Artigo Original

Atividade física habitual é inversamente relacionada aos transtornos de humor em jovens adultos saudáveis: um estudo transversal

Habitual physical activity is inversely related to mood disorders in young healthy adults: A cross-sectional study

Ricardo Borges Viana[1], Douglas de Assis Teles Santos[2], Thaissa Flavianny Franco da Costa[3], Rodrigo Luiz Vancini[4], Marília Santos Andrade[5], Claudio Andre Barbosa de Lira[6]

[1] Instituto de Educação Física e Esportes, Universidade Federal do Ceará, Fortaleza, Brazil

[2] Colegiado de Educação Física, Universidade do Estado da Bahia, Teixeira de Freitas, Bahia, Brazil

[3] Curso de Biomedicina, Universidade Federal de Jataí, Jataí, Goiás, Brazil

[4] Centro de Educação Física e Desportos, Universidade Federal do Espírito Santo, Vitória, Espiríto Santo, Brazil

[5] Departamento de Fisiologia, Universidade Federal de São Paulo, São Paulo, São Paulo, Brazil

[6] Faculdade de Educação Física e Dança, Universidade Federal de Goiás, Goiânia, Goiás, Brazil

* Correspondência: andre.claudio@gmail.com

Resumo: *Objetivos*: Avaliar os níveis de atividade física habitual e sua relação com os transtornos de humor (sintomas de ansiedade e depressão) em jovens adultos saudáveis e avaliar as diferenças entre homens e mulheres para essas variáveis. *Métodos*: Um total de 297 participantes (144 mulheres) responderam os seguintes questionários: *Baecke questionnaire*, para avaliar o nível de atividade física habitual; *State–Trait Anxiety Inventory*, para avaliar os sintomas de ansiedade; e *Beck Depression Inventory*, para avaliar os sintomas depressivos. *Resultados*: Foi encontrada uma correlação negativa significante entre o nível habitual de atividade física e os sintomas depressivos (rho = -0,132 "pequeno efeito", p = 0,023), níveis de ansiedade traço (rho = -0,205 "pequeno efeito", p < 0,001) e níveis de ansiedade estado (r = -0,216 "pequeno efeito", p < 0,001) dos participantes. Contudo, não foi encontrada diferença significante (p > 0,05) entre as correlações dos homens e mulheres para todas as variáveis investigadas. Os homens apresentaram um maior nível absoluto (p < 0,001, d = 0,549 "efeito médio") e médio (p < 0,001, d = 0,515 "efeito médio") de atividade física habitual, um menor nível de ansiedade traço (p < 0,001, r_B = -0,342 "efeito médio") e estado (p < 0,001, d = -0,483 "pequeno efeito") e menores sintomas depressivos (p = 0,007, r_B = -0,181 "pequeno efeito") do que as mulheres. *Conclusão*: A atividade física habitual caracterizada por um padrão não estruturado parece estar inversamente relacionada aos transtornos de humor.

Palavras-chave: ansiedade; depressão; saúde mental; exercício; humor

Abstract: *Purposes*: To examine the habitual physical activity levels and their relationship with mood disorders (anxious and depressive symptoms) in young healthy adults and evaluated sex differences for these variables. *Methods*: A total of 297 participants (144 women) answered the following questionnaires: Baecke questionnaire to evaluate habitual physical activity level; State–Trait Anxiety Inventory, to evaluate anxious symptoms; and Beck Depression Inventory, to evaluate depressive symptoms. *Results*: There was a significant negative correlation between habitual

physical activity levels and depressive symptoms (*rho* = -0.132 "small effect", p = 0.023), trait anxiety levels (*rho* = -0.205 "small effect", p < 0.001), and state anxiety levels (r = -0.216 "small effect", p < 0.001) of the participants. However, there was no significant difference (p > 0.05) between men and women correlations for all investigated variables. Men presented higher absolute total (p < 0.001, d = 0.549 "medium effect") and mean (p < 0.001, d = 0.515 "medium effect") habitual physical activity level, lower trait (p < 0.001, r_B = -0.342 "medium effect") and state (p < 0.001, d = -0.483 "small effect") anxiety levels, and lower depressive symptoms (p = 0.007, r_B = -0.181 "small effect") than women. *Conclusion*: Habitual physical activity that is characterized by unstructured pattern seems to be inversely related to mood disorders.

