



Social disadvantages modify the relationship between sedentary behavior and depression in major depressive disorder patients

Desvantagens sociais modificam relação entre comportamento sedentário e gravidade da depressão em pacientes depressivos

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ABSTRACT

Introduction: Major depressive disorder (MDD) is a disabling mental disorder with high global prevalence. While sedentary behavior (SB) has been consistently linked to adverse health outcomes, the influence of social determinants on SB in individuals with MDD, particularly from an intersectional perspective, remains underexplored. **Objective:** To investigate whether social determinants, analyzed intersectionality, are associated with the severity of depressive symptoms in adults with MDD, considering different levels of SB. **Methods:** A total of 108 adults (18–59 years) with a clinical diagnosis of MDD participated in an online survey. SB was assessed with the International Physical Activity Questionnaire. Depressive symptoms were measured with the Beck Depression Inventory. Social determinants were combined into a Jeopardy Index to classify participants into a dominant group and a minority group. **Results:** The association between social determinants and depression severity was moderated by SB level. In the low SB group, belonging to the minority group was associated with a higher proportion of moderate/severe depression (91.3% vs. 8.7%; $p = 0.039$) and a seven-fold increased risk for these symptoms ($OR = 7.0$; 95% CI: 1.27 – 38.47) compared to the dominant group. In contrast, no association was found in the high SB group. **Conclusion:** The intersectionality of social determinants was associated with depression severity in the low SB group. These findings reinforce the need for public health policies that consider social vulnerabilities to mitigate the impact of MDD, even in populations that do not exhibit high-risk sedentary behavior.

Keywords: Sedentary time; Mental health; Depressive disorder.

RESUMO

Introdução: O transtorno depressivo maior (TDM) é um transtorno mental incapacitante, com alta prevalência global. Embora o comportamento sedentário (CS) esteja consistentemente associado a desfechos adversos de saúde, a influência dos determinantes sociais sobre o CS em indivíduos com TDM, especialmente sob uma perspectiva interseccional, permanece pouco explorada. **Objetivo:** Investigar se os determinantes sociais, analisados sob a ótica da interseccionalidade, estão associados à gravidade dos sintomas depressivos em adultos com TDM, considerando diferentes níveis de CS. **Métodos:** Um total de 108 adultos (18–59 anos) com diagnóstico clínico de TDM respondeu um formulário online. O CS foi avaliado pelo Questionário Internacional de Atividade Física. Os sintomas depressivos foram mensurados pelo Inventário de Depressão de Beck. Os determinantes sociais foram combinados em um Índice de Vulnerabilidade para classificar os participantes em grupo dominante e grupo minoritário. **Resultados:** A associação entre determinantes sociais e a gravidade da depressão foi moderada pelo nível de CS. No grupo com baixo CS, pertencer ao grupo minoritário esteve associado a uma maior proporção de depressão moderada/grave (91,3% vs. 8,7%; $p = 0,039$) e a um risco sete vezes maior para esses sintomas ($OR = 7,0$; IC 95%: 1,27 – 38,47) em comparação ao grupo dominante. Em contraste, nenhuma associação foi encontrada no grupo com alto CS. **Conclusão:** A interseccionalidade dos determinantes sociais esteve associada à gravidade da depressão no grupo com baixo CS. Esses achados reforçam a necessidade de políticas de saúde pública que considerem vulnerabilidades sociais para mitigar o impacto do TDM, mesmo em populações que não apresentam comportamento sedentário de alto risco.

Palavras-chave: Tempo sedentário; Saúde mental; Transtorno depressivo.

Introduction

Major depressive disorder (MDD) is a highly prevalent mental disorder, affecting more than 280 million people worldwide¹. It is characterized by

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persistent sadness, fatigue, and anhedonia, often accompanied by cognitive and somatic symptoms. Beyond the individual suffering, MDD imposes a profound burden on societies, being associated with reduced work productivity, increased health care costs, and social disability². The societal implications of a mentally ill population highlight the urgency of understanding risk factors and protective conditions for MDD and its comorbidities³.

The determinants of mental health are not only biological but also strongly influenced by social, cultural, and economic factors⁴. Intersectionality provides an essential theoretical framework for understanding how multiple social positions shape health. However, its application within quantitative research remains limited and is often inadequately operationalized⁴. The Lancet Commission on Global Mental Health emphasized that mental disorders exist along a continuum and are shaped by a complex interaction of social and biological influences across the lifespan, underscoring the importance of addressing vulnerable populations who experience intersectional disadvantages⁵.

Building upon this perspective, mental health can be understood as the result of multiple, interrelated determinants operating at both micro (individual) and macro (societal) levels⁶. At the macro level, political, economic, and environmental structures, including national health policies, social protection systems, and patterns of resource distribution, influence opportunities for prevention and access to treatment. At the micro level, individual characteristics such as gender, race, ethnicity, income, education, and experiences of stigma directly shape mental health trajectories, highlighting how structural inequities are reproduced within personal circumstances.

