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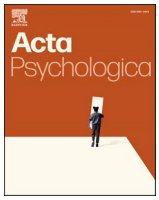

Regular physical activity and its components as predictors of depressive symptoms in young Brazilians after mandatory military service: A prospective cohort study

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A R T I C L E I N F O

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A B S T R A C T

Background: The prevalence of depressive symptoms among recruits in mandatory military service is a growing concern owing to its potential impact on the physical and psychological functions essential for military activities. Regular physical activity, especially in militarized environments, may contribute to mental health. Nonetheless, the association between the two needs to be investigated further.
Objective: This study examined the link between habitual physical activity and depressive symptoms in recruits. Furthermore, it assessed whether high levels of physical activity were a protective factor against depressive symptoms at the end of mandatory military service.
Materials and methods: This longitudinal study included 156 Brazilian Army recruits who completed a period of mandatory military service. The Beck Depression Inventory was used to evaluate depressive symptoms, and the Baecke Physical Activity Questionnaire was used to measure habitual physical activity (HPA) levels. Poisson regression models were employed to determine the association between depressive symptoms and physical activity components.
Results: High scores in total HPA, especially in the sports domain, were significant protective factors against depressive symptoms ($p < 0.05$). Poisson regression showed a reduced relative risk (RR) of depressive symptoms in case of high HPA levels: RR of 0.65 for total HPA and 0.46 for the sports domain. Optimal cutoff points for predicting depressive symptoms were $\leq$ 2.5 for sports and $\leq$ 8.75 for total HPA. This finding suggests that increased physical activity, especially in sports, may alleviate depressive symptoms in this population.
Conclusions: Promoting structured physical activity, especially sports, may be an effective strategy to reduce depressive symptoms among young adults after mandatory military service. However, further research is required to explore the underlying mechanisms and develop optimized interventions for this population.

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1. Introduction

The Brazilian Army is responsible for the defense of the national land territory, such as border protection, and actively participates in peace missions and health programs in difficult-to-reach regions (Brazil, 2014). The Brazilian Army comprises young adult population (mainly men), and there is a requirement of minimum physical conditions to face various military operations. Hence, soldiers must follow the rigid regulations of the Military Physical Training Manual structured in different types of physical activity for the development and maintenance of the required levels of physical fitness and health to combat and perform military tasks (Brazil, 2014).

Although military training is centered on physical activity, a segment of military personnel is categorized as insufficiently active, a factor that may contribute to susceptibility to mental health disorders (Ferraz et al., 2020; Webber et al., 2023). Moreover, military personnel are drawn from the civilian population, in which there is a notable prevalence of mental health disorders (Mota et al., 2021; Sampson et al., 2022, 2023; Sullivan et al., 2020). Given that military populations are also vulnerable to psychological challenges and an elevated risk of developing mental disorders (Connor et al., 2023; Moradi et al., 2021; Mota et al., 2021), there is a clear need for research that delves into this critical area.

Although there is a plethora of evidence regarding the positive effects of physical exercise on mental health (Connor et al., 2023; Ramos-Sanchez et al., 2021; You et al., 2024), an unfavorable and unfriendly working environment is associated with a high prevalence of mental health disorders (Chireh et al., 2023; de Oliveira et al., 2023; Rugulies et al., 2023; You, Chen, et al., 2025; You, Ding, et al., 2025; You, Wang, et al., 2025). Military personnel undergo rigorous physical training; however, it is imperative to ascertain whether this level of physical activity can counterbalance the adverse and challenging working conditions prevalent in the army.

An additional factor possibly related to psychological problems is military service volunteerism. In the post-World War II period, several countries had widespread mandatory military service (also known as conscription or the draft) (Puhani & Sterrenberg, 2022). In this context, nonvolunteer subjects can be recruited against their will, putting them at a greater risk of developing mental health disorders than voluntary soldiers.

Indeed, a previous study reported a high prevalence of mood disorders and low health-related quality of life, especially among those who did not volunteer for military service (De Lira et al., 2020). A few studies have examined the mental health of military personnel in times of peace (Martins, 2019; Moradi et al., 2021; Mota et al., 2021; Oliveira et al., 2019) Nevertheless, this is an important investigation owing to the nature of the army environment and the increasing prevalence of mental disorders, especially anxiety and depression, in young populations, which can impair their development and functionality (Dickson et al., 2024; Silvala et al., 2025).

Mental, physical, and social health are key dimensions for general well-being (You, Zheng, et al., 2025), and there is a shortage of research on mental health in the military population. Therefore, this study analyzed the association of habitual physical activity (HPA) and its components with depressive symptoms in young Brazilians recruited after their period of compulsory military service. Furthermore, this research verified the predictive determined cutoff points of HPA and its components concerning depressive symptoms. This study hypothesized that the higher the levels of physical activity, the lower are the levels of depression, despite the hazardous environment imposed by compulsory military service.