Keywords: anxiety; depression; mental health; exercise; mood

1. Introduction

The association between physical activity and health status is well-stablished [1]. Indeed, regular physical activity has been recommended for the prevention and treatment of noncommunicable diseases by different scientific health organizations, such as the *American College of Sports Medicine* [2], *Centers for Disease Control and Prevention* [3], and the *American Heart Association* [4]. Briefly, it has already been shown that physical exercise is an important tool used to prevent and treat diseases such as diabetes [5], arterial hypertension [6], obesity [7], anxiety [8] and depression [8]. However, despite the amount of evidence on the importance of physical activity, it is estimated that 27.5% of adults are not sufficiently active [9] and among young people the picture is worse (>80%) [10].

Among the benefits evoked by regular physical activity, a plethora of studies showed that physical activity can improve symptoms of anxiety [11] and depression [12,13]. Traditionally, depression and anxiety are treated through pharmacological therapy involving the following: mood stabilizers; antidepressants; anticonvulsants; and atypical antipsychotics [14]. However, regular physical activity has been shown to be an adjuvant therapy in the treatment of depression [15] and anxiety [11]. Specifically with regards to depression, several studies have shown an inverse relation between physical activity and depression, showing that mild to moderate depressive states can be minimized by regular physical activity [15].

Despite the indubitable effects of physical activity on the mood disorders, those studies that evaluated the effects of chronic physical activity on mood disorders used standardized physical activity protocols with rigorous control of frequency, intensity, time, and type of exercise [15]. However, there are several ways to be physically active (e.g., occupation activities, leisure, and sports), which for most people are activities performed in a non-standardized way (i.e., activities of daily living) – in other words, without control of frequency, intensity, time and type of physical activity. Therefore, it is reasonable to assume that the results present in the literature may not reflect the real-world settings, in which the person practices non-standardized physical activity.

Additionally, a recent review study [16] highlighted that physical activity (even in low doses) is associated with lower risk of mental illness, current guidelines may not ef-

fectively address mental health outcomes, and suggested that people do some of their physical activity during leisure-time or in active travel, where possible prioritizing activities they enjoy or personally choose to undertake. Moreover, it was reported that some physical activity is better than none for both physical and mental health [16]. Thus, the present study aimed to investigate the habitual physical activity levels in a sample of young healthy adults and their relationship with mood disorders (anxiety and depressive symptoms). Also, the presented study aimed to evaluate sex differences for these variables. We hypothesized that there is a significant negative relationship between habitual physical activity and anxiety and depression symptoms. If this hypothesis is true, our results would indicate that maybe there is no need for a person to be engaged in a structured physical activity program to improve mood disorders. Furthermore, we hypothesized that anxiety and depression levels and habitual physical activity would be impaired in women.

2. Methods

Participants and study design

This was a cross-sectional study that recruited 297 participants (a convenience sample) from both sexes (153 men and 144 women; 21.8 ± 3.9 years). The participants were recruited among undergraduate and graduate students and people around the University Campus through direct contact. The inclusion criteria were aged ≥18 years old. Participants who did not respond to one or more questionnaire or that completed the questionnaire incorrectly would be excluded from the study; however, no participants were excluded for this reason.

In the same day, the participants answered the following questionnaires: Baecke questionnaire to assess habitual physical activity level; State–Trait Anxiety Inventory (STAI) to assess anxious symptoms; and the Beck Depression Inventory (BDI) to assess depressive symptoms. All participants were informed of the potential risks and benefits of the study and signed an informed consent form to take part. All experimental procedures were approved by the Research Ethics Committee of the Federal University of Goiás (approval number 295/11) and conformed to the principles outlined in the Declaration of Helsinki.

Habitual physical activity level assessment

The habitual physical activity level of the participants was measured using the translated and validated version for Brazilian Portuguese [17] of the Baecke questionnaire. This questionnaire consists of 16 questions involving three habitual physical activity scores relating to the previous 12 months: occupational physical activity (eight questions); physical exercise in leisure time (four questions); and sport physical activity (four questions). The total score for habitual physical activity was obtained by summing occupational physical activity, physical exercise in leisure time, and sport physical activity scores. The higher the score achieved, the higher the level of habitual physical activity.

