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The associations between sedentary behavior and risk of depression: a systematic review and dose response meta-analysis

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Abstract

Background Depression is a prevalent mental health disorder affecting millions of people worldwide, imposing a significant economic burden on society. Despite the progress in treatment, many individuals with depression still face challenges in accessing appropriate care. Therefore, effectively preventing depression has become an area of focus. The purpose of this study is to explore the impact of sedentary behaviour and varying dose-response relationships on the risk of depression.

Methods A systematic search of relevant studies published up to 15 August 2024 was performed using the PubMed, Embase, and Web of Science databases. We selected original studies that reported a relationship between sedentary behaviour and the risk of depression. Two authors used pre-filled forms to independently extract the trial characteristics and intervention details. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were followed, and a random effects analysis was conducted. Clinical outcomes were assessed according to odds ratios (ORs) and 95% confidence intervals (CIs). The quality of the included studies was evaluated using the Eight-component Rating scale and the Cochrane Risk of Bias tool.

Results Twenty-five studies involving 252,503 participants were included. Compared with participants with less sedentary behaviour, those with more sedentary behaviour had a significantly increased risk of depression (OR 1.35 [95% CI 1.20–1.52], $p < 0.001$; $I^2 = 83.3\%$, $p < 0.001$). Furthermore, we found that among participants with sedentary behaviour, those aged 16–20 had the highest risk of depression (OR 1.69, $p < 0.001$), followed by those under the age of 16 (OR 1.43, $p < 0.001$) and those aged 20–40 (OR 1.05, $p = 0.032$). In contrast, participants > 40 years showed no significant difference (OR 1.14, $p = 0.073$). Participants from developed countries had a lower risk of depression than the risk in those from developing countries. Lastly, sedentary behaviour of varying intensities was associated with a higher risk of depression.

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Conclusions Sedentary behaviour greatly increases the risk of depression. Participants under the age of 20 were at a higher risk of developing depression owing to sedentary behaviour. Appropriate exercise can be effective for preventing depression.

Keywords Sedentary behavior, Depression, Dose-response, Meta-analysis

Background

Depression is widely recognised as one of the most pressing mental health issues. Over the past 30 years, the number of global depression cases has increased by nearly 50%, with more than 264 million people affected across all age groups [1, 2]. The main characteristic of depression is a persistent 'low mood', accompanied by cognitive and physical changes that disrupt normal functioning of an individual and can even lead to suicide [2–4]. Additionally, depression often has a high recurrence rate, with the American Psychiatric Association estimating a relapse rate as high as 75–90% [5, 6]. Data from the World Health Organization show that depression is one of the leading causes of mental and physical disability worldwide, significantly impacting social and economic well-being [7]. Owing to the unpredictable course, complex progression, and variable responses associated with depression, diagnosis and treatment in clinical settings present major challenges [8, 9]. Therefore, how to effectively prevent or reduce the risk of depression has become a question worth considering.

With technological advancements, computer and smartphone use has become increasingly widespread, and the number of people engaged in related work has grown substantially [10, 11]. Moreover, screen time, including watching television, using computers, and playing video games, is increasing among adolescents and adults, becoming a significant part of daily life and the most common form of sedentary behavior [12]. Sedentary behaviour refers to activities that require minimal physical movement and have an energy expenditure similar to that of being at rest [13]. Sedentary behaviour can greatly increase the risk of obesity and cardiovascular diseases, and may also be associated with some psychological disorders [14–16]. However, whether sedentary behaviour increases the risk of depression requires further clarification.

Huang et al. indicated in their meta-analysis that psychologically passive sedentary behavior may increase the risk of depression [17]. Sedentary behaviors, such as using a computer, can hinder face-to-face interactions among people, leading to reduced social engagement and an increased likelihood of developing depression [18]. In addition, Zhou et al. and Jiang et al. respectively explored the impact of sedentary behavior on depression in adult and elderly populations [19, 20]. However, there is currently a lack of research on young or adolescent populations. Adolescents, in particular, are often engaged in sedentary behaviors such as watching television or using smartphones [21]. Therefore, this study conducts a more detailed age stratification to investigate the impact of sedentary behavior on depression, in the hope of providing a basis for future effective prevention of depression.

It is currently unclear whether there is a link between sedentary behavior and the risk of depression. Pooling the existing evidence, we conducted a meta-analysis to the relationship between sedentary behaviour and the risk of depression. Subgroup analyses were also conducted for various countries, patient ages, sample sizes, and intensities of sedentary time to investigate the impact of different dose-response relationships on the risk of depression.