2. Methods

2.1. Study design and participants

This research was an epidemiological longitudinal study that used exploratory methods such as surveys. A part of it was a prospective cohort study on mental disorders and quality of life in mandatory military service. The baseline data collection was performed on March 11 and 17, 2012. The second data collection occurred on November 20, 21, 22, and 27, 2012.

A total of 353 men listed at baseline for compulsory military service in the 41st Motorized Infantry Battalion (Jataí, Goiás, Brazil) participated in this study. Of the 353 soldiers, 145 did not provide follow-up responses after the conclusion of their military service, which resulted in a final sample of 208 soldiers. In addition, 52 soldiers were excluded from the study because of preexisting depressive symptoms at the baseline assessment, culminating in a final sample size of 156 soldiers.

Baseline characteristics of participants included and not included in the final sample were compared (see Supplementary Table 1). The analysis indicated no significant differences between groups, except for occupational habitual physical activity, which was higher among those not included ($p = 0.012$). A plausible explanation for this finding is that some soldiers may have been engaged in occupational activities prior to military service, but were no longer able to work once conscripted.

All participants were supposedly healthy, did not present neurological disorders, and did not use drugs that compromised the health assessment. The risks and benefits of the study were explained to them, and informed consent was obtained from all participants. All procedures were performed according to the principles described in the Declaration of Helsinki and were approved by the Federal University of Goiás Human Research Ethics Committee under the number 295/11.

2.2. Data collection procedures

Data were collected via a questionnaire filled individually in the work environment. All participants completed the following questionnaires: 1. Beck Depression Inventory (BDI) to assess depressive symptoms levels and 2. Baecke questionnaire to verify HPA levels. All variables have been described below.

2.2.1. Symptoms of depression (BDI)

The depressive symptoms were assessed using the BDI (Beck et al., 1961), which was translated to Brazilian Portuguese and validated (Gorenstein & Andrade, 1996). It contained 21 questions about depressive symptoms that encompassed affective, behavioral, somatic, and interpersonal aspects. Each question comprised four statements to indicate the increase in depressive symptoms; the score ranged from 0 to 13 as normal, from 14 to 19 as mild depressive symptoms, from 20 to 28 as moderate depressive symptoms, and from 29 to 63 as severe depressive symptoms. The internal consistency of the questionnaire was approximately 0.85 (Gorenstein & Andrade, 1996). A binary variable with a cutoff of 18 points was stipulated for the analysis (Hautzinger et al., 1994).

2.2.2. Habitual physical activity (HPA)

The HPA levels were assessed using the Baecke questionnaire (Baecke et al., 1982), which was translated into Brazilian Portuguese and validated (Florindo et al., 2004). This instrument estimated the practice of usual physical activity in a record-keeping regarding the last 12 months. It comprised 16 questions and covered three components of physical activity: occupational, leisure time, and sports. The total score was obtained from the sum of all components; the higher the score, the higher is the usual physical activity level. The test–retest reliability was evaluated using Cronbach's alpha for occupational (0.52), leisure time (0.52), and sports (0.62) (Florindo et al., 2004).

2.3. Covariates

Based on prior population-based research (You, Chen, et al., 2025; You, Ding, et al., 2025; You, Wang, et al., 2025), age (in years); type of recruitment, which was either voluntary or nonvoluntary (for details see

De Lira et al. (2020)); and body mass index, which was calculated from the ratio of body mass divided by the square of height (kg/m^2), were used as adjustment variables.

2.4. Statistical analysis

The first part of the data analysis was conducted using the Statistical Package for Social Sciences software (SPSS, 26.0, Inc. Chicago, IL, USA). The Kolmogorov–Smirnov test was used to confirm the data distribution.

Continuous data were described as the mean, median, standard deviation, interquartile range, and minimum and maximal values. The differences between the two groups (absence and presence of depressive symptoms) and HPA questionnaire scores were evaluated using the Mann–Whitney *U* test. The effect size used for this test was the rank biserial correlation (r_B), which was classified as follows: $r_B < 0.10$ (trivial), $0.10 \leq r_B < 0.30$ (small), $0.30 \leq r_B < 0.50$ (medium), and $r_B \geq 0.5$ (large) (Munro, 1986).

Referring to previous population-based literature (You, Wang, et al., 2025), a generalized linear model with Poisson regression and robust estimates was employed to examine the bivariate and multivariate associations of depressive symptoms during military service with HPA and its components. The relative risk (RR) parameters were calculated, considering a 95 % confidence interval (CI) and adopting a significance level of 5 %.