The Cronbach's alpha of occupational physical activity, physical exercise in leisure time, and sport physical activity is 0.52, 0.52 and 0.62, respectively [17].

Anxious symptoms assessment

Symptoms of anxiety state and trait were evaluated using the translated and validated Brazilian Portuguese version [18] of the 20-item state anxiety component and 20-item trait anxiety component of STAI [19]. Participants were instructed to answer each item of the state and trait anxiety items according to how they felt "right now, that is, at this moment" and "generally," respectively. Briefly, these items assess subjective feelings of calm, tension, apprehension, nervousness, worry, and other questions that assess autonomic nervous system activity. State–Trait anxiety scale items are rated on a 4-point Likert scale (1 = not at all, 2 = somewhat, 3 = moderately so, and 4 = very much so). Thus, scores can vary from a minimum of 20 to a maximum of 80. A score equal to or lower than 30 indicates a low anxiety level, a score of 31 to 49 indicates a middle level of anxiety and a score greater than or equal to 50 indicates a higher degree of anxiety [19]. The internal consistency of the state anxiety and trait anxiety are good, with Cronbach's alpha of 0.93 and 0.87, respectively [20].

Depressive symptoms assessment

The depressive symptoms were evaluated using the translated and validated for the Brazilian Portuguese version [21] of the BDI [22]. The BDI is a self-rating scale and is composed of 21 groups of affirmations. Items 1 to 13 assess symptoms that are psychological in nature, while items 14 to 21 assess more somatic symptoms [22]. According to the Center of Cognitive Therapy, scores from 0 to 9 represent minimal depressive symptoms, scores of 10 to 16 indicate mild depressive symptoms, scores of 17 to 29 indicate moderate depressive symptoms, and scores of 30 to 63 indicate severe depressive symptoms [22]. The internal consistency of the BDI is good, with a Cronbach's alpha of around 0.9 [23].

Statistical analysis

Data was analyzed in JASP (version 0.14.1.0, Netherlands). Shapiro-Wilk test was used to examine data distribution. Pearson's correlation coefficient (r) was used to test the relationship between habitual physical activity level with state anxiety levels. Spearman's correlation coefficient (*rho*) was used to test any relationship between participants' habitual physical activity level with trait anxiety levels, and depressive symptoms. Pearson´s and Spearman's correlation coefficients were classified as "trivial" (r < 0.10), "small" (0.10 ≤ r < 0.30), "medium" (0.30 ≤ r < 0.50), and "large" (r ≥ 0.5) [24,25]. The "cocor" function (version 1.1-3) in RStudio (version 1.2.1335) was used to statistically compare the correlation coefficients values between men and women. Student's t test was performed to evaluate the effect of sex on state anxiety levels, and the absolute total score and mean score for habitual physical activity level. Mann–Whitney U test was performed to evaluate the effect of sex on trait anxiety levels, depressive symptoms, and the three

categories of the Baecke questionnaire (occupational physical activity, physical exercise in leisure time, and sport physical activity). For the Student's t test, effect size was represented by the Cohen's d. According to Cohen, the *d* values were classified as "trivial" (d < 0.30), "small" (0.30 ≤ d < 0.50), "medium" (0.50 ≤ d < 0.80), and "large" (d ≥ 0.8) [24,25]. For the Mann-Whitney test, effect size was represented by the rank biserial correlation (r_B). r_B values classification was based on the Pearson's correlation coefficient [24,25]. Parametric data are presented as mean ± standard deviation, mean difference and 95% confidence interval (95% CI). Non-parametric data are presented as median and interquartile range (IQR), median difference and 95% CI. Statistical significance was set at p ≤ 0.05.