In addition to social determinants, behavioral factors such as sedentary behavior (SB) are strongly implicated in the MDD. Several studies have shown that elevated depressive symptoms are often associated with higher levels of SB⁷⁻⁹. SB is defined as any waking behavior characterized by an energy expenditure ≤ 1.5 metabolic equivalents while in a sitting, reclining, or lying posture¹⁰⁻¹². Common examples include watching television, working on a computer, commuting by car, and prolonged sitting during leisure activities.

The prospective study by Hamer and Stamatakis⁸ demonstrated that individuals who spent more than six hours per day in sedentary activities had a significantly higher risk of developing depression, as well as a greater likelihood of cognitive decline, compared to those with lower sedentary time. The meta-analysis conducted by Zhai et al.⁹ demonstrated that individuals who spend more time in SB, such as watching television or remaining seated for long periods, have a significantly higher risk of developing depression. This finding suggests a bidirectional relationship, in which the presence of depressive symptoms may reduce motivation for active behaviors, contributing to increased sedentary time, prolonged SB, and exacerbating depressive symptoms.

Recent evidence further reinforces this association, indicating that SB is not only linked to an increased risk of developing depressive disorders but also to higher levels of depressive symptoms among adults. In a large prospective cohort study with more than 60,000 participants, using accelerometer-based measures⁷, observed that greater time spent in SB was positively associated with elevated depressive and anxiety symptom scores, even

after controlling for confounding factors such as physical activity, sleep, and socioeconomic status. Moreover, compositional analyses demonstrated that replacing sedentary time with moderate-to-vigorous physical activity significantly reduced depressive symptom scores, suggesting that SB constitutes a modifiable risk factor for mental health. These findings strengthen the understanding that reducing sedentary time may have an important role in mitigating depressive symptomatology and promoting psychological well-being.

Despite the recognition of its harmful effects, SB has not been sufficiently examined through the lens of social determinants in populations with MDD. The intersectional approach is a framework for understanding how overlapping social disadvantages (such as low income, female gender, racial minority status, and non-heteronormative identities) may influence access to health care and behavioral patterns¹³, including SB. The Jeopardy Index, derived from intersectionality theory, operationalizes these factors into a composite score that reflects cumulative social disadvantage¹³. By applying this approach, it is possible to investigate how social determinants shape SB in adults with MDD.

Therefore, the present study aimed to investigate the association between social determinants and analyzed intersectionally, with the severity of depressive symptoms in adults with MDD, considering different levels of SB. We hypothesized that individuals with multiple social disadvantages, analyzed intersectionally, would exhibit greater severity of depressive symptoms in the group with high SB.

Methods

Sample

This cross-sectional study was conducted in the city of Presidente Prudente, São Paulo, Brazil. The study was approved by the Research Ethics Committee (protocol nº 7.538.765 / CAAE: 87701025.2.0000.5402). Participants were recruited through social media platforms and completed an online questionnaire via Google Forms between March 2024 and August 2025. All participants provided informed consent electronically before participation. The study included 108 adults aged 18 to 59 years with a medical diagnosis of MDD. The MDD symptoms were confirmed by a psychiatrist through the Mini International Neuropsychiatric Interview (MINI), based on the criteria of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5).

Inclusion and exclusion criteria

Participants were adults aged 18 to 59 years with a clinical diagnosis of MDD. To obtain a more homogeneous clinical sample, individuals with severe psychiatric comorbidities (e.g., bipolar disorder, schizophrenia), substance abuse, and osteoarticular limitations were excluded. Additional exclusion criteria included contraindications to physical exercise, inability to understand the assessment instruments, and incomplete data for the primary variables analyzed.

Procedures

• Depression Symptoms Assessment

Depressive symptoms were evaluated using the Beck Depression Inventory, a widely validated self-report instrument designed to measure the severity of depressive symptomatology¹⁴. The Beck Depression Inventory consists of 21 items addressing cognitive, affective, and somatic domains of depression, such as mood, pessimism, sense of failure, self-dissatisfaction, guilt, fatigue, and changes in sleep and appetite. Each item is scored on a scale from 0 to 3, yielding a total score that ranges from 0 to 63. In this study, scores were categorized as mild depression (<19) and moderate/severe depression (≥19), following established cutoffs for clinical interpretation^{14,15}. In addition, the participants answered two additional yes/no questions regarding whether they were undergoing psychotherapy and medication treatment.

• Sedentary behavior assessment

The SB, assessed by sitting time, was self-reported using the 8-item short version of the International Physical Activity Questionnaire (IPAQ), a validated tool used for estimating physical activity and sedentary time across diverse populations^{16,17}. Participants reported the amount of time spent sitting or reclining on a typical weekday and on a typical weekend day, recorded in hours and minutes. In the version of the instrument used, sitting time excludes time spent in passive transportation. The total sedentary time was calculated and then dichotomized based on the median value of the sample. This categorization resulted in two groups: lower SB (< 6 hours/day) and higher SB (≥ 6 hours/day). The IPAQ is widely applied in epidemiological studies due to its feasibility in large populations and its ability to capture context-specific SBs^{16,17}.