The predictive capability and cutoff points of HPA and its components concerning depression symptoms were determined using the receiver operating characteristic (ROC) curve, verified using MedCalc (version 19.4.1, 2018, Belgium). Initially, the total area under the ROC curve was calculated for the overall HPA estimation, occupational, leisure time, and sports components. A larger area under the ROC curve indicates a greater discriminatory power for detecting depression. In addition, the cutoff points, along with their corresponding sensitivity and specificity values, were identified using the Youden index. It is important to note that the area under the ROC curve should not be <0.50. Throughout all analyses, a significance level of 5 % ($p \leq 0.05$) and a 95 % CI were maintained.

3. Results

A total of 156 soldiers were evaluated. The mean age, height, body mass, and body mass index were 18.94 ± 0.73 years, 1.73 ± 0.5 m, 69.23 ± 12.37 kg, and 23.07 ± 3.75 kg/m^2, respectively. According to the criteria adopted in this study, 12.82 % ($n = 20$) presented with depressive symptoms.

The comparison between the groups' absence and presence of depressive symptoms is presented in Table 1. When comparing the groups, the Mann–Whitney *U* test showed the presence of a significant difference between the HPA domain of sports ($p = 0.012$; effect size: 0.34; medium) and total ($p = 0.045$; effect size: 0.36; medium).

Table 2 shows the association of HPA and its domains with the presence of depressive symptoms in soldiers after the period of mandatory military recruitment. The sports component and the total score proved to be protective factors against depression.

Figs. 1 and 2 display the areas under the ROC curve for the scores across the domains and the total HPA utilized as discriminators of depression within the study population. HPA was used as a discriminator of depression in the study population. Of the variables analyzed, sports and total HPA presented a higher limit of the CI for the area under the ROC curve >0.50. When performing the comparison analysis between the accuracy of HPA scores and the sports component, no significant differences were observed ($p > 0.05$).

Using the ROC curve for analysis, it was discerned that within the sports domain, the optimal cutoff point for prognostication of the outcome stood at ≤2.5 points (sensitivity: 65.00 %; specificity: 62.50 %). For the aggregate HPA, the most advantageous cutoff point was identified to be ≤8.75 points (sensitivity: 65.00 %; specificity: 62.50 %).

Table 2
Association between habitual physical activity and its components in the relative risk of the presence of depression among young adults during military service.

Depression				
Variables	Crude RR (CI 95 %)	*p*	Multivariate* RR (CI 95 %)	*p*
HPA total	**0.68 (0.47–0.99)**	**0.045**	**0.65 (0.44–0.97)**	**0.037**
Sports	**0.46 (0.27–0.77)**	**0.003**	**0.46 (0.27–0.79)**	**0.006**
Occupational	1.12 (0.45–2.78)	0.802	0.97 (0.38–2.50)	0.962
Leisure time	0.72 (0.41–1.27)	0.262	0.70 (0.40–1.22)	0.217

HPA: Habitual Physical Activity; RR: Relative Risk; CI: Confidence Interval. *Adjusted by age, body mass index, and desire to serve in the military (volunteers and non-volunteers).

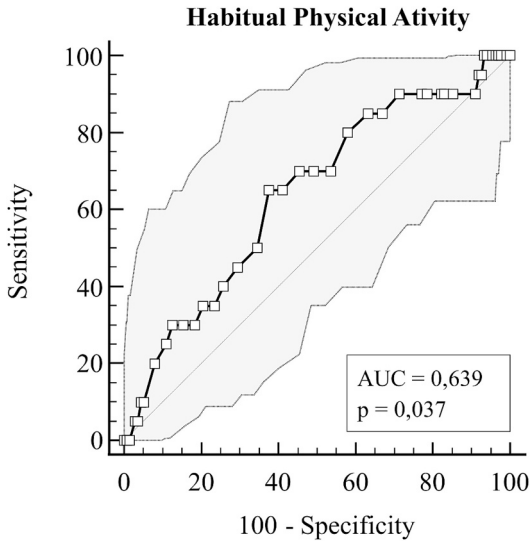

Fig. 1. ROC curves of weekly time spent in habitual physical activity for predicting depression in Brazilians recruited for mandatory military service.
AUC: Area Under the Curve.

Table 1
Comparison of habitual physical activity components between soldiers classified as absence or presence of depressive symptoms.

