Fatiha Chigr, Mohamed Najimi
Funding: PPR type B (Pr. M. Najimi)
Competing Interest: The authors have declared that no competing interest exists
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BACKGROUND: Mental health is a major public health issue worldwide. Many strategies have been developed to counter the negative effects of this phenomenon. In this sense, it is increasingly recognized that physical activity has positive effects on negative emotions and could be used as a therapeutic way.

AIM: Our objectives were focused on the evaluation of the level of physical activity, negative emotions, and the links between the two variables among a population of university Moroccan students.

METHODS: We used Ricci-Gagnon self-questionnaire to assess the physical activity profile and depression, anxiety, and stress scale (DASS-21) is used to evaluate state of stress, and the anxiety-depressive symptomatology of 648 participants (average age = 24.12 years).

RESULTS: First, the results show that male students practice more physical activity than females who are found to be more anxious and stressed. Despite gender, we found that there is a highly relevant relationship between physical activity and the intensity of negative emotions. This relationship implies that the most physically active subjects had mild anxiety-depressive symptomatology associated with low stress levels.

CONCLUSION: The results of our study showed that 57% of students were “active” and 43% had an “inactive” physical profile. By gender, males were more physically active than females. In our study sample, a strong correlation was found between the level of physical activity and emotional well-being.

Introduction

Mental health is a major global public health preoccupation, as reflected in the World Health Organization’s (WHO) Mental Health Action Plan 2013–2020 [1]. According to the latter, mental health is related to the concept of well-being and has a positive character: A state of well-being that enables people to realize their potential, to cope with the normal difficulties of life, to work successfully and productively, and to be able to contribute to the community. Affective disorders, a term used in the mental health field, can be described as mood changes or mood swings. These disorders are associated with the occurrence of psychological trauma, early brain injury, or childhood neglect as well as the condition of attachment disorder [2]. Affective disorders may also be present in people with other psychiatric disorders such as attention deficit disorder, bipolar disorder, borderline personality disorder, or post-traumatic stress disorder [3]. According to the WHO (2013), mental health disorders are ranked second in terms of morbidity costs, behind heart disease [1]. It

should be noted that the university educational cycle is one of the periods when many psychiatric pathologies begin to manifest [4]. Remember also that the presence of psychological difficulties in the student population is associated with poorer academic performance and lower future job performance [5]. In addition, the presence of negative emotions will have a functional impact on work, on the ability to adapt to the university environment, and on social and family relationships [4]. Among university students, coursework, examinations, thesis of the end of studies, learning disabilities, and financial hardship are all factors associated with psychiatric problems [6], [7]. Among the means being considered to address this issue, it is increasingly recognized that physical activity has positive psychological benefits that affect several dimensions of mental health. Indeed, several types of research focused on the impact of physical activity on mental health (mood, anxiety, stress, depression, self-esteem, sense of efficacy, cognitive performance, and somatic effects) have shown the psychological benefits of physical effort [8], [9]. These positive effects would help to increase the individual’s state of well-being, promoting the realization of full potential and increasing

psychological resources to face life's normal difficulties. Similarly, a significant reduction in depressive and anxiety states, associated with physical activity, has been demonstrated in the population at large as well as in subgroups with a psychiatric diagnosis of these disorders [10], [11], [12]. Such benefits of physical exercise can be explained by physiological, biochemical, and psychological processes. Given this, it is important to promote the virtues of physical activity not only for physical health but also for mental health. Thus, currently in some countries, and more particularly in the United States, specific programs of physical exercise are emerging in the treatment centers of somatic and mental disorders. Several studies have been conducted to determine the effectiveness of physical activity on health. In the international literature, three axes of research can be distinguished in the field of the impact of physical exercise on mental health: The type and frequency of activities, the specificity of mental disorder, and the mechanisms of physical effort on health.

