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Original Article

EFFECTS OF PHYSICAL ACTIVITY ON THE MOOD STATES OF YOUNG STUDENTS

EFEITOS DA ATIVIDADE FÍSICA SOBRE OS ESTADOS DE HUMOR DE JOVENS ESTUDANTES

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ABSTRACT

The objective of this research was to analyze the effect of level of physical activity on perception of mood states among young students in the final grades of high school. The sample consisted of a total of 216 students, of both sexes, with an average age of 16.89±1.48 years. This cross-sectional research was characterized as descriptive and of a quantitative nature. For data collection, the Brunel Mood Scale (BRUMS) and the Habitual Physical Activity Questionnaire were used. Normality was verified through the Kolmogorov-Smirnov test. Subsequently, inferential statistics for non-parametric data were applied, with the Kruskal-Wallis and Dunn's Post-Hoc tests. Spearman's correlation coefficient was used to check the relationship between level of physical activity and mood states. Significance was set at $p<0.05$. From the results, we found that the perception of mood states reported by young students had significant differences when we consider this population's level of physical activity. Young individuals classified as physically inactive reported a lower level of vigor, as well as a greater predisposition to negative mood aspects compared to physically active ones. In this case, physical activity can contribute to a better perception of psychological health.

Keywords: Physical activity. Mood**.** Mental health. Adolescents' health

RESUMO

O objetivo desta pesquisa foi analisar o efeito do nível de atividade física na percepção dos estados de humor em jovens estudantes das séries finais do Ensino Médio. A amostra foi constituída por um total de 216 estudantes, de ambos os sexos, com uma idade média de 16,89 ±1,48 anos. Esta pesquisa de caráter transversal se caracterizou como descritiva e de aspecto quantitativo. Para a coleta de dados foram utilizados a Escala de Humor de Brunel (BRUMS) e o Questionário de Atividades Físicas Habituais. A verificação da normalidade foi realizada através do teste de Kolmogorov-Smirnov. Posteriormente aplicou-se a estatística inferencial para dados não paramétricos, com os testes de Kruskal-Wallis e Post-Hoc de Dunn. O coeficiente de correlação de Spearman foi utilizado para verificar a relação entre o nível de atividade física e os estados de humor. A significância adotada foi de $p<0,05$. A partir dos resultados verificamos que a percepção dos estados de humor relatadas por jovens escolares possuem diferenças significativas quando consideramos o nível de atividade física dessa população. Jovens classificados como inativos fisicamente relataram um menor nível de vigor bem como uma maior predisposição aos aspectos negativos de humor quando comparado aos jovens ativos fisicamente. Nesse caso, a atividade física pode contribuir para uma melhor percepção da saúde psicológica.

Palavras-chave: Atividade física. Humor**.** Saúde mental. Saúde do Adolescente.

Introduction

Adolescence represents an important development period, being characterized by profound and all-encompassing changes in one's physical, cognitive, social and psychological aspects[1]. In this phase of life, behavioral patterns that can interfere with mental health are established[2]. It is estimated that mental health disorders increase markedly during adolescence, and approximately 20% of teenagers worldwide have a diagnosed mental health illness[3]. This period can be critical to improve mental health, and regular physical activity can be a way to achieve these improvements[4]. However, according to a study that sought to describe the levels

of physical activity of adolescents with data from 32 countries, most of the teenagers investigated do not meet the current recommendations for physical activity[5]. In Brazil, for instance, it was found that the country has a worrying situation in the young population, due to the high prevalence of physical inactivity found among them[6,7], which makes this epidemic a public health issue.

Given the fact that physical activity decreases sharply during adolescence[8], and that this phase is associated with high emotional reactivity[9], this context not only renders young people particularly vulnerable to biological complications, due to their evident low engagement in physical activities[6], but also exposes them to negative psychological mood aspects, so some disorders such as anxiety and depression can manifest, proving the relevance of studying mental health in adolescents[9,10].

There are many investigations describing the positive effects of physical activity on mental health[11]. Broadly speaking, evidence suggests that physical activity stimulates generalized neurobiological, hormonal and physiological adaptations[12], which result in improved mood state[13], reduce stress, anxiety and depression levels[12], and can act effectively in preventing and treating psychological disorders, as well as promoting mental health[14]. However, although the literature shows a positive association between exercise and psychological health[11,15], variables such as the level of physical activity, age and sex of active individuals can act as moderators of the effects of exercise on mood[16].

At the present time, the understanding of the relationship between level of physical activity and mood states is still incipient in some populations[17], and there is still no consensus on this relationship. Thus, it is important to develop research in different contexts to examine the overall effect of physical activity on the mental health of young people, in order to guide health policies for this population[18] and provide a basis for interventions aimed at changing risk behaviors and promoting healthy habits among students, considering that care related to mental health is fundamental for youths[19].