HPA	Depressive symptoms				*p*
	Absence ($n = 136$)		Presence (n = 20)		
	Median [IQR]	Min-Max	Median [IQR]	Min-Max	
Sports	3.00 [0.75]	1.25–4.50	2.50 [0.62]	1.25–3.25	**0.012**
Occupational	3.38 [0.63]	2.13–4.38	3.25 [0.37]	2.63–4.13	0.968
Leisure time	3.00 [1.00]	1.25–4.50	3.00 [0.75]	1.25–4.50	0.407
Total	9.25 [1.50]	6.63–11.75	8.69 [1.66]	6.88–10.88	**0.045**

HPA: Habitual Physical Activity; IQR: interquartile range; Min-Max: minimum-maximum.

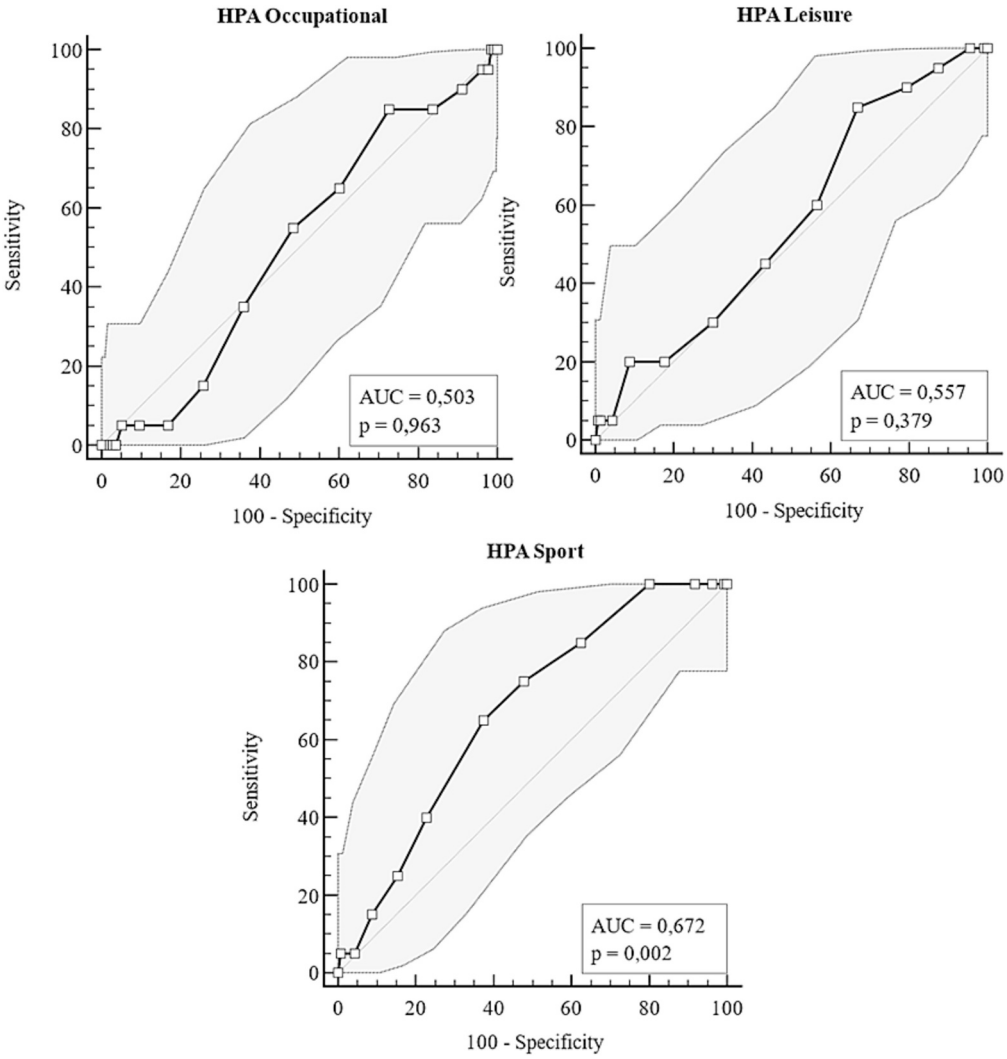

Fig. 2. ROC curves of weekly time in habitual physical activity: occupational, leisure, and sport for predicting depression in Brazilians recruited for mandatory military service.
HPA: Habitual Physical Activity; **AUC:** Area Under the Curve.

4. Discussion

The results of this study revealed that the total HPA score and the sports domain were potential predictors of the prevention of depressive symptoms. Upon examining the relative risk, these variables appeared to be protective factors against depressive symptoms. These findings agree with the existing literature highlighting the benefits of physical activity for mental health (Granero-Jiménez et al., 2022; Ramos-Sanchez et al., 2021; Rodríguez-Romo et al., 2023). Nevertheless, there is a noticeable paucity of studies focusing on military personnel, which accentuates the originality and significance of our findings.