3. Results

Correlations

Overall, we found a significant negative correlation between habitual physical activity levels and depressive symptoms (*rho* = -0.132 "small", p = 0.023), trait anxiety levels (*rho* = -0.205 "small", p < 0.001), and state anxiety levels (r = -0.216 "small", p < 0.001) of the participants (Figure 1).
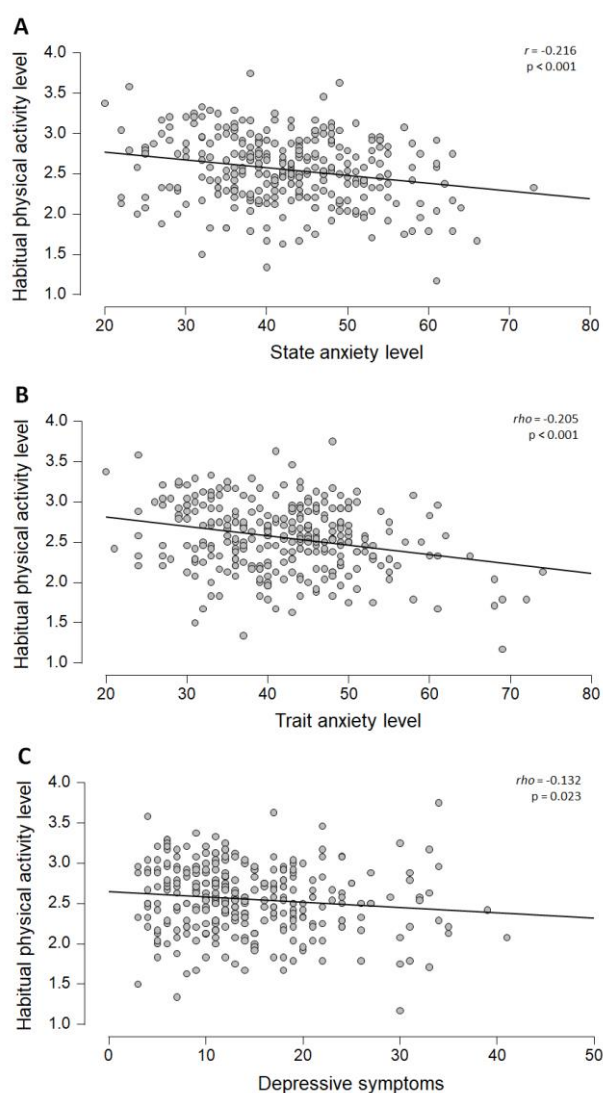
Figure 1. Relationship between habitual physical activity levels and (A) state and (B) trait anxiety levels, and (C) depressive symptoms (n = 297).

When, the participants' sex was considered, we found a significant negative correlation between habitual physical activity levels and state anxiety levels (*rho* = -0.266, $p <$ 0.001) in men, and between habitual physical activity levels and trait anxiety levels in women (*r* = -0.181, p = 0.030). There was no significant difference (p > 0.05) between men and women correlations for all investigated variables (Table 1).

Table 1. Correlations between habitual physical activity levels and mood disorders, and comparison between correlation coefficients (men versus women).

	Men (n = 153)		Women (n = 144)		Difference (95% CI)		Fisher's z	p
	rho	p	*rho*	p				
BDI	-0.131	0.108	-0.073	0.387	-0.058	(-0.283; 0.168)	-0.4998	0.6172
STAI – trait	-0.120	0.141	-0.181	0.030	0.061	(-0.163; 0.282)	0.5323	0.5945
STAI – state	-0.266¥	<0.001	-0.057¥	0.495	-0.209	(-0.426; 0.014)	-1.8371	0.0662

rho: Spearman's correlation coefficient; STAI: State–Trait Anxiety Inventory; BDI: Beck Depression Inventory. CI: confidence interval. ¥Pearson's correlation coefficient.

Habitual physical activity level

The absolute total and mean habitual physical activity levels of the participants were 7.6 [IQR: 1.2] and 2.6 [IQR: 0.04], respectively. Men presented a significant higher total (p < 0.001, d = 0.549 "medium") and mean (p < 0.001, d = 0.515 "medium") habitual physical activity levels than women (Table 2).

Anxious symptoms

The participants presented a middle trait (median: 43.0 [IQR: 12.0]) and state anxiety level (mean: 42.3 (standard deviation: 12.0). Men presented a significant lower trait (p < 0.001, r_B = -0.342 "medium") and state anxiety level (p < 0.001, d = -0.483 "small") than women (Table 2).

Depressive symptoms

The participants presented mild depressive symptoms (median: 13.0 [IQR: 10.0]). Men presented significant lower depressive symptoms (p = 0.007, rʙ = -0.181 "small") than women (Table 2).