Materials and methods

This study was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [22] and registered in the International Prospective Register of Systematic Reviews (PROSPERO) (registration number: CRD42024583157).

Search strategy

Two authors (HDH and HT) systematically and independently searched for relevant literature using the PubMed, Web of Science, and Embase databases up to 15 August 2024. The search strategy included the terms 'sedentary behavior*' OR 'sedentary lifestyle' OR 'physical inactivity' OR 'lack of physical activity' OR 'sedentary time*', AND 'depression' OR 'depressive symptom' OR 'emotional depression' OR 'depressive' OR 'dysthymia' OR 'mental illness', combined with 'Clinical Trial'. The reference lists of the included studies were also within the scope of our screening.

Screening criteria

The risk of depression was defined as a clinical diagnosis of depression, including major depressive disorder (Single/recurrent depressive episodes with ICD-10 codes F32 or F33, or the criteria for MDD in DSM-5) and mood disorders (excluding bipolar disorder), or the possibility of developing or experiencing subclinical depressive symptoms. The inclusion criteria were as follows: (1) studies investigating the impact of sedentary behaviour or screen time on depression; (2) results quantified with odds ratios (ORs), mean differences (MDs), or standardised mean differences (SMDs), accompanied by the relevant 95% confidence intervals (CIs); (3) observational studies or randomised controlled trials; (4) The number of MDD

episodes or treatment response is not restricted; and (5) age of participants > 10 years. The exclusion criteria were as follows: (1) studies involving non-human research; (2) studies published in a language other than English; (3) studies involving other non-depressive mood disorders, such as bipolar disorder F31, dysthymia F34.1, psychotic depression, and organic affective disorders; and (4) studies in the form of reviews, meta-analyses, conference abstracts, letters, or editorials.

Data extraction

Two authors (HDH and HT) independently extracted data, and disagreements were resolved by consulting a third researcher. The data extracted from each selected study included the first author, year of publication, country, age (years), sample size, depression indicator, sedentary behaviour indicator, categories (intensities of sedentary behaviour), study design, quality score, and outcome(s) (including OR/MD/SMD, 95% CI).

Evaluation of study quality

A refined Eight-component Rating scale was used to assess the methodological rigour of the included studies [23]. The scale encompasses six key domains: selection bias; study design, such as cross-sectional or cohort studies; control of confounding factors including age and sex; methods of data collection; data extraction processes; and analytical techniques. Each domain was assigned a qualitative rating (weak, moderate, or strong). Upon completing the assessment of all domains, an aggregate rating was assigned to each study: weak if two or more domains were deemed weak; moderate if fewer than three domains were strong and no more than one was weak; or strong if three or more domains were strong and one or none was weak. Furthermore, the Cochrane Risk of Bias tool [24] was used to evaluate randomised controlled trials, addressing potential biases including selection, reporting, performance, detection, attrition, and other considerations. Each aspect was classified as high risk, low risk, or unclear. The studies were subsequently categorised into three tiers of quality: weak if three or more aspects were at low or unclear risk, moderate for all other cases not classified as strong or weak, and strong if no more than one aspect was at low or unclear risk.

Data analysis

The ORs/MDs and corresponding 95% CIs were used to assess the relationship between sedentary behaviour and depression. Where possible, adjusted effect sizes were utilised. A random effects model was employed for the meta-analysis of the effect sizes (OR) and the corresponding 95% CI using Review Manager version 5.4 (R Foundation for Statistical Computing, Vienna, Austria) and Stata version 15 (StataCorp LLC, College Station, TX, USA) [25].

Furthermore, we also calculated the prediction intervals for the relevant ORs [26], using the following formula: Prediction Intervals = $\ln(ORs) \pm (Z_{0.975} \times SE \times \sqrt{2})$; $SE = \{\ln(upper) - \ln(lower)\} / (2 \times Z_{0.975})$; $Z_{0.975} \approx 1.96$.

Additionally, stratified subgroup analyses were conducted based on sex, country (developed, developing), age (< 16, 16–20, 20–40, > 40), intensity of sedentary behaviour (> 4 h/day, ≤ 4 h/day), and sample size. The heterogeneity of the results was assessed using the I^2 statistic, with $I^2 > 50\%$ indicating significant heterogeneity [25]. Publication bias was evaluated using funnel plots, Egger's, and Begg's tests [27]. Finally, aside from heterogeneity, a p-value of less than 0.05 was considered statistically significant.