The observation that the sports domain is strongly associated with reduced depressive symptoms suggests that a structured and competitive physical activity may offer more benefits than less structured activities. Indeed, physical activity and organized sports not only promote physical conditioning but also provide opportunities for social interaction and the development of teamwork skills, which can enhance the psychological well-being of combat veterans (Caddick & Smith, 2014; Waldhauser et al., 2025). This finding is particularly relevant for intervention programs aimed at promoting mental health in military populations and other high-risk groups.

Building on the demonstrated protective association of physical activity, the study further assessed its predictive capacity for depressive symptoms using ROC curve analysis. The results showed that HPA levels, particularly within the sports domain, had significant discriminatory accuracy for the likelihood of developing depressive symptoms. The optimal cutoff points identified were $\leq$ 2.5 for the sports domain and $\leq$ 8.75 for total HPA. These cutoff points yielded a sensitivity of 65.00 % and a specificity of 62.50 %. While these values are moderate, their balanced nature is a clinically relevant aspect, especially considering their classically inverse proportionality.

Interpretation of these cutoff points allows two complementary perspectives of substantial clinical and epidemiological utility. From the angle of sensitivity and risk identification, our results show that individuals with physical activity scores at or below the established cutoff points (e.g., $\leq$ 2.5 for sports) face a significantly higher probability of developing depressive symptoms over the study's follow-up period. This finding means that HPA assessment can serve as a valuable screening tool for the early identification of individuals more prone to developing the outcome. Such proactive screening capability facilitates the implementation of targeted monitoring strategies or preventive interventions before depressive symptoms fully manifest or worsen. This is a crucial consideration in populations such as military personnel.

In contrast, when specificity and the protective effect are considered, the data indicate that individuals with physical activity scores above the identified cutoff points (e.g., $>$ 2.5 for sports) tend to have a lower

probability of developing depressive symptoms. These individuals can be effectively identified as "true negatives" regarding the outcome. This interpretation provides a practical objective for health promotion: encouraging individuals to maintain or elevate their physical activity levels to thresholds above these cutoff points can confer a substantial protective effect. Beyond identifying risk, our findings deliver a quantitative parameter for behavioral interventions aimed at fostering sufficient physical activity to mitigate the risk of depression. Such actions contribute to resilience and psychological well-being. Physical training programs in armed forces, for instance, could be strategically modified to incorporate more structured sports activities. This would ensure recruits consistently achieve or surpass these protective levels. A proactive approach to mental health, grounded in modifiable behavior, offers a promising avenue for reducing the incidence and impact of depression in vulnerable populations. It also aligns with the growing demand for effective and evidence-based interventions.

Recent studies have provided further support for the mental health benefits of physical activity. Rodríguez-Romo et al. (2023) reported that leisure time and occupational physical activity are associated with decreased vulnerability to potential mental health problems in undergraduate students. Granero-Jiménez et al. (2022) observed that the higher the level of physical activity in young adults, the higher are the scores in psychological well-being.

Specifically, in army recruits, studies have verified the importance of physical activity in maintaining mental health. Post et al. (2023) demonstrated that the Invictus Pathways Program exerts a positive impact on the psychological health of veterans. This program is an initiative by the University of South Australia and is inspired by the spirit of the Invictus Games. It aims to use sports and physical activity to support the physical, psychological, and social well-being of veterans. Initially designed to help veterans train for the Invictus Games, this program has since expanded to include all veterans and offers opportunities for recovery and community reintegration via tailored exercise regimens. Caddick and Smith (2018) noted that recent investigations have emphasized the importance of incorporating exercise as a supplementary therapy to address mental health issues, such as posttraumatic stress disorder, in military veterans. Hruby et al. (2021) found that certain healthy behaviors were linked to improved mental health in over 12,000 US military personnel. These studies underscore the importance of physical activity as an effective intervention for promoting mental health in military contexts. Furthermore, they highlight the need to incorporate robust physical activity components in military training programs.

The findings from this study have practical implications because they suggest that interventions that encourage participation in sports activities may be effective in alleviating depressive symptoms. Physical training programs in the armed forces could be modified to include more structured sports activities, which can not only augment physical fitness but also serve as a valuable means for social and psychological support.