Table 2. Habitual physical activity levels, trait and state anxiety levels, and depressive symptoms of the participants (men versus women).

	Men (n = 153) Median [IQR]	Women (n = 144) Median [IQR]	Median difference [95% CI]	p	rʙ [95% CI]	Effect size classification	Total (n = 297) Median [IQR]
Baecke score							
Work (0–5)	2.6 [0.8]	2.5 [0.6]	0.1 [-6.220e-5; 0.3]	0.108	0.108 [-0.024; 0.235]	Small	2.5 [0.8]
Sport (0–5)	2.8 [1.0]	2.3 [1.0]	0.5 [0.3; 0.8]	<0.001	0.365 [0.245; 0.473]	Medium	2.5 [1.3]
Leisure time (0–5)	2.5 [1.0]	2.3 [0.8]	3.717e-5 [-2.428e-5; 0.3]	0.184	0.089 [-0.043; 0.217]	Trivial	2.5 [0.8]
Absolute total score (0–15)	8.0 (1.2)ⁱ	7.3 (1.1)ⁱ	0.7 (0.4; 0.9)ⁱⁱ	<0.001	0.549 (0.317; 0.780)¥	Medium	7.6 (1.2)ⁱ
Mean score (0–5)	2.7 (0.4)ⁱ	2.4 (0.4)ⁱ	0.2 (0.1; 0.3)ⁱⁱ	<0.001	0.515 (0.283; 0.746)¥	Medium	2.6 (0.4)ⁱ
STAI score							
Trait (20–80)	40.0 [12.0]	45.0 [11.0]	-5.0 [-7.0; -3.0]	<0.001	-0.342 [-0.453; -0.221]	Medium	43.0 [12.0]
State (20–80)	40.2 (9.1)ⁱ	44.6 (9.2)ⁱ	-4.4 (-6.5; -2.3)ⁱⁱ	<0.001	-0.483 (-0.714; -0.252)¥	Small	42.3 (9.4)ⁱ
BDI score (0–63)	12.0 [8.0]	14.0 [10.0]	-2.0 [-4.0; -1.0]	0.007	-0.181 [-0.305; -0.052]	Small	13.0 [10.0]

IQR: interquartile range; CI: confidence interval; STAI: State–Trait Anxiety Inventory; BDI: Beck Depression Inventory. rʙ: rank biserial correlation. ⁱData presented as mean (standard deviation). ⁱⁱData presented as mean difference (95% confidence interval). ¥For the Independent t test, effect size is given by the Cohen's d. Note. For the Mann-Whitney test, effect size is given by the rank biserial correlation (rʙ).

4. Discussion

The present study aimed (i) to examine the habitual physical activity levels in young healthy adults and their relationship to mood disorders (anxiety and depressive symptoms), and (ii) to evaluate sex differences for these variables. Our hypotheses were confirmed, since we found a small negative correlation between habitual physical activi-

ty levels and anxiety levels (trait and state), and depressive symptoms. Moreover, healthy young men presented a higher habitual physical activity level (medium effect size) and lower depressive symptoms (small effect size), and trait (medium effect size) and state anxiety levels (small effect size) than healthy young women.

The negative correlation between habitual physical activity and anxiety levels found in the present study might be explained by the fact that adults who engage in regular physical activity experience fewer anxious symptoms [26], and physical activity positively affects a number of physiological (e.g., lower sympathetic nervous system and hypothalamic–pituitary–adrenal axis reactivity) and psychological mechanisms (e.g., distraction, anxiety sensitivity, and sense of self-efficacy), which might result in a decrease in the anxiety levels [27]. Thus, this evidence supports the notion that habitual physical activity may be effective for improving anxiety levels and confirm our hypothesis that a structured physical exercise program is not necessary to improve anxiety levels. We also found that healthy young men presented lower trait and state anxiety levels than healthy young women. Indeed, epidemiological data show that women are approximately 60% more likely to develop anxiety throughout life compared to men [28] and that prevalence of anxiety disorder is almost double in women [29]. Therefore, our findings are in line with the literature.