Results

Initially, 1,894 relevant studies were identified, with an additional 10 studies included from the reference lists. After excluding 853 duplicate studies, 1,006 irrelevant studies were excluded by screening the abstracts and titles, leaving 45 studies for full-text assessment. Per the inclusion and exclusion criteria, 20 studies were excluded, including reviews, meta-analyses, or case reports ($n = 4$), studies with no pertinent results reported ($n = 9$), those with no depression events described ($n = 4$), and those whose full texts were unavailable ($n = 3$). A total of 25 studies [28–52] were ultimately included in this analysis (Fig. 1).

Study characteristics

The 25 included studies comprised 252,503 participants (Table 1). Among the studies, 15 were cross-sectional studies, 8 were cohort studies, and 2 were randomised controlled trials. After assessing the quality of the literature, 60% of the studies were of strong quality, 28% were of moderate quality, and 12% were of weak quality. Regarding the sample sizes, 7 studies included more than 5,000 participants, whereas 18 included 5,000 or fewer participants (Table 1).

Sedentary behavior and risk of depression

Compared with participants with less sedentary behaviour time, those with longer sedentary behaviour time had a significantly increased risk of depression (OR 1.35 [95% CI 1.20–1.52], $p < 0.001$; Prediction Interval: 1.14–1.60), despite significant heterogeneity ($I^2 = 83.3\%$, $p < 0.001$) (Fig. 2). Moreover, a randomised controlled study [29] indicated that for each additional hour of social media usage, the depression symptom score increased by 0.64 units (95% CI 0.48–0.81; Prediction Interval:0.43–0.90) (Table 1).