Although the effects of physical activity on reducing emotional distress are considered a psychotherapeutic process in its own right, the rate of sedentary behavior remains very high in the population at large. The radical changes in the current lifestyle, especially due to new technologies, seem to be the major factor favoring physical inactivity. This is the reason why we decided to carry out this research with an objective to study the links between some mental health indices and the level of physical activity among a population of students. The choice of this population is justified by the fact that university sports in Morocco are in decline due to a lack of means and logistics to motivate students to practice a physical activity. The physical activity space is very limited or even absent in several university educational institutions. Although there are offices dedicated to sports and artistic activities, physical education teachers are not recruited at the university level. These are some factors, among others, that led us to focus on university students in this study. Our approach consists of describing, in a first step, the physical activity profiles of participants. An evaluation of the anxiety-depressive symptomatology, as well as the level of stress, will be the object of the second step. Finally, we will examine the links between the two parameters.

Materials and Methods

Population and study site

Our cross-sectional study was carried out on a sample of 648 students pursuing their studies in different disciplines at the Sultan Moulay Slimane University in Beni Mellal city (center Morocco). The

participants in this study belong to several institutions of the university, their academic level ranges from the undergraduate level of the first degree obtained at the university to the doctoral level. The students from different institutions at Sultan Moulay Slimane University are considered admitted to participate in our study sample. Due to the psychological burden of chronic diseases and neurodevelopmental disorders, students affected by them are excluded from the study. The sampling technique used simple random sampling. The sample size was calculated by setting the margin of error at 4% and confidence interval at 95%.

During our study, the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Subjects have given their informed consent and their anonymity is preserved.

Tools

In addition to questions on the sociocultural and family characteristics of the participants, the questionnaire administered is composed of two self-evaluation scales, one assessing depression, anxiety, and stress. The other estimates the level of physical activity of the population.

Depression, anxiety, and stress scale (DASS-21)

DASS-21 [13] is a set of three self-report scales designed to measure the negative emotional states of depression, anxiety, and stress. It is composed of three subscales of 7 items each. Items 3, 5, 10, 13, 16, 17, and 21 form the depression subscale with scores divided into a normal score (0–9), mild depression (10–12), moderate depression (13–20), severe depression (21–27), and extremely severe depression (28–42). Questions 2, 4, 7, 9, 15, 19, and 20 form the anxiety subscale. The total score was divided into normal (0–6), mild anxiety (7–9), moderate anxiety (10–14), severe anxiety (15–19), and extremely severe anxiety (20–42). Questions 1, 6, 8, 11, 12, 14, and 18 form the stress subscale, the intensity of which is as follows: Normal stress (0–10), mild stress (11–18), moderate stress (19–26), severe stress (27–34), and extremely severe stress (35–42). Respondents express their degree of agreement or disagreement on a scale ranging from 0 (does not apply to me at all) to 3 (applies to me a lot or most of the time), the total score is obtained by adding the marks corresponding to the checked statement. We chose this scale because it is short, simple to administer, and covers the evaluation of three dimensions of mental health. It has also been the subject of several international studies and validations that have shown good psychometric qualities [14], [15], [16]. Good

convergent and discriminant validity in the French version, used in this study, has been demonstrated [14]. The internal consistency of the three subscales varies between 0.82 and 0.94 [14].

Ricci-Gagnon self-questionnaire [17]

It is a self-assessment questionnaire that allows evaluating the sedentary state. It addresses in 9 points the usual level of physical activity of the patients by taking into account the physical activities of leisure (including sport) as well as the physical activities of daily life (work, housework, gardening.) and travel. It provides a score ranging from 6 (non-active person) to 45 (very active person). It is used to distinguish active individuals (score ≥ 18) from inactive individuals (score < 18). The Ricci and Gagnon questionnaire was chosen for its simplicity, its instantaneous production of a numerical score out of 45, it is very useful for statistical purposes, and its relatively short duration.

Protocol

The two questionnaires used were submitted online by sharing them through social networks in Facebook and WhatsApp groups of university students. The survey was conducted during a period from January to the beginning of March 2020, before the application of health security measures related to the occurrence of coronavirus disease 2019 (COVID-19). Our experimental approach consists of describing the physical activity profiles and the prevalence of psychopathological disorders found in the studied sample. Next, the associations between physical activity level and the intensity of anxiety, stress, and depression will be examined by controlling for various population characteristics.

Statistical analysis

The data from the questionnaire were regrouped and analyzed using Microsoft Excel and SPSS version 21 software. For quantitative variables, we used the t-test, which is the most common method for evaluating differences between the means of two groups. In the case of qualitative variables, we used the Chi-square test of independence. The level of significance was set to be < 0.05 .