Despite the contributions of this study, certain inherent limitations must be acknowledged. The relatively small sample size, drawn from a single military unit, limits the generalizability of the findings to the entire Brazilian Army. This constraint should be considered when interpreting the results. Furthermore, although there is a clear association between physical activity and depression, we cannot definitively conclude that physical activity decreases depressive symptoms or that individuals with such symptoms are less likely to be physically active. Future research should therefore aim to include larger, more diverse samples from multiple regions to enhance external validity. Additionally, experimental approaches such as randomized controlled trials, which can more directly assess the impact of physical activity on depressive symptoms, are necessary to confirm causal effects. Moreover, future studies should incorporate objective assessment methods, such as physical activity tracking devices, to complement self-reported data and reduce potential measurement bias.

5. Conclusion

The findings of this study suggest that promoting physical activities, especially structured activities such as sports, may represent a promising component of mental health promotion and management strategies among young adults after mandatory military service. Implementing programs that encourage sports participation may offer considerable mental health benefits. Nonetheless, further studies with a methodological approach are needed to confirm these findings, explore the underlying mechanisms, and develop optimized interventions for these populations.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.actpsy.2025.105771.

CRediT authorship contribution statement

Naiane Silva Morais: Writing – review & editing, Writing – original draft, Conceptualization. **Rizia Rocha-Silva:** Writing – review & editing, Writing – original draft, Formal analysis. **Mila Alves Matos Rodrigues:** Writing – review & editing, Writing – original draft. **Lucas dos Santos:** Formal analysis. **Vanessa Assis Menezes:** Writing – review & editing, Writing – original draft. **Tais Malysz:** Project administration, Methodology, Conceptualization. **Allison Gustavo Braz:** Project administration, Methodology, Conceptualization. **Rodrigo Luiz Vancini:** Writing – review & editing, Writing – original draft. **Marília Santos Andrade:** Writing – review & editing, Writing – original draft. **Katja Weiss:** Writing – review & editing, Writing – original draft. **Thomas Rosemann:** Writing – review & editing, Writing – original draft. **Beat Knechtle:** Writing – review & editing, Writing – original draft. **Claudio Andre Barbosa de Lira:** Writing – review & editing, Project administration, Methodology, Conceptualization.

Declaration of competing interest

No competing interests exist.

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Data availability

Data will be made available on request.

References

Baecke, J., Burema, J., & Frijters, J. (1982). A short questionnaire for the measurement of habitual physical activity in epidemiological studies. *The American Journal of Clinical Nutrition, 36*(5), 936–942. https://doi.org/10.1093/ajcn/36.5.936

Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., & Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry, 4*, 561–571.

BRASIL, P. (2014). no 012-E. de 29 de janeiro de 2014. In *Manual de Fundamentos EB20-MF-10.101*.

Caddick, N., & Smith, B. (2014). The impact of sport and physical activity on the well-being of combat veterans: A systematic review. *Psychology of Sport and Exercise, 15*(1), 9–18. https://doi.org/10.1016/J.PSYCHSPORT.2013.09.011

Caddick, N., & Smith, B. (2018). Exercise is medicine for mental health in military veterans: a qualitative commentary. *Qualitative Research in Sport, Exercise and Health, 10*(4), 429–440. https://doi.org/10.1080/2159676X.2017.1333033

Chireh, B., Essien, S. K., Novik, N., & Ankrah, M. (2023). Long working hours, perceived work stress, and common mental health conditions among full-time Canadian working population: A national comparative study. *Journal of Affective Disorders Reports, 12*, Article 100508. https://doi.org/10.1016/J.JADR.2023.100508

Connor, M., Hargreaves, E. A., Scanlon, O. K., & Harrison, O. K. (2023). The effect of acute exercise on state anxiety: A systematic review. *Sports (Basel, Switzerland), 11*(8). https://doi.org/10.3390/SPORTS11080145

De Lira, C. A. B., Morais, N. S., Assis Menezes, V., Santos Andrade, M., Vancini, R. L., Braz, A. G., & Malysz, T. (2020). Identifying mood disorders and health-related quality of life of individuals submitted to mandatory military service. *Acta Neuropsychiatrica, 33*(1), 9–14. https://doi.org/10.1017/neu.2020.29

Dickson, S. J., Oar, E. L., Kangas, M., Johnco, C. J., Lavell, C. H., Seaton, A. H., … Rapee, R. M. (2024). A systematic review and Meta-analysis of impairment and quality of life in children and adolescents with anxiety disorders. *Clinical Child and Family Psychology Review, 27*(2), 342–356. https://doi.org/10.1007/S10567-024-00484-5

Ferraz, A.d. F., de Andrade, E. L., Viana, M. V., Rica, R. L., Bocalini, D. S., & Júnior, A. F. (2020). Physical activity level and sedentary behavior of military police staff. *Revista Brasileira de Medicina do Esporte, 26*(2), 117–121. https://doi.org/10.1590/1517-869220202602208923

Florindo, A. A., de Oliveira, D., Latorre, M.d. R., Constante Jaime, P., Tanaka, T., & de Freitas Zerbini, C. A. (2004). Methodology to evaluation the habitual physical activity in men aged 50 years of more. *Revista de Saúde Pública, 38*(2), 307–314. https://doi.org/10.1590/s0034-89102004000200022

Gorenstein, C., & Andrade, L. (1996). Validation of a Portuguese version of the Beck depression inventory and the state-trait anxiety inventory in Brazilian subjects. *Brazilian Journal of Medical and Biological Research = Revista Brasileira de Pesquisas Medicas e Biologicas, 29*(4), 453–457.