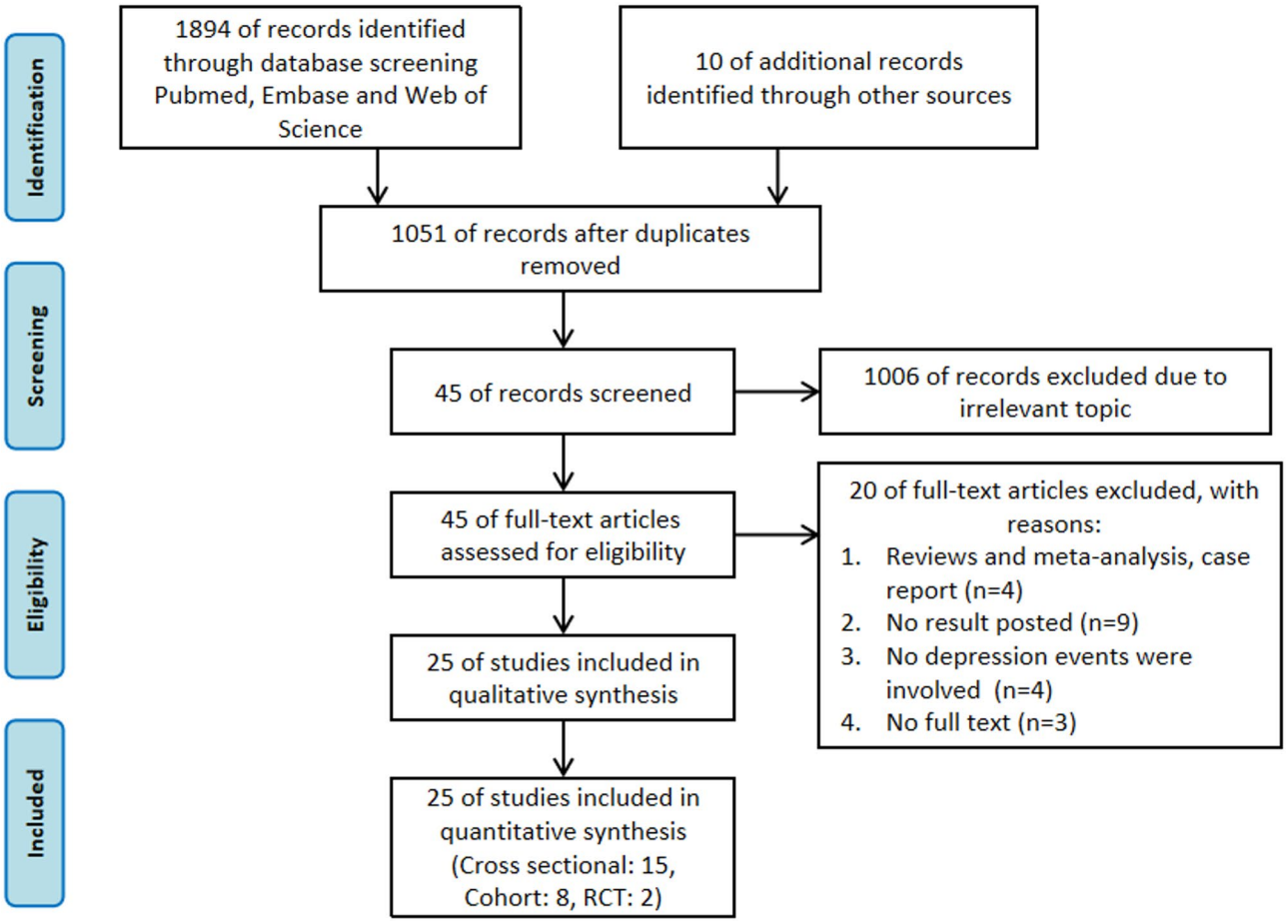

Fig. 1 The flow chart of screening studies

Subgroup analysis

To further explore the potential sources of heterogeneity, subgroup analyses were conducted based on sex, country (developed, developing), age (< 16, 16–20, 20–40, > 40), intensity of sedentary behaviour (> 4 h/day, ≤ 4 h/day), and sample sizes (> 5,000, ≤ 5,000). The results revealed that compared to all participants, female participants (OR 1.43 [95% CI 0.94–2.18], $p = 0.09$) did not show a significantly higher risk of depression due to sedentary behaviour (Table 2). As shown in Table 2, we found that participants from developed countries (OR 1.13 [95% CI 1.04–1.23], $p = 0.003$) who engaged in longer periods of sedentary behaviour had a lower risk of depression compared with that of individuals from developing countries (OR 1.50 [95% CI 1.18–1.91], $p = 0.001$). Both analyses exhibited significant heterogeneity (developed countries, $I^2 = 95.4\%$, $p < 0.001$; developing countries, $I^2 = 63.2$, $p = 0.001$). Furthermore, we found that the risk of depression associated with sedentary behaviour varied across age groups. Compared with those with shorter sedentary behavior times, participants aged 16–20 years had the highest risk (OR 1.69 [95% CI 1.47–1.93], $p < 0.001$; $I^2 = 7.8\%$, $p = 0.338$), followed by those under 16 (OR 1.43 [95% CI 1.37–1.72], $p < 0.001$; $I^2 = 28.8\%$, $p = 0.238$) and those 20–40 (OR 1.05 [95% CI 1.00–1.10], $p = 0.032$; $I^2 = 0\%$, $p = 0.684$). Participants over 40 did not show significant differences (OR 1.14 [95% CI 0.99–1.31], $p = 0.073$; $I^2 = 65.3\%$, $p = 0.013$) (Table 2).

Regarding sedentary behaviour time, 12 studies used > 4 h/day as the reference group, with a pooled OR of 1.25 (95% CI 1.12–1.39; $p < 0.001$), and high heterogeneity ($I^2 = 90.9\%$). Eight studies used ≤ 4 h/day as the reference group, with a pooled OR of 1.36 (95% CI 1.16–1.60; $p < 0.001$), and high heterogeneity ($I^2 = 81.8\%$) (Table 2). Considering whether the sample size might influence the results, seven studies with a sample size > 5,000 had a pooled OR of 1.36 (95% CI 1.11–1.61; $p = 0.004$), with high heterogeneity ($I^2 = 91.9\%$). Seventeen studies with a sample size ≤ 5,000 had a pooled OR of 1.26 (95% CI 1.15–1.38; $p < 0.001$), with high heterogeneity ($I^2 = 84.5\%$) (Table 2).