In this sense, bearing in mind that the comprehension of modifiable factors that can improve mental health has an important role in public health[20], and that adolescence is characterized as being a complex period of emotional and social development, the objective of this research is to analyze the effect of level of physical activity on perception of mood states among young students in the final grades of high school.

Methods

Participants

The sample consisted of a total of 216 students – 102 (47.2%) males and 114 (52.8%) females, with an average age of 16.89 ± 1.48 years, regularly enrolled in the third year of high school in the state education network of Pará state, in the cities of Castanhal (n=128) and Santo Antônio do Tauá (n=88). Participation in the study was voluntary, with a non-probabilistic sampling by convenience being adopted. All participants signed the Free and Informed Consent Form (FICF). The present study was approved by the Research Ethics Committee (REC) involving human beings, in accordance with legal opinion 65796326.3.0000.0017.

Instruments

The mood state scores were collected by means of the Brunel Mood Scale (BRUMS), which was adapted from the Profile of Mood States[21] and validated for Portuguese by Rohlfs et al.[22], presenting good internal consistency, with Cronbach's alpha values above 0.70, thus being

a reliable instrument to measure mood in teenage students. The BRUMS was developed to allow a quick measurement of the mood state of populations composed of adults and adolescents.

The scale is composed of 24 items that include six mood states: anger, confusion, depression, fatigue, tension and vigor, with the latter being considered the only positive mood state. Each mood state is made up of four items. With the sum of the answers, a score can be obtained, which can vary from 0 to 16. High values for vigor and low values for tension, depression, anger, fatigue and mental confusion characterize the iceberg profile, or positive mental health profile, a profile close to that deemed ideal. In a situation that is opposite to the iceberg profile, in which there is a lower level of vigor and higher levels of fatigue, tension, anger, mental confusion and depression, the mood is considered negative[21].

Table 1. Mood states from the Brunel Mood Scale – BRUMS

Mood state	Definition
Tension	State of musculoskeletal tension and worrying.
Depression	Emotional state of gloom, sadness, unhappiness.
Anger	State of hostility towards others.
Vigor	State of energy, physical vigor.
Mental confusion	State of haze, instability in emotions.
Fatigue	State of tiredness, low energy.

Source: Brandt et al.[23]

To assess the level of habitual physical activity of the students in their daily lives, the Habitual Physical Activity Questionnaire was used, which was originally developed by Pate[24] and translated and adapted for the Brazilian population by Nahas[25]. The questionnaire is used to estimate levels of habitual physical activity based on daily occupational and leisure activities performed by the assessed individuals, being characterized by its convenience and reliability among adolescents and young adults[25].

The questionnaire applied contains 11 closed-ended questions that consider daily occupational physical activities and leisure activities. Based on the final score obtained by the assessed subjects, the instrument allows them to be classified as: inactive (< 6 points); moderately active (6 - 11 points); active (12 - 20 points); and very active (> 21 points).

To collect sociodemographic data, in order to characterize the sample, an individual form was used, which requested the following information referring to the research participant: age, sex, school and sports practices.

Procedures

First, a prior contact with the schools' boards was made for the study and its procedures to be explained, and for authorization to be granted. After a meeting with the pedagogical coordination of the schools, the dates and times for applying the questionnaires were defined. During contact with the participating students, they were informed about the conditions for them to join and the research objectives. All participants received the FICF, the demographic assessment form and the instruments for assessing mood states and level of physical activity, with a total of four sheets to be filled out individually and without consulting a classmate or anyone else. The questionnaires were completed at a time reserved for their application, in a noise-free environment, and without the intervention of the researcher or anyone else. No questionnaire could be taken to be filled out later at home. The questionnaires were applied in the presence of the first author.

Data analysis

Normality was verified through the Kolmogorov-Smirnov test. The data were analyzed by means of descriptive statistics, using median values. In order to compare the mood states and the level of habitual physical activity (LHPA) in the sample, inferential statistics for nonparametric data were applied, with the Kruskal-Wallis and Dunn's Post-Hoc tests. Spearman's correlation coefficient (rho) was used to verify the relationship between level of physical activity and mood states. Statistical significance and a minimum critical value of rho ≥ 0.40 were considered as acceptable for the analysis, with the latter corresponding to the lower limit of the moderate intensity for the correlation between variables[26]. The effect size (ES) was calculated using Cohen's d[27] for each comparison between groups. The effect size valuesn were defined as: no effect (0.0-0.1), small (0.20-0.40), medium (0.50-0.70) and large (> 0.80)[27]. Significance was set at $p<0.05$. The data were analyzed using the GraphPad Prism 8.0 software.