We also found a negative correlation between habitual physical activity and depressive symptoms. Rebar et al. [12] in a meta-analysis showed a reduction in depression and anxiety as a result of physical activity, even in nonclinical populations. Moreover, some evidence suggests that physical activity has beneficial effects on depression symptoms that are comparable to those of antidepressant treatments [13]. One of the possible explanations for this beneficial effect of physical activity on depressive symptoms found in the mentioned studies may be related to an increase in the brain plasticity and brain-derived neurotrophic factor, a neurotrophin that is vital to the maintenance, growth and survival of neurons in key brain circuits involved in cognitive function and emotion, especially in persons with depression [30]. We also found that men presented lower depressive symptoms than women. Indeed, epidemiological data showed that depression is more common among females than males [29]. Therefore, our findings are in line with the literature.

Additionally, we found that healthy young men presented a higher habitual physical active level than healthy young women. This result is in accordance with previous evidence about overall populations, in which 31.7% and 23.4% of women and men are inactive, respectively [31]. Therefore, policies that tackle the gender gap in physical activity are necessary, such as providing better access and investment and shifting sociocultural norms [31]. Thus, regular physical activity could have a substantial impact on overall population health [31].

Altogether, the data presented here suggest that habitual physical activity may be an affordable and effective method to improve mood disorders in healthy individuals. However, as there is evidence that points out that a large proportion of people with anxiety and/or mood disorders do not exercise regularly [9,10], strategies are necessary to

reduce barriers and increase adherence to regular physical activity among people worldwide.

This study is not without limitations. First, the findings of this study cannot be extrapolated to the entire population because participants were from a specific sample of young healthy individuals. Second, the achievement of a direct measurement of physical activity levels is also a point that can be revised in future studies. Third, as with all studies employing questionnaires, the present results rely on the honesty and level of recall of the participants. Finally, we had no information about the menstrual cycle of the women participants. Also, we had no socioeconomic participants' information. Nevertheless, we believe that these limitations do not prevent the study from drawing conclusions.

5. Conclusion

The present study found a small negative correlation between habitual physical activity levels and anxiety levels and depressive symptoms in young healthy adults. Therefore, even habitual physical activity that is characterized by unstructured pattern seems to be inversely related to mood disorders. In a public health context, ours results reinforce counseling people to perform physical activity of any nature. Furthermore, men presented a higher habitual physical activity level and lower depressive symptoms, and anxiety levels than women.

Author Contributions: RBV: conception and design of the study, analysis and interpretation of data, elaboration of the article, critical review of the intellectual content of the article and approval of the final version to be published. TFFC: conception and design of the study, critical review of the intellectual content of the article and approval of the final version to be published. DATS: critical review of the intellectual content of the article and approval of the final version to be published. RLV: critical review of the intellectual content of the article and approval of the final version to be published. MSA: critical review of the intellectual content of the article and approval of the final version to be published. CABL: conception and design of the study, analysis and interpretation of data, elaboration of the article, critical review of the intellectual content of the article and approval of the final version to be published.

Ethics approval: All experimental procedures were approved by the University Research Ethics Committee and conformed to the principles outlined in the Declaration of Helsinki.

Conflicts of interest/Competing interests: The authors declare that they have no any type of conflicts of interest.

References

1. Pescatello LS, Arena R, Riebe D, Thompson PD (2014). ACSM's guidelines for exercise testing and prescription. 9th ed. Philadelphia: Wolters Kluwer/Lippincott Williams & Wilkins Health.

2. Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee I-M, et al. (2011) American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. Med Sci Sports Exerc. 43:1334–59.

3. Centers for Disease Control and Prevention. About physical activity. 2019. Available from: https://www.cdc.gov/physicalactivity/about-physical-activity/index.html

4. American Heart Association. (2017) Highlights of the 2017 American Heart Association focused updates on adult and pediatric basic life support and cardiopulmonary resuscitation quality.

5. Qi L, Hu FB, Hu G. (2008) Genes, environment, and interactions in prevention of type 2 diabetes: a focus on physical activity and lifestyle changes. Curr Mol Med. 8:519–32.

6. Pescatello LS. (2005) Exercise and hypertension: recent advances in exercise prescription. Curr Hypertens Rep. 7:281–6.