Publication bias

A funnel plot was used to assess publication bias. The effect size OR did not exhibit clear symmetry, and some studies fell outside the funnel plot (Supplementary

Table 1 Characteristics of included studies

Author	Year	Country	Women (%)	Age	Sample size	Depression indicator	Sedentary behavior indicator	Categories	Study design	Quality score	Outcome(s)
Primack	2009	USA	47.5	21.8 ± 1.8	4142	CES-D (20-item)	Self-report hours of exposure to electronic media	Continuous	Cohort	Strong	OR:1.05,95%CI: 1.00-1.10
Wang	2019	China	45.8	15.38 ± 1.74	1062	SDS	Questionnaires survey	> 2 h	Cross sectional	Moderate	OR:1.431,95%CI: 1.027–1.994
Boers	2019	Canada	47	12.7 ± 0.5	3826	Brief Symptoms Inventory	Rosenberg Self Esteem Scale	Continuous	RCT	Strong	1-hour increase in socialmedia use: 0.64-unit(95% CI, 0.48–0.81) depression symptoms
Song	2020	China	NR	11.56 ± 2.42	5959	Adolescent Self-Rating Life Events Checklist	Strengths and Difficulties Questionnaire	> 2 h	Cross sectional	Moderate	OR:1.39,95%CI: 1.16–1.67
Cao	2011	China	47.9	13.2 ± 1.00	5003	NR	Self-administered questionnaire	2 h	Cross sectional	Moderate	OR:1.52,95%CI: 1.31–1.76
Tilden	2023	USA	58.6	15.9 ± 1.3	29	PHQ-9	Questionnaire	NR	Cohort	Weak	OR:0.5,95%CI: 0.2–1.8
Zhu	2018	China	36.8	61.1 ± 9.6	4043	PHQ-9	Subjects' self-reported	Occasionally	RCT	Moderate	OR:1.33,95%CI: 0.81–2.17
Teychenne	2010	Australia	NR	18–45	3645	CES-D (10-item)	Self-reported time	1 h	Cross sectional	Strong	OR:1.12,95%CI: 0.93–1.35
Vallance	2010	Australia	50.5	45.7 ± 13.7	2862	PHQ-9	ActiGraph AM-7164 accelerometer	> 4 h	Cross sectional	Strong	OR:0.86,95%CI: 0.47–1.59
Lucas	2011	USA	NR	30–55	49,821	Clinical depression	Self-reported time	1 h	Cohort	Weak	OR:1.05,95%CI: 0.94–1.18
Thomée	2012	Sweden	41.6	20–24	4163	Self-reported symptoms	Self-reported time	2 h	Cohort	Strong	OR:1.20,95%CI: 0.87–1.65
Breland	2013	USA	100	18–96	535	PHQ-8	Self-reported time	> 4 h	Cross sectional	Weak	OR:2.38,95%CI: 1.39–4.07
Sloan	2013	Singapore	51.1	18–79	4337	GHQ-12	GPAQ v2	2 h	Cross sectional	Strong	OR:1.29,95%CI: 1.04–1.60
Van	2013	Australia	100	50–55	8950	CES-D (10-item)	Self-reported time	> 4 h	Cohort	Moderate	OR:1.17,95%CI: 1.04–1.31
Arredondo	2013	USA	NR	43.4 ± 16.9	397	PHQ-9	GPAQ	Continuous	Cross sectional	Strong	OR:1.10,95%CI: 1.00-1.20
Feng	2014	China	42.6	18.9 ± 0.9	1106	SDS	Self-reported time	2 h	Cross sectional	Strong	OR:1.49,95%CI: 1.05–2.12
Wu	2015	China	58.4	19.26 ± 1.40	4747	CES-D	Self-reported time	2 h	Cross sectional	Strong	OR:1.86,95%CI: 1.55–2.23
Sui	2015	China	21.1	18–80	4802	CES-D (10-item)	Self-reported time	Continuous	Cohort	Moderate	OR:1.02,95%CI: 1.01–1.03
Wu#	2016	China	NR	18.43 ± 0.96	2521	CES-D (20-item)	Self-reported time	2 h	Cross sectional	Strong	OR:1.55,95%CI: 1.25–1.93
Padmapriya	2016	Singapore	100	30.7 ± 5.1	1144	EPDS	Self-reported time	> 4 h	Cohort	Strong	OR:1.22,95%CI: 0.69–2.16
Madhav	2017	USA	49.95	20–74	3201	PHQ-9	Self-reported time	> 4 h	Cross sectional	Strong	OR:1.96,95%CI: 1.43–2.68
Barros	2017	Brazil	52.1	18–59	49,025	PHQ-9	Self-reported time	> 4 h	Cross sectional	Strong	OR:2.13,95%CI: 1.80–2.52

Table 1 (continued)