Results

Characteristics of the population

Our study population consisted of 648 participants, of which female students numbered

239, representing 56% of the sample. The age of the respondents varies from 18 to 30 years (the average age is 24.12 years, the standard deviation is 4.65 years). The proportions according to each age category and some other data of participants are shown in Table 1.

Table 1: Characteristics of the study population

Variable	n	%
Gender		
Male	285	44
Female	363	56
Living environment		
Urban	460	71
Rural	188	29
University level		
1 st year	117	18
2 nd year	110	17
Bachelor's degree	194	30
Master degree	117	18
PhD student	110	17
Age		
18 à 21 years	190	29
22 à 25 years	298	46
Above 25 years	160	25

Description of physical activity level in the student population

In this section, we will describe the profiles determining the level of physical practice in our population. According to Ricci-Gagnon self-questionnaire, 43% of the participants are "inactive," 50% are "active" whereas only 7% had a "very active" profile (Figure 1).

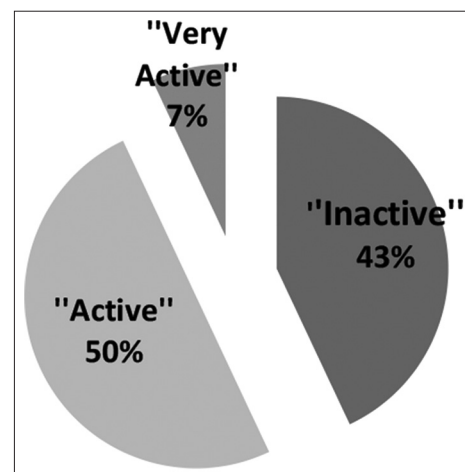


Figure 1: Distribution of physical activity profiles in the study population

Physical activity profile by gender and age of participants

The analysis of the scores obtained on the scale evaluating the level of physical activity in each sex showed that 32% of the boys were "inactive," 57% were "active," while the "very active" profile represented only 11%. For girls, these proportions are 52%, 44%, and 4%, respectively (Figures 2 and 3).

The mean score reported on Ricci-Gagnon self-questionnaire by male students was $M = 27.02$ ($SD = 5.36$) while that of female students was $M = 25.12$ ($SD = 4.64$). Comparison of these average scores by

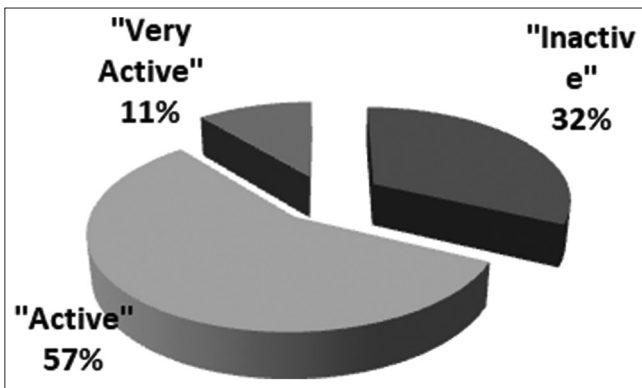


Figure 2: Physical activity in the male students

Student's t-test revealed a significant difference in favor of men ($t=2.79$; $p=0.006$). Statistical analysis of the self-administered questionnaire scores by age did not show any relevant associations. The mean scores of Ricci-Gagnon self-questionnaire according to age categories are shown in Figure 4.

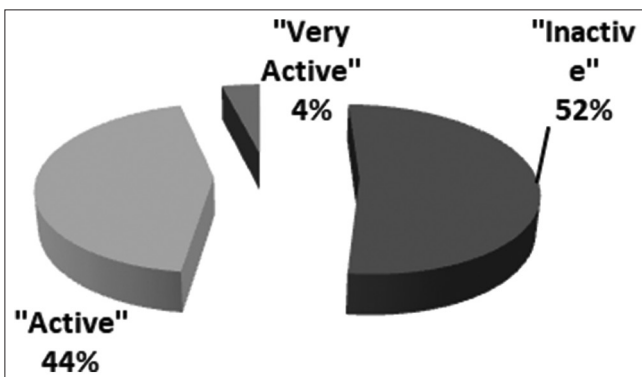


Figure 3: Physical activity in the female students

Living environment, field of study, educational level, and physical activity

Looking at the mean score reported in both living environments, we found that rural respondents had a significantly higher score than urban respondents ($p=0.01$; $r=0.21$). This means that students from the first area make more physical effort than their peers living in the urban area. When examining the variation in physical activity by students' educational level and disciplines, statistical analysis did not show significant relationships