• Social determinants assessment

Social determinants were analyzed using the Jeopardy

Index, an intersectionality-based composite measure designed to account for multiple overlapping sources of social disadvantage^{13,18,19}. To quantify this index, scores were assigned to four variables: gender (response options: male, female), racial identity (response options: white, black, mixed race, asian, indigenous), sexual orientation (response options: heterosexual, homosexual, bisexual, pansexual), and education level (had completed undergraduate education vs. no formal education or primary/secondary education). The scoring system was as follows: Gender (male = 0, female = 1), Racial identity (White = 0, Non-white = 1), Sexual orientation (heterosexual = 0, non-heterosexual = 1), and Education Level (Higher Education = 0, lower education level = 1). The Scores for each variable were summed to create a Social Jeopardy Index, ranging from 0 to 4. Participants were categorized into two main groups: the Dominant and the Minority groups. The Dominant group (scores 0-1), and the minority group (scores ≥ 2).

Statistical analysis

Descriptive statistics were composed, including mean, standard deviation, and frequencies. Given that the main analysis involved categorical outcomes (presence or absence of depression), the chi-square test was employed to assess the existence of associations between dependent and independent variables (crude analysis), with Yates' correction used in two-by-two contingency tables. Binary logistic regression was adopted as the multivariate model, expressed as an odds ratio (OR) and its 95% confidence intervals (95% CI). The Hosmer and Lemeshow test was used to assess the goodness-of-fit assumption. The models were simultaneously adjusted by general information, including intersectionality factors (sexual orientation [heterosexual vs. non-heterosexual], gender [male vs. female], race/ethnicity [White vs. Non-white], education Level [Higher Education = 0, lower education level = 1], and social jeopardy index [dominant vs. minority]). The models were adjusted for age and body mass index. Analyses were also conducted stratified according to the SB level (low or high). Statistical significance (p-value) was set at <5%. Data analysis was performed using the Statistical Package for Social Sciences 29.0 (SPSS Inc. Chicago, IL, USA).

Results

The study sample consisted of 108 individuals diagnosed with MDD, with a mean age of 37.2 ± 10.5

years (Table 1). Most of the participants were female (72.2%), white (68.5%), heterosexual (82.4%), and did not have a university education (50.9%). Additionally, most participants reported undergoing psychotherapy (85.2%) and using medication (77.8%). When the sample was stratified by SB, the following profiles were observed: the Lower SB group (n = 43) was predominantly composed of females (86%), white individuals (62.8%), heterosexuals (88.4%), and those without a university education (53.5%). The majority were also in psychotherapy (83.7%) and on medication (76.7%). The higher SB group (n = 65) was also mostly female (63.1%), white (72.3%), and heterosexual (78.5%), but the majority had a university education (50.8%). Most were also undergoing psychotherapy (86.2%) and using medication (78.5%).

Table 1 – Characteristics of the sample.

Variable	Overall (n = 108)	Lower sedentary behavior (n = 43)	Higher sedentary behavior (n = 65)
Age (years)	40.0 $\pm$ 12.3	44.3 $\pm$ 11.9	37.2 $\pm$ 11.8
Gender			
Male – n (%)	30 (27.8)	6 (14.0)	24 (36.9)
Female – n (%)	78 (72.2)	37 (86.0)	41 (63.1)
Race/ethnicity			
White – n (%)	74 (68.5)	27 (62.8)	47 (72.3)
Non-white – n (%)	34 (31.5)	16 (37.2)	18 (27.7)
Sexual orientation			
Heterosexual – n (%)	89 (82.4)	38 (88.4)	51 (78.5)
Non-heterosexual – n (%)	19 (17.6)	5 (11.6)	14 (21.5)
Education Level			
University education – n (%)	53 (49.1)	20 (46.5)	33 (50.8)
Non-University education – n (%)	55 (50.9)	23 (53.5)	32 (49.2)
Psychotherapy treatment			
On psychotherapy – n (%)	92 (85.2)	36 (83.7)	56 (86.2)
Non-psychotherapy – n (%)	16 (14.8)	7 (16.3)	9 (13.8)
Medication treatment			
On medication – n (%)	84 (77.8)	33 (76.7)	51 (78.5)
Non-medication – n (%)	24 (22.2)	10 (23.3)	14 (21.5)

Legends: n = number of subjects; % = percentile.

The prevalence of moderate/severe depressive symptoms was analyzed according to individual social determinants and stratified by the level of SB, as presented in Table 2.

In the lower SB group (n = 43), the gender female accounted for 91.3% of the cases with moderate/severe symptoms, compared to 80.0% of those with mild symptoms. For race/ethnicity, non-whites accounted for

Table 2 – Prevalence of moderate/severe depressive symptoms by individual social determinants in people with major depressive disorder.