Author	Year	Country	Women (%)	Age	Sample size	Depression indicator	Sedentary behavior indicator	Categories	Study design	Quality score	Outcome(s)
Nam	2017	South Korea	59.86	≥ 20	4145	PHQ-9	Self-reported time	> 4 h	Cross sectional	Strong	OR:0.83,95%CI: 0.45–1.53
Hallgren	2018	Sweden	64.1	51.6 ± 16.1	40,569	Clinical diagnosis	Self-reported time	> 4 h	Cohort	Moderate	OR:0.93,95%CI: 0.79–1.10
Stubbs	2018	China, Ghana, India, Mexico, Russia, and South Africa	50.1	43.8 ± 14.4	42,469	WMHCIDI	Self-reported time	> 4 h	Cross sectional	Strong	OR:1.94,95%CI: 1.32–2.86

RCT: Randomized Controlled Trial, NR: no report, OR: odds ratio, CI: confidence interval, h/d: hours/day

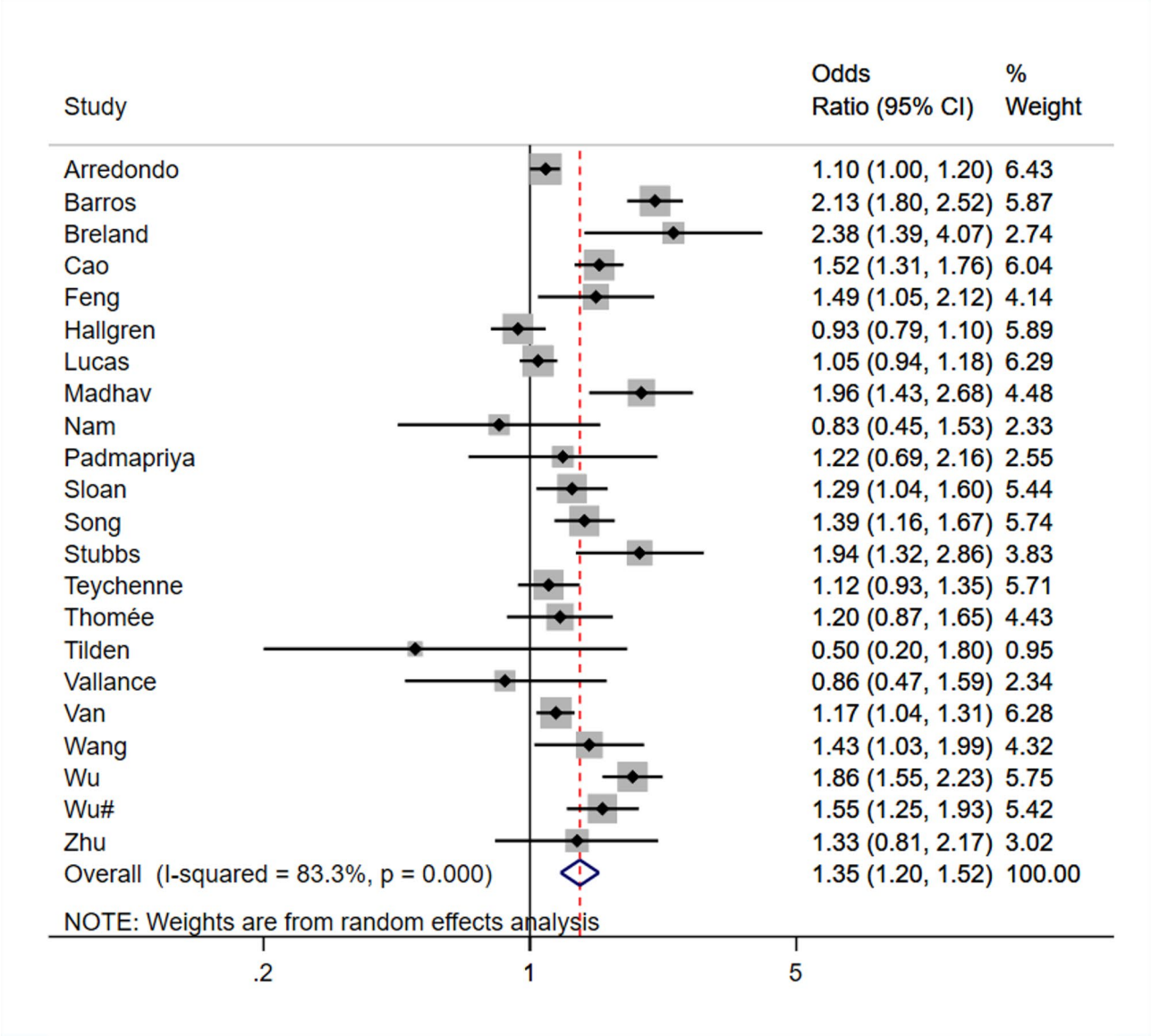

Fig. 2 The forest plots of the odds ratio (OR) and 95% CIs for the relationship between sedentary behavior and depression. Tau-squared value = 0.0520