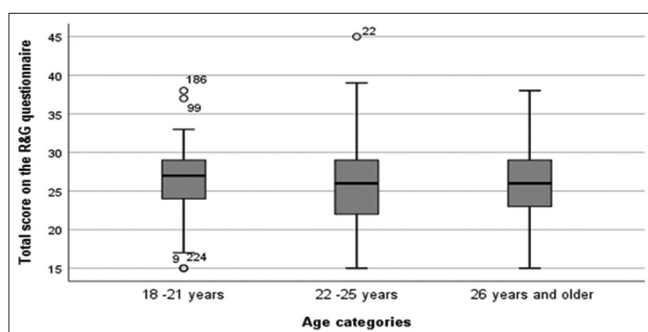


Figure 4: Mean scores of Ricci-Gagnon self-questionnaire in each age category

between these parameters. Comparing students of the same gender from the two living environments by Student's t-test showed that participants from rural areas had significantly higher scores on the Ricci-Gagnon scale than those from urban areas ($t = 2.62$, $p=0.008$; $t=2.16$, $p=0.032$ for male and female students, respectively).

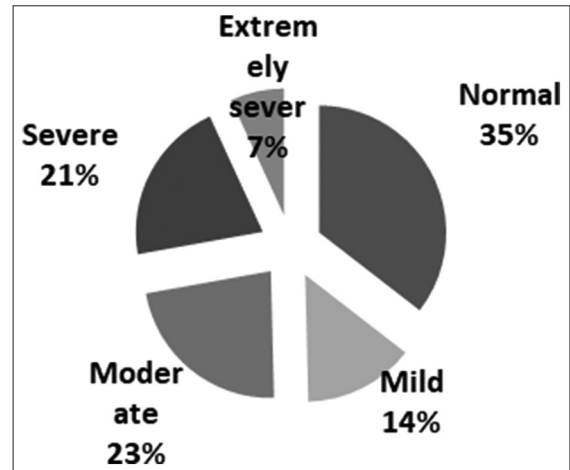


Figure 5: State of stress in the study population

Description of negative emotions in students

Stress, anxiety, and depression in the study population

Half of our sample (50%) had a "normal to mild" level of stress, 21% were severely stressed, and extremely severe stress state was found in 23% of participants (Figure 5). For anxiety, slightly more than half (52%) had severe to very severe anxiety symptomatology whereas 48% had normal to moderate anxiety (Figure 6).

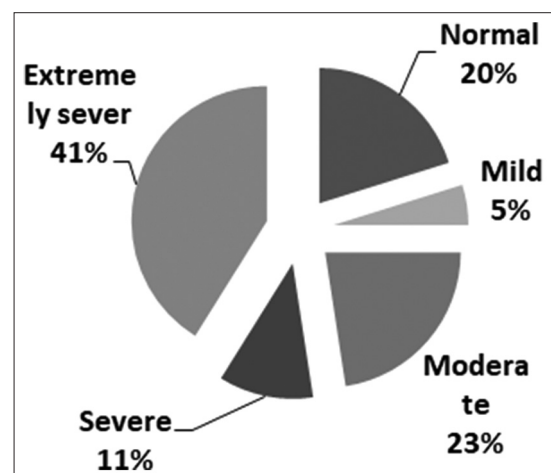


Figure 6: Level of anxiety in the study population

The prevalence of depression in our population showed that one-third of respondents (34%) had severe to extremely severe depressive symptoms and 66% had normal to moderate depression (Figure 7).