Variables	Lower sedentary behavior (n = 43)		Higher sedentary behavior (n = 65)	
	Depression symptoms			
	n (%)	n (%)	n (%)	n (%)
Gender	Male	Female	Male	Female
Mild	4 (20)	16 (80.0)	5 (38.5)	8 (61.5)
Moderate/ severe	2 (8.7)	21 (91.3)	19 (36.5)	33 (63.5)
Race/ethnicity	White	Non-white	White	Non-white
Mild	13 (65.0)	7 (35.0)	10 (76.9)	3 (23.1)
Moderate/ severe	14 (60.9)	9 (39.1)	37 (71.2)	15 (28.8)
Sexual orientation	Hetero	Non- Hetero	Hetero	Non- Hetero
Mild	19 (95.0)	1 (5.0)	9 (69.2)	4 (30.8)
Moderate/ severe	19 (82.6)	4 (17.4)	42 (80.8)	10 (19.2)
Education Level	Higher education	Non-higher education	Higher education	Non-higher education
Mild	8 (40.0)	12 (60)	8 (61.5)	5 (38.5)
Moderate/ severe	15 (65.2)	8 (34.8)	24 (46.2)	28 (53.8)

Legends: *denotes significant association (chi-square test with p-value < 0.05); n = number of subjects; % = percentile.

39.1% of those with moderate/severe symptoms, versus 35.0% in the mild symptoms group. Sexual orientation of non-heterosexual individuals made up 17.4% of the group with moderate/severe symptoms, versus 5.0% in the mild symptoms group. Participants with higher education represented 65.2% of moderate/severe cases, while this proportion was 40.0% in the mild cases group.

In the higher SB group (n = 65), female gender remained the majority, representing 63.5% of moderate/severe cases and 61.5% of mild cases. For race/ethnicity, 28.8% of the non-white group had moderate/severe symptoms, versus 23.1% in the mild symptoms group. Sexual orientation in non-heterosexual individuals accounted for 19.2% of moderate/severe cases, compared to 30.8% of mild cases. Higher education was observed in 46.2% of individuals with moderate/severe symp-

toms, compared with 61.5% in the mild group.

The Analysis of the Social Jeopardy Index and Depression Severity is presented in Table 3. The analysis using the Social Jeopardy Index, which combines multiple social determinants, revealed a significant association in the group with lower SB. In the lower SB group (n = 43), individuals classified as belonging to the minority group showed a significantly higher proportion of moderate/severe depressive symptoms (91.3%) compared to the dominant group (8.7%). This difference was statistically significant (p = 0.039). In the higher SB group (n = 65), no significant difference in depression severity was observed between individuals from the dominant group (50%) and the minority group (50%) (p = 0.999).

Binary logistic regression was used to examine the association between social determinants (both isolated and combined through intersectionality) and the severity of depression (Figure 1). The main findings were: (1) the individual social determinants (gender, race/ethnicity, sexual orientation, and education level) did not show a significant association with depression severity in either group, and (2) the intersectionality, as measured by the Social Jeopardy Index, showed a significant association: in the low SB group, belonging to the minority group increased the risk of depression by 7 times (OR = 7.0, 95% CI: 1.27 – 38.47, p = 0.025), even after adjustment for age (OR = 5.9, 95% CI: 1.02 – 34.11, p = 0.047) and body mass index (OR = 6.1, 95% CI: 1.05 – 35.71, p = 0.044). In the high SB group, no significant association was found between belonging to the minority group and the severity of depression (OR = 0.86, 95% CI: 0.25 – 2.90, p = 0.804).

Discussion

The main finding of this study was a higher prevalence of depression severity in the minority group compared to the dominant group, but only among MDD patients with lower SB. No significant difference was found in

Table 3 – Depression symptoms prevalence according to the social jeopardy index among people with major depressive disorder with lower and higher sedentary behavior.

Depression Severity	Lower sedentary behavior (n = 43)			Higher sedentary behavior (n = 65)		
	Social jeopardy index					
	Dominant	Minority	p	Dominant	Minority	p
Mild	8 (40.0)	12 (60.0)	0.039	6 (46.2)	7 (53.8)	> 0.999
Moderate/severe	2 (8.7)	21 (91.3)		26 (50.0)	25 (50.0)	

Legends: Symptom severity: <19 = mild; ≥19 moderate/severe. Social jeopardy index (cluster of social determinants). Dominants = clusters 0-1 points; Minority = clusters 2-4. *chi-square test with p-value < 0.05.