Results

Analyzing the students' LHPA, we found that 22.68% (n=49) of the students are classified as inactive, while 22.23% (n=48) are classified as little active, 33.34% (n=72), as moderately active, and 21.75% (n=47), as very active. Table 2 presents the groups' perceptions of the six mood states (tension, fatigue, depression, vigor, mental confusion and anger).

Table 2. Comparison of mood states between groups

	Inactive (n=49)	Little active (n=48)	Moderately active (n=79)	Very active (n=47)	
	MD (Q1-Q3)	MD (Q1-Q3)	MD (Q1-Q3)	MD (Q1-Q3)	ES
Tension	7.00 (4.00-10.00)*	5.00 (3.00-9.00)	6.00 (4.00-8.00)	5.00 (3.00-8.00)	0.346
Fatigue	8.00 (5.00-1.00)*#	6.00 (3.25-10.75)	5.00 (4.00-9.00)	4.00 (3.00-7.00)	0.588
Depression	4.00 (1.00-7.00)	1.50 (0.00-4.75)	3.00 (0.00-5.00)	2.00 (0.00-5.00)	0.329
Mental confusion	8.00 (4.50-11.00) *#†	6.00 (3.00-8.75)	6.00 (3.00-8.00)	4.00 (2.00-8.00)	0.482
Anger	8.00 (4.50-11.00)*#†	5.00 (2.25-7.00)	5.00 (2.00-8.00)	4.00 (2.00-8.00)	0.473
Vigor	7.00 (5.00-9.00)*#	9.00 (6.25-11.00)*	10.00 (8.00-13.00)	11.00 (9.00-13.00)	0.851

Note: ES = effect size; * $p<0.05$ in relation to the very active group; # $p<0.05$ in relation to the moderately active group; † $p<0.05$ in relation to the little active group

Source: The authors

Analyzing tension, we found significant difference only between the inactive group and the very active group ($p=0.0194$). As for fatigue, the inactive group showed significant differences compared to the moderately active one ($p=0.0161$), as well as to the very active group ($p<0.0001$). Depression did not show any significant difference between groups. In the mental confusion mood, the inactive group showed significantly higher scores compared to the little active ($p=0.0459$), moderately active ($p=0.0434$) and very active ($p=0.0015$) groups. Analyzing anger, we then again found significantly higher scores for the inactive group compared to the little active ($p=0.0227$), moderately active ($p=0.0047$) and very active ($p=0.0141$) groups. When it comes to vigor, the inactive group showed significant differences compared to the moderately active group ($p<0.0001$) and the very active group ($p<0.0001$), and the little active group showed a significant difference compared to the very active group ($p=0.0066$).

Table 3 shows the correlations obtained between level of habitual physical activity and mood states.

Table 3. Correlation between level of physical activity and mood states

	Tension	Fatigue	Depression	Mental confusion	Anger	Vigor
LHPA	-0.1502*	-0.3090*	-0.1219	-0.2263*	-0.1735*	0.4330*

Note: LHPA = Level of habitual physical activity; * $p<0.05$
Source: The authors

Physical activity showed a negative and significant relationship, of weak intensity, with these mood states: tension ($p=0.0273$), fatigue ($p<0.0001$), mental confusion ($p=0.0008$) and anger ($p=0.0106$); this indicates that the higher the level of physical activity, the lower the perception of these negative psychological dimensions. In addition, a positive, significant and moderate-intensity relationship was found between physical activity and vigor ($p=0.0106$), which is considered the only positive mood state. Therefore, the higher the level of physical activity, the greater the state of vigor. Depression did not show any significant correlation with physical activity ($p=0.0739$).

Discussion

The objective of this research was to analyze the effect of levels of physical activity on perception of mood states in young students. The main results show that the perception of mood states reported by them has differences when we consider this population's level of physical activity. Young participants classified as physically inactive reported a lower level of vigor, as well as a greater predisposition to negative mood aspects compared to the other groups of physically active youths.

In general, the results suggest that regular physical activity, even at low levels, can improve the perception of mood of young individuals. However, analyzing each mood state individually, we see that only those individuals with greater engagement in regular physical activity showed less tension compared to the group of physically inactive young students. The underlying mechanisms responsible for the effects of physical activity on tension and on mental health are unclear[18]. Nonetheless, several hypotheses have been proposed. For instance, studies suggest that participation in physical activity can improve mental health through the release of endorphins[28], increase in the brain-derived neurotrophic factor[29] and growth of new capillaries[30], which, in their turn, can improve the structure and functional composition of the brain. Other theoretical frameworks propose that increased levels of physical activity and reduced sedentary behavior can help meet basic psychological needs (social connection, self-acceptance and purpose in life) and, consequently, improve the general mental health of young people[4].