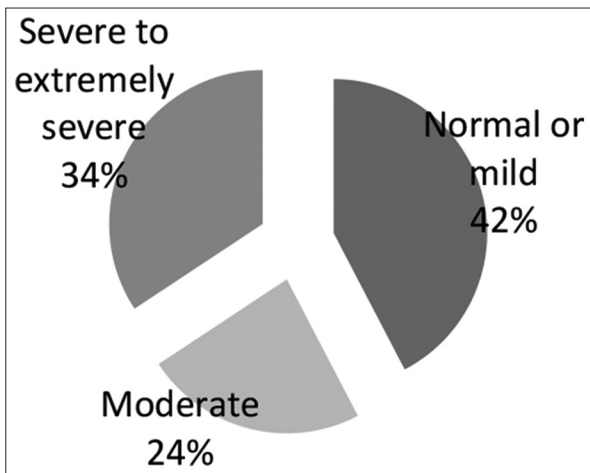


Figure 7: Distribution of depressive symptomatology in the study population

Stress, anxiety, and depression in relation to gender and age

The overall prevalence of the three disorders studied indicates that female students are more stressed, more anxious, and more depressed than male students. The severity of the three disorders was significantly correlated with gender. Thus, in the female group, the percentages of “severe to extremely severe” intensity of stress, anxiety, and depression were respectively in the order of 35%, 62%, and 38% which corresponds to 18%, 39%, and 29% in the male group (Figure 8).

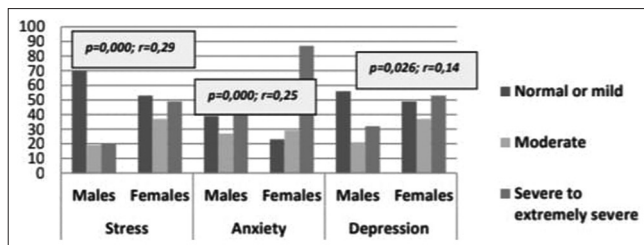


Figure 8: The intensity of negative emotions by gender

A more detailed analysis of the scores on the three subscales of the depression, anxiety, and stress self-questionnaire (DAS-21) between women and men revealed that urban women, in particular, were significantly more stressed, anxious and depressed than men. These gender differences found in the urban setting were not established in the rural participants (no significant differences between girls and boys in the rural area).

Concerning the age variable, the prevalence of stress and depressive disorders varied considerably according to age categories, while the evolution of anxiety intensity was not associated with these categories (Table 2). Statistical analysis show that participants aged between 22 and 25 years are the most stressed and depressed, this preponderance is reflected in a high proportion of “severe to extremely severe” intensity of negative emotions in this age category. Indeed, more than half (61%), and almost half (49%), and 48% of respondents had “severe to

Table 2: Correlations between the intensity of negative emotion, gender, and age

Gender	Stress intensity	Anxiety intensity	Depression intensity
Pearson correlation	0.250**	0.252**	0.142*
Sig. (bilateral)	0.000	0.000	0.026
n	648	648	648
Age categories			
Spearman rho	-0.253**	-0.103	-0.146*
Sig. (bilateral)	0.000	0.137	0.034
n	648	648	648

The correlation is significant at the level: *0.05; **0.01.

extremely severe” intensity of stress, anxiety, and depression, respectively (Table 2).

Still looking at the highest intensity of negative emotions in the other age categories of our population, it turns out that the youngest age groups are the least affected (Figure 9).

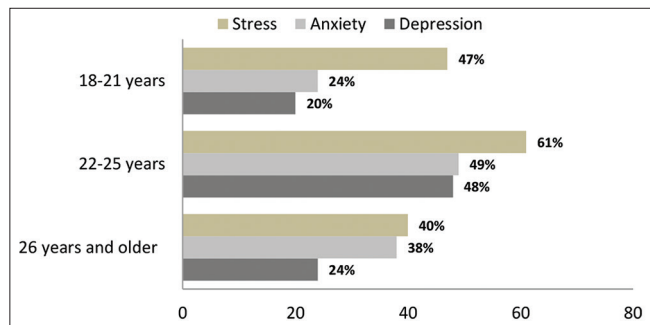


Figure 9: Percentage of “severe” to “very severe intensity” of negative emotions by age

The study of the intensity of negative emotions between the two sexes according to each age category showed that girls in the first two categories (19–21 years and 23–25 years) were significantly affected than boys. In the oldest category, differences in average scores on all subscales of the depression, anxiety, and stress questionnaire (DASS-21) between the two sexes were not relevant.