Granero-Jiménez, J., López-Rodríguez, M. M., Dobarrio-Sanz, I., & Cortés-Rodríguez, A. E. (2022). Influence of physical exercise on psychological well-being of young adults: A quantitative study. *International Journal of Environmental Research and Public Health, 19*(7), 4282. https://doi.org/10.3390/ijerph19074282

Hautzinger, M., Bailer, M., Worall, H., & Keller, F. (1994). *Beck-depressions-inventar (BDI)*. Bern.

Hruby, A., Lieberman, H. R., & Smith, T. J. (2021). Symptoms of depression, anxiety, and post-traumatic stress disorder and their relationship to health-related behaviors in over 12,000 US military personnel: Bi-directional associations. *Journal of Affective Disorders, 283*, 84–93. https://doi.org/10.1016/j.jad.2021.01.029

Martins, L. C. X. (2019). Prevalência de agravos à saúde e associações com nível atividade física em militares do sexo feminino do Exército Brasileiro. *Revista de Educação Física, 88*, 830–846.

Moradi, Y., Dowran, B., & Sepandi, M. (2021). The global prevalence of depression, suicide ideation, and attempts in the military forces: A systematic review and Meta-analysis of cross sectional studies. *BMC Psychiatry, 21*(1), 510. https://doi.org/10.1186/S12888-021-03526-2

Mota, N., Bolton, S. L., Enns, M. W., Afifi, T. O., El-Gabalawy, R., Sommer, J. L., … Sareen, J. (2021). Course and Predictors of Posttraumatic Stress Disorder in the Canadian Armed Forces: A Nationally Representative, 16-Year Follow-up Study: Cours et prédicteurs du trouble de stress post-traumatique dans les Forces armées canadiennes: une étude de suivi de 16 ans nationalement représentative. *The Canadian Journal of Psychiatry, 66*(11), 982–995. https://doi.org/10.1177/0706743721989167

Munro, B. H. (1986). *Statistical methods for health care research*. JB Lippincott.

Oliveira, A. J., Neto, G. A. M., Osmar, Barros, D., Pedreiro, R., Murillo-Rodriguez, E., … Machado. (2019). Association between physical fitness and psychological distress among Brazilian armed force personnel. *Sport Sciences for Health, 15*, 141–147. https://doi.org/10.1007/s11332-018-0503-9

de Oliveira, C., Saka, M., Bone, L., & Jacobs, R. (2023). The role of mental health on workplace productivity: A critical review of the literature. *Applied Health Economics and Health Policy, 21*(2), 167–193. https://doi.org/10.1007/S40258-022-00761-W/METRICS

Post, D., Baker, A., Milanese, S., Freegard, S., & Parfitt, G. (2023). The physical, psychological, and social impacts of participation in the Invictus pathways program: A qualitative analysis of veterans' perceptions and experiences. *PLoS One, 18*(10), Article e0287228. https://doi.org/10.1371/journal.pone.0287228

Puhani, P. A., & Sterrenberg, M. K. (2022). Effects of mandatory military and alternative community service on wages and other socioeconomic outcomes. *Kyklos, 75*(3), 488–507. https://doi.org/10.1111/kykl.12301

Ramos-Sanchez, C. P., Schuch, F. B., Seedat, S., Louw, Q. A., Stubbs, B., Rosenbaum, S., … Vancampfort, D. (2021). The anxiolytic effects of exercise for people with anxiety and related disorders: An update of the available meta-analytic evidence. *Psychiatry Research, 302*. https://doi.org/10.1016/J.PSYCHRES.2021.114046

Rodríguez-Romo, G., Acebes-Sánchez, J., García-Merino, S., Garrido-Muñoz, M., Blanco-García, C., & Diez-Vega, I. (2023). Physical activity and mental health in undergraduate students. *International Journal of Environmental Research and Public Health, 20*(1), 195. https://doi.org/10.3390/ijerph20010195