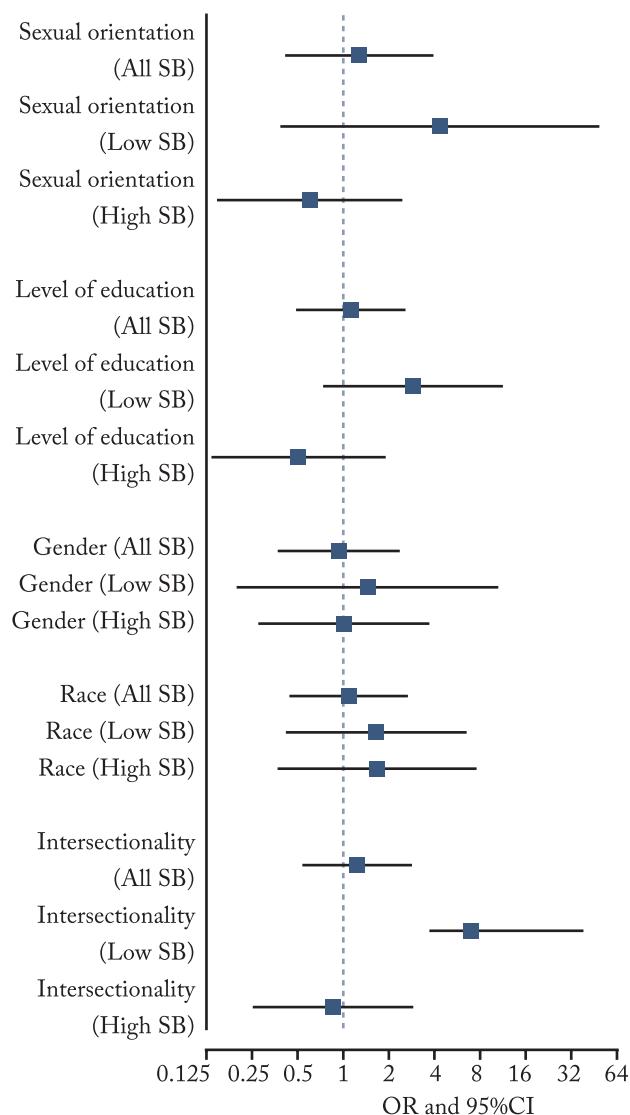


Figure 1 – Social determinants and intersectionality: odds ratio analysis.

Legends: OR = odds ratio, representing the likelihood of the outcome occurring in one group compared to the reference group; SB = Sedentary behavior.

MDD patients with higher SB. Additionally, no association was observed between individual social determinants (gender, race/ethnicity, sexual orientation, and education level) and depression severity when analyzed in isolation.

Several studies and meta-analyses have confirmed the association between SB and depression. For instance, a meta-analysis by Zhai et al.⁹ involving over 190,000 participants showed that individuals with greater exposure to SB had an approximately 25% higher risk of depression. This higher risk was consistent across both cross-sectional and longitudinal studies. Similar findings were reported by Hu et al.²⁰, which

found a 35% increase in depression risk among the most sedentary individuals compared to the least sedentary. Study by Wang et al.²¹ also demonstrated that higher levels of SB are associated with an increased risk of depression, while higher levels of moderate-to-vigorous physical activity exert a protective effect. Although this evidence reinforces a consistent relationship between SB and depression, little is known about how social and contextual factors might influence this association, which is a unique aspect addressed in the current study.

This study showed for the first time that social determinants should be considered when analyzing this relationship. Among participants with low SB, those in the less privileged group, who accumulated two or more social determinants, had a significantly higher risk of presenting severe depressive symptoms compared to the most privileged group, with approximately a sevenfold increase in the likelihood of moderate to severe symptoms. On the other hand, when all levels of SB were analyzed together, no significant association was observed between social determinants and depression severity. Furthermore, when each social determinants were analyzed separately, no significant differences were found between groups. This finding may be explained by the interrelated nature of social determinants, which often operate cumulatively rather than independently, and whose combined effects may be better captured using intersectional approaches^{22–24}. In agreement, a recent umbrella review by Alon et al.²⁵ showed association of other mental health social determinants with the risk or prevalence of MDD, which reinforces the importance to considerate social determinants in this relationship.

A plausible explanation for the observed association between social disadvantages and greater depressive symptom severity among individuals with lower SB may lie in the nature of the physical activity performed. Individuals who spend less time sitting are often engaged in occupations that demand greater physical activity and reduced sedentary time. These types of work, typically characterized by manual labor, repetitive movements, and limited autonomy, are commonly associated with low wages and poor working conditions and are disproportionately occupied by socially disadvantaged groups²⁶. However, occupational physical activity was not directly measured in the present study, and this interpretation should be considered speculative.

In this context, the higher levels of occupational physical activity observed among socially disadvan-

tagged individuals differ markedly from leisure-time physical activity in both quality and physiological demands. Recent meta-analytic evidence indicates that physical activity performed in the occupational domain is positively associated with mental disorder, whereas leisure-time physical activity is strongly linked to better mental health outcomes²⁷. Thus, jobs requiring high physical demands (and consequently less SB) are often linked to economic strain, job insecurity, and psychosocial stressors that may exacerbate depressive symptoms. This interpretation is also supported by the “physical activity paradox,” which suggests that occupational physical activity may not confer the same health benefits as leisure-time activity due to prolonged low-intensity effort, limited recovery, and reduced autonomy²⁸.