Links between physical activity level, anxiety-depressive symptomatology, and stress

Examination of the relationship between physical activity level and stress and other anxiety-depressive disorders revealed that the physical activity profile is significantly and positively correlated with the intensity of symptoms reflecting these psychopathological difficulties (Table 3). This means that students classified as having “active” profile, in terms of physical exercises practice, had less anxiety and depressive symptoms than their peers with “inactive” profile.

Table 3: Correlation between physical activity profile and intensity of negative emotions

Physical activity profile	Stress intensity	Anxiety intensity	Depression intensity
Pearson correlation	1	-0.109	-0.138*
Sig. (bilateral)	0.086	0.029	0.040
n	648	648	648

*The correlation is significant at the 0.05 level.

In the group that did not make enough physical effort, the analysis of the negative emotions intensity

evaluated indicated that more than half of the students had a prevalence of “severe to extremely severe” stress and anxiety (in 66% and 64% of the participants, respectively, vs. 23% and 44% in the group considered “physically active”). As for depression, almost two-thirds (70%) of the participants, categorized as “active,” had normal to moderate depressive symptomatology compared to 61% in the “inactive” category (Figure 10).

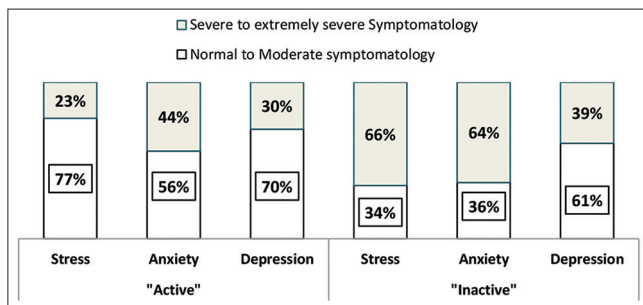


Figure 10: Prevalence of negative emotions according to physical activity profile

To understand the evolution of the links between mental health problems and physical effort, we conducted more detailed analysis while setting certain parameters for our population. When analyzing the degree of emotional difficulties for the same physical activity profile, we found that female students had significantly higher scores than male students. Thus, in the “active” profile category, girls were more stressed and anxious than boys ($t = 2.96$; $p = 0.004$, $t = 2.52$; $p = 0.01$, respectively). These differences are even more emphasized in the “inactive” group of students, whose girls show higher depressive symptomatology with very high levels of significance ($t = 4.02$; $p = 0.000$, $t = 4.03$; $p = 0.000$, and $t = 3.20$; $p = 0.000$, for stress, anxiety, and depression, respectively) (Figure 11).

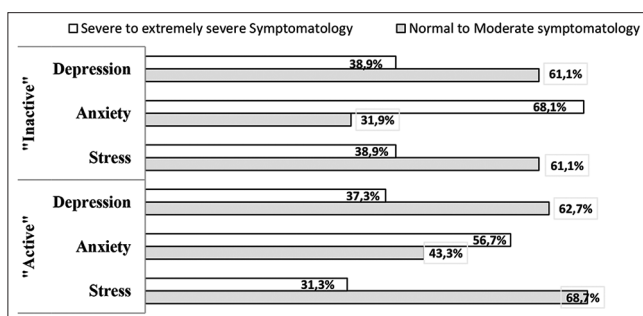


Figure 11: Intensity of negative emotions in two physical activity profiles for female students

Cross-tabulating the physical activity profile with age categories, highly significant differences in average scores DASS-21 were recorded by gender in the “active” population, particularly in the younger age categories (18–21 and 22–25 years), thus describing the female gender as having altered mental health status. In both physical activity profiles, the average scores on the three subscales assessing well-being did not vary significantly between the two sexes in the oldest category (26 years or older) (Table 4). From the variation in stress, anxiety, and depression scores

shown in Table 4, we can stipulate that males enjoy the mental health benefits of exercise much more than females.