Regarding fatigue, we observed that engaging in physical activities, regardless of their level, decreases the perception of this mood state, showing that inactive individuals feel more fatigued compared to those with a higher LHPA. According to Rolfhs et al.[22], a reaction to fatigue can occur in the form of physical tiredness or a feeling of gloom in actual everyday situations, with symptoms being related to gradual changes in attention, concentration and memory. Our results show an association between negative values for mood states and physical inactivity. This relationship suggests that physical activity can be a protective factor for mental health[31,32].

In the case of depression, we observed that the perception of depressive symptoms did not differ between groups, and no relationship was found between this mood state and level of physical activity. However, evidence from a meta-analysis that investigated the potential preventive effect of physical activity on depression suggests that an increase in levels of physical activity in childhood and adolescence is associated with a decrease in depressive

symptoms[33]. In addition, a study that examined the relationship between physical activity and depression in 40,401 subjects aged from 19 to 71 years old, of both sexes, contextualizing the intensity and type of the activity[34], concluded that individuals who engage in regular leisure activity of any intensity are less likely to present symptoms of depression. These results provide a basis for the preventive role of physical activity against the development of depression, even at lower levels of physical activity[35].

About the underlying mechanisms, it is possible that no single mechanism explains this relationship between physical activity and depression; instead, it is likely that a series of physiological, biochemical and psychosocial mechanisms work together to promote these preventive effects[35]. In view of this, systematic reviews of meta-analyses and prospective studies report that the conflicting results found in the literature may be due to a lack of standardized measures for physical activity, as well as the use of self-report measures and the cross-sectional characteristic of the studies that analyze this relationship[33,35], which may explain the lack of relationship between physical activity and depression found in the present study.

Mental confusion was found to be inversely related to physical activity, regardless of the level of engagement in it. We observed a lower perception of mental confusion on the part of individuals who perform physical activities in their daily lives compared to those who are physically inactive. This mood state can be considered a response to anxiety and depression, and high levels of this variable can cause an instability in the subject's emotional control and attention[36].

When it comes to anger, the result found indicates a greater perception of this mood state on the part of inactive individuals. Anger is associated with factors based on interpersonal relationships and affective aspects, being considered a feeling that arises in the presence of aversive stimulation, usually triggered by feelings of hostility related to oneself and/or to others, or even when there is no reinforcing event[36] (any object or person capable of providing positive stimuli or sensations). Therefore, it is possible to observe that subjects who exercise regularly perceive fewer symptoms related to anger and stress[16], characterizing a positive relationship between the maintenance of an active lifestyle and mental well-being[16], which characterizes participation in physical activities as a reinforcing event.

The vigor mood state showed higher values in young students with moderate or high levels of physical activity compared to those with lower LHPA, correlating positively with level of physical activity. Contrarily to the traditional belief that vigor and fatigue exist at opposite ends of the spectrum of one single mood, they have recently been described as separate constructions[37]. However, the maintenance of a positive mood state depends on the relationship between both mood states, since the relationship of increased perception of fatigue and low vigor is associated with poorer health and quality of life[38]. Thus, our results show the positive influence of physical activity at moderate and high levels in improving the perception of vigor in adolescents, with said state being commonly associated with improved health, quality of life, and cognitive and physical performance[39].

Despite the present study pointing out positive effects of a physically active behavior on mood states, there is still no consensus in the literature as to this relationship[11,40]. However, as described above, the benefits of physical activity to mood can be explained by both psychological and neuropsychological mechanisms[41,42]. Moreover, considering that lack of time is commonly described as a barrier for individuals to exercise[42], important implications can be considered based on our results, bearing in mind that we observed that it is possible to have an improvement in the perception of mood states even at lower levels of physical activity. These results are relevant, as they evidence the association between psychosocial stressors and the incidence of problems related to the mental health of the young population[19]. In this sense, we emphasize the importance of adopting interventions based on physical activity, especially in the school environment, in order to improve the mental health of young students[19].

The present study has some limitations. First, its design does not allow establishing a causal relationship between the variables analyzed, due to its cross-sectional character. Second, the use of a self-report measure to assess levels of physical activity indicates the need for caution when interpreting the results. Therefore, we suggest that future research employs objective and standardized measures to analyze levels of physical activity, in addition to using experimental and longitudinal designs to investigate what the ideal conditions of physical activity would be to improve aspects related to mood states, and what factors can interfere with this relationship. Finally, we suggest the need for further investigations on the factors related to physical activity that can influence mental health and, thus, provide a foundation for the development of public health policies aimed at the young population, seeking to establish effective prevention strategies.

Conclusions

Physically active individuals presented a higher level of vigor, as well as a lower perception of negative mood factors, with the exception of depression. Physical activity, therefore, can contribute to a better perception of psychological health, even at lower levels, becoming a proposal for a supporting intervention to control young individuals' different mood states.

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