Additionally, the relationship between SB and health outcomes appears to depend on the overall movement profile. Evidence from large harmonized analyses indicates that moderate-to-vigorous physical activity may attenuate the detrimental effects of prolonged sitting, suggesting that individuals with higher sedentary time may still achieve protective effects if they engage in structured exercise during leisure time²⁹. Taking together, these findings suggest that the lower SB observed in this group does not necessarily reflect a healthier lifestyle but may instead represent a marker of socioeconomic disadvantage and exposure to physically demanding and mentally taxing work environments, which could partly explain the present study's findings.

The literature also indicated that domestic activity could represent a substantial portion of total physical activity, especially for women, accounting for more than one-third of their moderate-to-vigorous physical activity^{27,30,31}. While these tasks (e.g., cooking, cleaning, childcare) may reduce sitting time, they do not necessarily promote health benefits, as they often involve the use of small muscle groups, repetitive movements, and isometric exertion, which can lead to fatigue without meaningful improvements in body composition³¹. Moreover, domestic and occupational activities may contribute to lower sedentary time without necessarily improving mental health, particularly when performed under conditions of high demand and limited autonomy. Therefore, the lower SB observed among women may reflect a greater burden of domestic work, although this variable was not directly assessed, and this interpretation should be considered speculative.

Consistent with epidemiological trends, the study

sample was predominantly female (72.2%), and females showed a higher prevalence of depressive symptoms. Depression is reported to be 1.5 to 2 times more prevalent among women than men, a phenomenon attributed to biological, hormonal, psychological, and social factors³². Psychosocial factors are crucial, as women are more frequently exposed to interpersonal stressors, gender-based violence, the double burden of professional and domestic roles, and socioeconomic disparities^{32,33}. These conditions contribute not only to a higher vulnerability to depressive symptoms but also to greater chronicity and severity³². Although women tend to seek health services more frequently, which might increase diagnosis rates, this does not fully explain the gender differences observed^{34,35}. The predominance of women in this study, where all participants already had an MDD diagnosis, reinforces their vulnerability and suggests that the intersectionality of social roles exacerbates the burden of depression.

This study has some limitations. First, the cross-sectional design precludes causal inferences. Second, the sample size became relatively small after stratifications, which may have reduced statistical power to detect associations. Third, information regarding participants' occupational and domestic activities was not collected, limiting the interpretation of the mechanisms underlying lower SB. Additionally, sedentary time domains (occupational, leisure, and domestic) were not distinguished. The lack of adjustment for medication use, psychotherapy exposure, cognitive function, and other clinical characteristics may also have influenced the findings, introducing potential residual confounding. Furthermore, although there was a significant association between intersectionality and depressive symptoms in the low SB group, the wide confidence interval (1.27 - 38.47) indicates substantial uncertainty and should therefore be interpreted with caution. Future studies should examine sedentary time across different domains and employ longitudinal designs to clarify causal pathways.

In conclusion, the intersectionality of social determinants was associated with depression severity in the low SB group among adults with MDD. However, these findings should be interpreted with caution due to the cross-sectional design, limited sample size after stratification, and potential residual confounding. Additionally, the mechanisms underlying lower SB were not directly assessed. Future studies with larger samples and longitudinal designs are needed to better

understand the role of social determinants in the relationship between SB and depression severity.

Conflict of interest

The authors declare no conflict of interest.

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Author's contributions

Campos JMS: Conceptualization; Software; Validation; Investigation; Writing – original draft; Approval of the final version. Quizzini GH: Validation; Investigation; Writing – original draft; Approval of the final version. Amorim TA: Investigation; Writing – original draft; Approval of the final version. Trombetta-Lima M, Nascimento C and Santos SFS: Conceptualization; Writing – review & editing; Approval of the final version. Victo ER: Methodology; Writing – review & editing; Approval of the final version. Daca TSL: Investigation; Writing – review & editing; Approval of the final version. Neves LM: Methodology; Formal analysis; Data curation; Visualization; Writing – original draft; Writing – review & editing; Approval of the final version. Rossi FE: Conceptualization; Methodology; Software; Validation; Formal analysis; Investigation; Resources; Supervision; Project administration; Writing – original draft; Writing – review & editing; Approval of the final version.

Declaration regarding the use of artificial intelligence tools in the article writing process

For the preparation of this manuscript, The ChatGPT artificial intelligence tool was used to perform English grammar and spelling revisions. The authors declare that all material derived from

this process has been reviewed and assume full responsibility for all the content of the manuscript.

Availability of research data and other materials

After publication the data will be available on demand to authors.