Rugulies, R., Aust, B., Greiner, B. A., Arensman, E., Kawakami, N., LaMontagne, A. D., & Madsen, I. E. H. (2023). Work-related causes of mental health conditions and interventions for their improvement in workplaces. *Lancet, 402*(10410), 1368–1381. https://doi.org/10.1016/S0140-6736(23)00869-3/ASSET/044E5812-074F-4411-A50A-EF242177A5C0/MAIN.ASSETS/GR1.JPG

Sampson, L., Cabral, H. J., Rosellini, A. J., Gradus, J. L., Cohen, G. H., Fink, D. S., … Galea, S. (2022). Stressful life events and trajectories of depression symptoms in a U. S. military cohort. *Scientific Reports, 12*(1), 1–11. https://doi.org/10.1038/s41598-022-14496-0, 2022 12:1.

Sampson, L., Gradus, J. L., Cabral, H. J., Rosellini, A. J., Fink, D. S., Cohen, G. H., … Galea, S. (2023). Stressful life events and incident depression among U.S. military personnel. *Social Psychiatry and Psychiatric Epidemiology, 58*(7), 1009–1018. https://doi.org/10.1007/S00127-023-02445-9/METRICS

Silvala, J., Korpelainen, R., Koivumaa-Honkanen, H., Sirkiä, C., Parkkola, K., Yliherva, A., Taanila, A., & Hurtig, T. (2025). Self-reported depressive and anxiety symptoms associated with fitness for military service and social-communicative skills in young Finnish men. *Nordic Journal of Psychiatry, 79*(3), 218–226. https://doi.org/10.1080/08039488.2025.2475932

Sullivan, K. S., Hawkins, S. A., Gilreath, T. D., & Castro, C. A. (2020). Mental health outcomes associated with profiles of risk and resilience among U.S. army spouses. *Journal of family psychology : JFP : journal of the Division of Family Psychology of the American Psychological Association (Division 43), 35*(1), 33. https://doi.org/10.1037/FAM0000702

Waldhauser, K. J., Hives, B. A., Liu, Y., Puterman, E., Sharifian, N., Castañeda, S. F., … Beauchamp, M. R. (2025). Military veterans' psychological health and physical activity after separation from service. *American Journal of Preventive Medicine, 69*(2), Article 107642. https://doi.org/10.1016/J.AMEPRE.2025.04.012/ASSET/D7A9766B-687E-4E94-9185-682D3891FFEC/MAIN.ASSETS/GR1.JPG

Webber, B. J., Bornstein, D. B., Deuster, P. A., O'Connor, F. G., Park, S., Rose, K. M., & Whitfield, G. P. (2023). BMI and physical activity, military-aged U.S. population 2015–2020. *American Journal of Preventive Medicine, 64*(1), 66–75. https://doi.org/10.1016/J.AMEPRE.2022.08.008/ATTACHMENT/9AAFBDE4-00E2-4BE2-9CCC-2C92E5B53321/MMC1.PDF

You, Y., Chen, Y., Ding, H., Liu, Q., Wang, R., Xu, K., Wang, Q., Gasevic, D., & Ma, X. (2025). Relationship between physical activity and DNA methylation-predicted epigenetic clocks. *npj. Aging, 11*(1). https://doi.org/10.1038/S41514-025-00217-0

You, Y., Ding, H., Tang, M., Wang, W., Yan, N., Min, L., Chen, Y., & Ma, X. (2025). Dose–response relationship between leisure-time physical activity and metabolic syndrome in short sleep US adults: evidence from a nationwide investigation. *Applied Physiology, Nutrition and Metabolism, 50*. https://doi.org/10.1139/APNM-2024-0347

You, Y., Wang, D., Ding, H., Wang, W., Liu, Q., Zhang, D., Chen, Y., & Ma, X. (2025). Mediation role of telomere length in the relationship between physical activity and PhenoAge: A population-based study. *Journal of Exercise Science and Fitness, 23*(3), 149–156. https://doi.org/10.1016/j.jesf.2025.03.004

You, Y., Wang, R., Li, J., Cao, F., Zhang, Y., & Ma, X. (2024). The role of dietary intake of live microbes in the association between leisure-time physical activity and depressive symptoms: a population-based study. *Applied Physiology, Nutrition, and Metabolism, 49*(8), 1014–1024. https://doi.org/10.1139/apnm-2023-0550

You, Y., Zheng, K., Ablitip, A., Wang, D., Chen, C., Liu, Y., … Ma, X. (2025). Life's essential 8 and depression: A National Cross-Sectional Analysis in US emerging adults. *Journal of Adolescent Health, 77*(1), 84–93. https://doi.org/10.1016/j.jadohealth.2025.03.023