Table 2 The subgroup analysis of the relationship between sedentary behavior and depression

Subgroup	No. of studies	MD (95% CI)	*P* value	Heterogeneity		Prediction Interval	Tau-squared Value	Egger's Value
				I2 (%)	*P* value			
Gender								
Women	3	1.43[0.94, 2.18]	0.09	68.8	0.04	[0.79–2.59]	0.094	0.484
Country								
Developing country	9	1.50[1.18,1.91]	0.001	95.4	< 0.001	[1.06–2.11]	0.12	0.003
Developed country	14	1.13[1.04,1.23]	0.003	63.2	0.001	[1.00-1.27]	0.01	0.264
Age								
< 16	4	1.43[1.24,1.65]	< 0.001	28.8	0.239	[1.17–1.75]	0.006	0.118
16–20	3	1.69[1.47,1.93]	< 0.001	7.8	0.338	[1.39–2.04]	0.001	0.467
20–40	4	1.05[1.00,1.10]	0.032	0	0.684	[0.98–1.12]	0.001	0.761
> 40	6	1.14[0.99,1.31]	0.073	65.3	0.013	[0.93–1.39]	0.016	0.635
Sedentary behavior time								
> 4 h/d	12	1.25[1.12,1.39]	< 0.001	90.9	< 0.001	[1.07–1.45]	0.02	0.037
≤ 4 h/d	8	1.36[1.16,1.60]	< 0.001	81.8	< 0.001	[1.09–1.71]	0.04	0.37
Sample size								
> 5000	7	1.36[1.11,1.68]	0.004	91.9	< 0.001	[1.02–1.83]	0.07	0.276
≤ 5000	17	1.26[1.15,1.38]	< 0.001	84.5	< 0.001	[1.11–1.43]	0.017	0.004

OR: odds ratio, CI: confidence interval, h/d: hours/day

Fig. 1). Therefore, the possibility of publication bias cannot be disregarded. Egger's ($p = 0.27$) and Begg's ($p = 0.91$) tests were used to verify publication bias. The results indicated no significant publication bias (Supplementary Fig. 2).

Sensitivity analysis

After adjustments, the sensitivity analysis of the relationship between sedentary behaviour and depression revealed that no study significantly impacted the final pooled OR value (Supplementary Fig. 3).

Discussion

In this study, we investigated the impact of sedentary behaviour on the risk of depression under various factors. We found that participants under the age of 20 had a greater risk of developing depression due to sedentary behaviour compared with that in other groups. This study also found that sedentary behaviour times of > 4 h/day or ≤ 4 h/day pose a higher risk of depression for participants.

Several mechanistic studies have attempted to explain the relationship between sedentary behaviour and the risk of depression. Luban et al. have proposed a series of related studies on neurobiological, psychosocial, and behavioural mechanisms [53]. Research indicates that participation in physical activity enhances cognitive and mental health by altering the structure and functional composition of the brain [54]. Reducing sedentary behavior may be beneficial for reducing negative emotions [55]. Additionally, sedentary behaviour, accompanied by a reduction in activity levels, leads to changes in mental health outcomes that are mediated by alterations in related behaviours, particularly those affecting sleep duration and quality [56]. Interestingly, studies suggest that decreased brain-derived neurotrophic factor (BDNF) levels are associated with an increased risk of depression [57, 58]. BDNF is a key molecule that regulates neuroplasticity; it can promote neuronal growth, synaptic formation, and functional maintenance; and plays a crucial role in emotional regulation and cognitive function repair [59]. A decline in BDNF levels may lead to dysfunction of the hypothalamic-pituitary-adrenal axis, increasing cortisol release, which further impairs neuronal function and exacerbates depressive symptoms [60]. In contrast, prolonged sedentary behavior can disrupt the levels of BDNF, leading to issues such as central nervous system arousal disorders and sleep disturbances [61, 62]. Moreover, sedentary behaviour has also been shown to be associated with obesity [63]. The results of this study indicated that participants with longer sedentary behaviour times had a significantly higher risk of depression than the risk in those with shorter sedentary behaviour times (OR 1.35, $p < 0.001$). Therefore, effectively avoiding sedentary behaviour is a strategy worth considering.