7. Patterson CM, Levin BE. (2008) Role of exercise in the central regulation of energy homeostasis and in the prevention of obesity. Neuroendocrinology. 87:65–70.

8. Barbour KA, Edenfield TM, Blumenthal JA. (2007) Exercise as a treatment for depression and other psychiatric disorders. J Cardiopulm Rehabil Prev. 27:359–67.

9. Guthold R, Stevens GA, Riley LM, Bull FC. (2018) Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1·9 million participants. Lancet Glob Heal. 6:e1077–86.

10. World Health Organization. (2018) Physical activity. Health Topics. World Health Organization.

11. Mello MT de, Boscolo RA, Esteves AM, Tufik S. (2005) Physical exercise and the psychobiological aspects. Rev Bras Med do Esporte.11:203–7.

12. Rebar AL, Stanton R, Geard D, Short C, Duncan MJ, Vandelanotte C. (2015) A meta-meta-analysis of the effect of physical activity on depression and anxiety in non-clinical adult populations. Health Psychol Rev. 9:366–78.

13. Dinas PC, Koutedakis Y, Flouris AD. (2011) Effects of exercise and physical activity on depression. Ir J Med Sci.180:319–25.

14. Duval F, Lebowitz BD, Macher J-P. (2006) Treatments in depression. Dialogues Clin Neurosci. Les Laboratoires Servier. 8:191–206.

15. Kvam S, Kleppe CL, Nordhus IH, Hovland A. (2016) Exercise as a treatment for depression: A meta-analysis. J Affect Disord. 202:67–86.

16. Teychenne M, White RL, Richards J, Schuch FB, Rosenbaum S, Bennie JA. (2020) Do we need physical activity guidelines for mental health: What does the evidence tell us? Ment Health Phys Act. 18:100315.

17. Florindo AA, Latorre M do RD de O, Jaime PC, Tanaka T, Zerbini CADF. (2004) Methodology to evaluation the habitual physical activity in men aged 50 years or more. Rev Saude Publica. 38:307–14.

18. Biaggio AMB, Natalício L. (1979) Manual para o Inventário de Ansiedade Traço-Estado (IDATE). Rio de Janeiro: Editor de Psicologia Aplicada-CEPA.

19. Spielberger C. (1989) State-Trait Anxiety Inventory: Bibliography. 2nd ed. Palo Alto, CA: Consulting Psychologists Press.

20. Knight RG, Waal-Manning HJ, Spears GF. (1983) Some norms and reliability data for the state-trait anxiety inventory and the Zung self-rating depression scale. Br J Clin Psychol. 22:245–9.

21. Gorenstein C, Andrade L. (1996) Validation of portuguese version of the Beck depression inventory and the state-trait anxiety inventory in brazilian subjects. Brazilian J Med Biol Res. 29:453–7.

22. Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J. (1961) An inventory for measuring depression. Arch Gen Psychiatry. 4:561–71.

23. Storch EA, Roberti JW, Roth DA. (2004) Factor structure, concurrent validity, and internal consistency of the beck depression inventory - second edition in a sample of college students. Depress Anxiety. 19:187–9.

24. Cohen J. (1988) Statistical power analysis for the behavioral sciences statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale-New Jersey: Lawrence Erlbaum Associates.

25. Cohen J. (1992) A power primer. Psychol Bull. 112:155–9.

26. Anderson E, Shivakumar G. (2013) Effects of exercise and physical activity on anxiety. Front Psychiatry. 4:1–4.

27. Ströhle A. (2009) Physical activity, exercise, depression and anxiety disorders. J Neural Transm. 116:777–84.

28. NIMH. Any anxiety disorder among adults. (2016) Natl. Inst. Ment. Heal. Available from: https://www.nimh.nih.gov/health/statistics/prevalence/any-anxiety-disorder-among-adults.shtml

29. World Health Organization. (2017) Depression and other common mental disorders: global health estimates. Geneva. Available from: https://apps.who.int/iris/rest/bitstreams/1080542/retrieve

30. Phillips C. (2017) Brain-derived neurotrophic factor, depression, and physical activity: making the neuroplastic connection. Neural Plast. 2017:1–17.

31. The Lancet Public Health. (2019) Time to tackle the physical activity gender gap. Lancet Public Heal. 4:e360.