Discussion

We recall that the objectives of our present study focused on physical activity levels, negative emotions, and the analysis of the relationship between the two issues in a population of university students. On the axis devoted to the description of the physical activity level, our study revealed that 57% of the students were “active” and 43% of them had an “inactive” profile. By gender, boys were more active than girls (68% of males were active vs. 48% of females). Similar results were described in a previous study conducted by the WHO among girls in Oman [18]. Statistics from this study indicate that 32% of the girls in the sample do not exercise at all, and 41% exercise little while 27% of them exercise regularly.

Concerning the description of negative emotional intensity, our study revealed that slightly more than half (52%) of the students had severe to very severe anxiety symptomatology and 48% had normal to moderate anxiety. For depression, we found that 34% of the subjects had severe to extremely severe symptomatology. Similarly, half of our sample had normal to moderate stress levels (50%). Our results describe participants in the age group between 21 and 25 years as the most exposed to high levels of depression and anxiety. This finding is similar to a study conducted with medical school students, which showed that the age group between 21 and 23 years old is more likely to be anxious and depressed [19]. Such finding can be explained, in the Moroccan context, as students in this age category are comforted with challenges and pressures that can place an enormous psychological burden on them. Indeed, this is a time period when university students are facing final examinations to validate their training and obtain their degree. Another interpretation worth mentioning is the one that links this age to the search for internships, whether in the context of end-of-study projects or recruitment and hiring internships, which seem to be stressful situations for students in this age category. These alarming results are quite logical as we know that at the level of Moroccan universities, there is no medical service for the psychological support for students. The creation of support units for students, both during search for internships and after graduation and the search for employment, also seems to be a priority to be taken into consideration by those in charge of the Moroccan educational system.

In the section dedicated to the examination of the links between physical inactivity and negative emotions, a strong correlation was found between the

Table 4: Cross-tabulation of DAS-21 scores with gender and physical activity profile

Age categories (years)	Female students			Male students			P1 p	P2	P3
	Stress	Anxiety	Depression	Stress	Anxiety	Depression			
"Active" profile									
18–21	25.48 (1.83)	21.63 (1.93)	17.56 (1.75)	14.80 (3.83)	10.80 (3.93)	14.20 (3.49)	0.03	0.01	NS
22–25	22.27 (5.34)	22.00 (3.3)	25.07 (5.38)	15.02 (4.74)	13.17 (4.82)	11.61 (2.39)	0.012	0.006	0.000
26 years and older	19.33 (5.43)	15.78 (4.34)	16.66 (4.63)	13.90 (5.83)	12.29 (4.15)	12.10 (3.45)	NS	NS	NS
"Inactive" profile									
18–21	22.25 (6.91)	17.25 (5.93)	17.75 (6.75)	24.5 (8.37)	18.5 (7.34)	24.5 (6.54)	NS	NS	NS
22–25	23.77 (8.13)	21.54 (8.53)	19.15 (7.75)	17.38 (5.76)	14.77 (7.11)	14.92 (8.29)	0.03	0.04	NS
26 years and older	12.67 (6.81)	18.5 (7.3)	13.33 (6.42)	14.3 (6.53)	12.75 (5.36)	12.2 (4.57)	0.01	NS	NS

p1: Significance of the difference between the average stress scores. p2: Significance of the difference between the average scores of anxiety. p3: Significance of the difference between the average scores of depression. NS: Not significant.

level of physical activity and emotional well-being in our study sample. This finding allows us to assume that physical effort has a positive impact on mental health by reducing feelings of depression, anxiety, and stress. On the other hand, we concluded that male students benefit considerably more from the mental health benefits of exercise than female students. These results were also confirmed by Lewis (2006) research, which showed that male students have a higher level of self-esteem than female students who were found to be overweight and less interested in sports activities [20]. Our results are consistent with other previous studies that have indicated that physical activity has a positive effect on depression, anxiety, and overall mental health, for males and females of different ages [21], [22], [23], [24]. Furthermore, recent studies show strong inverse associations between sedentary leisure time behavior and depression [25]. In the same sense, several studies have specified that exercise has a direct impact on self-confidence, self-esteem, and a sense of competence and control [26]. Antidepressant effects of physical activity are, therefore, regularly raised [27]. A recent study involving a large sample (36,595 participants) and objectively measuring exercise frequency and cardiovascular fitness, by a 6 min VO₂max test on a cycle ergometer, showed that exercising at least 1–2 times per week is associated with a lower likelihood of depression/anxiety symptoms [28]. The contribution of physical exercise to the improvement of mood and the construction of a positive self-concept have been explained, in several previous scientific types of research, by the involvement of three types of factors: Psychological, chemical, and physiological.