Wang et al. and Huang et al. [17] only included cohort, cross-sectional, or prospective studies in their meta-analysis. In this study, we expanded the scope to include randomised controlled trials, thereby increasing the reliability of our results. Notably, compared with the studies by Zhou et al. [19] and Jiang et al. [20], we conducted a more detailed stratification of the participants' ages. We found that participants under the age of 20 were at a greater risk of developing depression due to sedentary behaviour. Hoare et al. [64] and Rodriguez-Ayllon et al.

[55] demonstrated in their studies a significant positive correlation between sedentary behaviour and depressive symptoms in adolescents. This result is consistent with the findings of the present study. Furthermore, the association between sedentary behaviour and depression may be bidirectional. Therefore, more experiments are needed to explore the link between sedentary behaviour and depression and clarify their causal relationship.

In the subgroup analysis, we found that, regarding sedentary behaviour, participants from developed countries have a lower risk of depression compared with the risk of those from developing countries. This may be associated with the medical systems or mental health resources available in these countries. Herrman et al. [65] indicated that the types and prevalence of depressive symptoms and early signs varied greatly across different cultures and contexts. Additionally, we found that long and short durations of sedentary behaviour can greatly increase the risk of depression (>4 h/day: OR 1.25 95% CI 1.12–1.39; ≤ 4 h/day: OR 1.36 95% CI 1.16–1.60). Appropriately increasing physical activity can help reduce the occurrence of depression and the risk of obesity and cardiovascular diseases [15, 16]. Given that depression is a common but under-recognized illness, further research is necessary on the risk of depression and the impact of different types of sedentary behaviours such as watching television, using computers and the internet for work, and playing video games. This can better facilitate the prevention of depression.

Furthermore, we found that the risk of depression as it relates to sedentary behavior varied across age groups. The highest risk was observed in individuals aged 16–20 years, followed by those under 16, those over 40, and those 20–40. The link between sedentary behaviour and depression in older adults is associated with the type of sedentary activity, and mentally active sedentary behaviours may reduce the risk of depression [20]. Adolescents often have relatively long screen times, with certain sedentary behaviours (such as watching TV or using smartphones) significantly increasing the risk of depression in individuals under 20 [21].

The heterogeneity in this study was more pronounced in the subgroup analysis. The I^2 statistic fluctuated particularly significantly in groups stratified by age and country. However, neither the publication bias assessment nor the sensitivity analysis indicated that any single study significantly influenced the final pooled ORs value. This may be related to the establishment of depression measurement criteria. Studies using screening tools (such as the PHQ-9) may include more individuals with mild or subclinical symptoms, thereby magnifying the association between sedentary behavior and depression. In addition, the cut-off values of different scales (such as the CES-D) may also affect the consistency of the results. Future studies need to adopt a consistent definition of sedentary behavior and the gold standard for depression diagnosis to reduce the heterogeneity of studies.

This study has certain limitations. First, although randomised controlled trials were included, the number of studies was relatively small, with the majority being cross-sectional and cohort studies. This is highly unfavourable for exploring the causal relationship between sedentary behaviour and depression. Second, regarding the indicators of sedentary behaviour, most studies used self-reported time, which might have involved certain memory biases and subjectivity. Finally, some uncontrollable factors could have also affected the results. For instance, some participants might have underreported their conditions owing to the stigma associated with mental illness, leading to potential biases. Therefore, multicentre, randomised controlled trials should be conducted in the future.

Conclusion

We found that sedentary behaviour significantly increases the risk of depression, especially in individuals under the age of 20. Engaging in appropriate exercise and reducing sedentary behaviour can be beneficial to prevent depression.

Abbreviations

PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
OR	Odds Ratio
CI	Confidence Interval
MD	Mean differences
SMD	Standardized mean differences
BDNF	Brain-derived neurotrophic factor

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-23418-4.

Supplementary Material 1

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Author contributions

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Data availability
Data sharing is not applicable to this article as no datasets were generated or analyzed during the current study.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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