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References

1. World Health Organization. Depression and Other Common Mental Disorders. 2017. Available from: <https://www.who.int/publications/i/item/depression-global-health-estimates> [2026 march].
2. Anderson E, Crawford CM, Fava M, Ingelfinger J, Nikayin S, Sanacora G, et al. Depression — Understanding, Identifying, and Diagnosing. *N Engl J Med*. 2024;390(17):e41. doi: <https://doi.org/10.1056/NEJMp2310179>
3. Taylor D, Richards D. Triple Jeopardy: Complexities of Racism, Sexism, and Ageism on the Experiences of Mental Health Stigma Among Young Canadian Black Women of Caribbean Descent. *Front Sociol*. 2019;4:43. doi: <https://doi.org/10.3389/fsoc.2019.00043>
4. Bauer GR, Churchill SM, Mahendran M, Walwyn C, Lizotte D, Villa-Rueda AA. Intersectionality in quantitative research: A systematic review of its emergence and applications of theory and methods. *SSM Popul Health*. 2021;14:100798. doi: <https://doi.org/10.1016/j.ssmph.2021.100798>
5. Patel V, Saxena S, Lund C, Thornicroft G, Baingana F, Bolton P, et al. The Lancet Commission on global mental health and sustainable development. *The Lancet*. 2018;392(10157):1553–98. doi: [https://doi.org/10.1016/S0140-6736\(18\)31612-X](https://doi.org/10.1016/S0140-6736(18)31612-X)
6. Frankish H, Boyce N, Horton R. Mental health for all: a global goal. *The Lancet*. 2018;392(10157):1493–4. doi: [https://doi.org/10.1016/S0140-6736\(18\)32271-2](https://doi.org/10.1016/S0140-6736(18)32271-2)
7. Kandola AA, del Pozo Cruz B, Osborn DPJ, Stubbs B, Choi KW, Hayes JF. Impact of replacing sedentary behaviour with other movement behaviours on depression and anxiety symptoms: a prospective cohort study in the UK Biobank. *BMC Med*. 2021;19(1):133. doi: <https://doi.org/10.1186/s12916-021-02007-3>
8. Hamer M, Stamatakis E. Prospective Study of Sedentary Behavior, Risk of Depression, and Cognitive Impairment. *Med Sci Sports Exerc*. 2014;46(4):718–23. doi: <https://doi.org/10.1249/MSS.0000000000000156>
9. Zhai L, Zhang Y, Zhang D. Sedentary behaviour and the risk of depression: a meta-analysis. *Br J Sports Med*. 2015;49(11):705–9. doi: <https://doi.org/10.1136/bjsports-2014-093613>
10. Ainsworth BE, Haskell WL, Herrmann SD, Meckes N, Bassett DR Jr, Tudor-Locke C, et al. 2011 Compendium of Physical Activities: a second update of codes and MET values. *Med Sci Sports Exerc*. 2011;43(8):1575–81. doi: <https://doi.org/10.1249/MSS.0b013e31821ece12>
11. Powers SK. Exercise physiology: Theory and application to fitness and performances. *Med Sci Sports Exerc*. 1995;27(3):1–466. doi: <https://doi.org/10.1249/00005768-199503000-00027>