Physiologically, neurogenesis, monoamine synthesis, reduction of systemic inflammation and oxidative stress, and regulation of the endocrine system are mechanisms underlying the influence of physical exercise on mental health [29]. Improved diversity and composition of the gut microbiota have been suggested, by emerging research, to explain the beneficial effects of exercise on well-being [30], [31]. The increase in circulating endorphins (e.g., opiates) during physical exercise would have a mediating effect on the psychological effects, due to their importance in the regulation of emotions and the perception of pain [32]. Thus, this increase in plasma concentrations of endorphins would influence mood and anxiety. The increase in body temperature after the physical activity has also been considered responsible for the decrease in anxiety [32].

The chemical explanation stipulates that the benefits of physical activity would be associated with an increase in brain chemical neuromediators levels (e.g., dopamine, norepinephrine, and serotonin). Thus, physical activity could, by this process, reduce depression, which is associated with a disturbance of cerebral monoamines. Dopamine, which also plays an important role in the movement, is said to be increased by physical activity [33]. Norepinephrine is the largest modulator of neuronal activity in the brain. Noradrenergic responses modulate physiological and behavioral responses as well as adaptations to stress [34]. An increase in norepinephrine and its metabolite has been observed in various regions of the brain after a period of exercise [35]. Finally, from a psychological perspective, the effect of physical activity on depression and anxiety is the result of an increase in feelings of control and efficacy [36], [37]. The researchers concluded that this feeling mediated the relationship between exercise and depression, and between body mass index and depression in obese patients [36], [38]. Ryan (2008) suggested that improvements in self-esteem, as well as improvements in self-efficacy, were sufficient for physical activity to have antidepressant results [39]. Regular exercise can lead to greater social support [40]. Other authors consider that the "time-out," which corresponds to the time of distraction or the detour of attention from the signs of physical or psychological discomfort, would be the benefits' origin of physical activity on anxiety and depression. Improved body image, self-esteem, and social relationships may also explain these beneficial effects of physical activity [41].

The implication of this research is that the practice of a physical activity is very important since it moderates the intensity of negative emotions in the student population. It is a simple and inexpensive alternative to pharmacotherapy and psychotherapy, which can be evoked in the treatment and prevention of negative emotions that are generated by concerns associated with the university environment in students. Based on the results of several studies, such as the ones derived from our present work, we know the importance and positive impact of sports activities on physical and mental health. These findings should encourage higher education authorities to integrate compulsory physical education sessions into the university curriculum while providing sufficient infrastructure and human resources. Building well-equipped gyms, diversifying and organizing motivating and enjoyable physical activities, as well as

setting sports challenges, by academic institutions, can motivate students to fight against a sedentary lifestyle. We also recommend the opening of teaching/training and sports streams that allow flexibility for students to practice their favorite sport and/or physical activity while pursuing their university education.

This study had some limitations. First, the study population was composed of students from a single university located in one of the Moroccan areas known by socioeconomic precariousness. Caution should be exercised in generalizing the results of this study to other Moroccan universities. Similar studies are also recommended to be conducted in other universities. Second, it is important to note that personality traits are one of the factors related to the intensity of negative emotions. Thus, a study conducted among medical students showed that personality traits such as high novelty-seeking (HNS) predispose to academic burnout (AB), which is considered an antecedent of depressive disorders [42]. In the same study, physical activity plays a moderating role in the relationship between AB and HNS [42]. Finally, we point out another limitation related to the Ricci-Gagnon self-questionnaire, which is a relatively recent measurement scale, since it has not been sufficiently studied in terms of validation.

Conclusion

Physical activity appears to have particularly interesting effects on reducing negative emotions. The integration of physical education and sports activity courses within university institutions is, therefore, a measure that should be urgently considered. Further studies are needed to better understand the relationship between physical exercise and emotional well-being by controlling for several factors related to mental health status.

Acknowledgments

We thank all the university students who participated in this study.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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