12. Tremblay MS, Aubert S, Barnes JD, Saunders TJ, Carson V, Latimer-Cheung AE, et al. Sedentary Behavior Research Network (SBRN) – Terminology Consensus Project process and outcome. *Int J Behav Nutr Phys Act.* 2017;14(1):75. doi: <https://doi.org/10.1186/s12966-017-0525-8>
13. Collins PH. Intersectionality's definitional dilemmas. *Annu Rev Sociol.* 2015;41(1):1–20. doi: <https://doi.org/10.1146/annurev-soc-073014-112142>
14. Beck AT, Ward CH, Mendelson M, Mock J, Erbaugh J. An Inventory for Measuring Depression. *Arch Gen Psychiatry.* 1961;4(6):561–71. doi: <https://doi.org/10.1001/archpsyc.1961.01710120031004>
15. Beck AT, Steer RA, Carbin MG. Psychometric properties of the Beck Depression Inventory: Twenty-five years of evaluation. *Clin Psychol Rev.* 1988;8(1):77–100. doi: [https://doi.org/10.1016/0272-7358\(88\)90050-5](https://doi.org/10.1016/0272-7358(88)90050-5)
16. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, et al. International Physical Activity Questionnaire: 12-Country Reliability and Validity. *Med Sci Sports Exerc.* 2003;35(8):1381–95. doi: <https://doi.org/10.1249/01.MSS.0000078924.61453.FB>
17. IPAQ Research Committee. Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ)-short and long forms. 2005.
18. Dowd JJ, Bengtson VL. Aging in Minority Populations an Examination of the Double Jeopardy Hypothesis. *J Gerontol.* 1978;33(3):427–36. doi: <https://doi.org/10.1093/geronj/33.3.427>
19. King DK. Multiple jeopardy, multiple consciousness: The context of a Black feminist ideology. *Signs: Journal of women in culture and society.* 1988;14(1):42–72. doi: <https://doi.org/10.1086/494491>
20. Hu D, Xie P, Xia L, Hou H, Wang H, Zheng X, et al. The associations between sedentary behavior and risk of depression: a systematic review and dose response meta-analysis. *BMC Public Health.* 2025;25(1):2254. doi: <https://doi.org/10.1186/s12889-025-23418-4>
21. Wang D, Zhang Y, Guo Z, Lu S. Sedentary behavior and physical activity are associated with risk of depression among adult and older populations: a systematic review and dose-response meta-analysis. *Front Psychol.* 2025;16:1542340. doi: <https://doi.org/10.3389/fpsyg.2025.1542340>
22. Assari S. General Self-Efficacy and Mortality in the USA; Racial Differences. *J Racial Ethn Health Disparities.* 2017;4(4):746–57. doi: <https://doi.org/10.1007/S40615-016-0278-0>
23. Cairney SA, Durrant SJ, Hulleman J, Lewis PA. Targeted Memory Reactivation During Slow Wave Sleep Facilitates Emotional Memory Consolidation. *Sleep.* 2014;37(4):701–7. doi: <https://doi.org/10.5665/sleep.3572>
24. Alghamdi AA, Alghamdi A H. Determining the Best Approach: Comparing and Contrasting the Impact of Different Coping Strategies on Work-Related Stress and Burnout Among Saudi Commercial Pilots. *Cureus.* 2023;15(7):e41948. doi: <https://doi.org/10.7759/cureus.41948>
25. Alon N, Macrynika N, Jester DJ, Keshavan M, Reynolds CF, Saxena S, et al. Social determinants of mental health in major depressive disorder: Umbrella review of 26 meta-analyses and systematic reviews. *Psychiatry Res.* 2024;335:115854. doi: <https://doi.org/10.1016/j.psychres.2024.115854>
26. Teychenne M, Sousa GM, Baker T, Liddelow C, Babic M, Chauntry AJ, et al. Domain-specific physical activity and mental health: an updated systematic review and multilevel meta-analysis in a combined sample of 3.3 million people. *Br J Sports Med.* 2025;60(4):267–85. doi: <https://doi.org/10.1136/bjsports-2025-109806>
27. Scaranni POS, Griep RH, Pitanga FJG, Barreto SM, Matos SMA, Fonseca MJM. Work from home and the association with sedentary behaviors, leisure-time and domestic physical activity in the ELSA-Brasil study. *BMC Public Health.* 2023;23(1):305. doi: <https://doi.org/10.1186/s12889-023-15167-z>
28. Holtermann A, Krause N, Van Der Beek AJ, Straker L. The physical activity paradox: six reasons why occupational physical activity (OPA) does not confer the cardiovascular health benefits that leisure time physical activity does. *Br J Sports Med.* 2018;52(3):149–50. doi: <https://doi.org/10.1136/bjsports-2017-097965>
29. Ekelund U, Steene-Johannessen J, Brown WJ, Fagerland MW, Owen N, Powell KE, et al. Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. *The Lancet.* 2016;388(10051):1302–10. doi: [https://doi.org/10.1016/S0140-6736\(16\)30370-1](https://doi.org/10.1016/S0140-6736(16)30370-1)
30. Guidetti M, Averna A, Castellini G, Dini M, Marino D, Bocci T, et al. Physical Activity during COVID-19 Lockdown: Data from an Italian Survey. *Healthcare.* 2021;9(5):513. doi: <https://doi.org/10.3390/healthcare9050513>
31. Murphy MH, Donnelly P, Breslin G, Shibli S, Nevill AM. Does doing housework keep you healthy? The contribution of domestic physical activity to meeting current recommendations for health. *BMC Public Health.* 2013;13(1):966. doi: <https://doi.org/10.1186/1471-2458-13-966>
32. Kuehner C. Why is depression more common among women than among men? *Lancet Psychiatry.* 2017;4(2):146–58. doi: [https://doi.org/10.1016/S2215-0366\(16\)30263-2](https://doi.org/10.1016/S2215-0366(16)30263-2)
33. Seedat S, Scott KM, Angermeyer MC, Berglund P, Bromet EJ, Brugha TS, et al. Cross-National Associations Between Gender and Mental Disorders in the World Health Organization World Mental Health Surveys. *Arch Gen Psychiatry.* 2009;66(7):785–95. doi: <https://doi.org/10.1001/archgenpsychiatry.2009.36>
34. Ladwig KH, Marten-Mittag B, Formanek B, Dammann G. Gender differences of symptom reporting and medical health care utilization in the German population. *Eur J Epidemiol.* 2000;16(6):511–8. doi: <https://doi.org/10.1023/A:1007629920752>
35. Redondo-Sendino Á, Guallar-Castillón P, Banegas JR, Rodríguez-Artalejo F. Gender differences in the utilization of health-care services among the older adult population of Spain. *BMC Public Health.* 2006;6(1):155. doi: <https://doi.org/10.1186/1471-2458-6-155>

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Reviewers' assessment

The authors and/or reviewers did not authorize the publication of either of the two reviews.