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Prolonged Standing and Low Back Pain Among Workers: A Systematic Review

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Abstract

Background: Prolonged standing is a common occupational demand across multiple sectors and has been identified as a potential risk factor for low back pain (LBP), one of the most prevalent work-related musculoskeletal disorders. However, evidence regarding this association remains inconsistent.

Objective: This study aimed to systematically evaluate the association between prolonged standing and low back pain among workers.

Methods: A systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Five databases—Google Scholar, PubMed, ProQuest, Scopus, and ScienceDirect—were searched for studies published between 2016 and 2026. Eligible studies employed a cross-sectional design and examined prolonged standing as an exposure variable for LBP. Methodological quality was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist.

Results: Eight studies met the inclusion criteria. Six studies (75%) reported a statistically significant association between prolonged standing and LBP ($p < 0.05$), with adjusted odds ratios ranging from 1.24 to 8.19. Significant associations were most consistently observed among teachers, healthcare professionals, and food service workers with longer work experience. The remaining two studies reported non-significant findings, likely due to confounding factors and heterogeneity in exposure definitions and measurement methods. Based on the Oxford Centre for Evidence-Based Medicine (OCEBM) 2011 criteria, the evidence was classified as Level 3 with moderate certainty.

Conclusion: Prolonged standing is associated with low back pain among workers, although the strength of this relationship varies depending on methodological and population factors. Workplace interventions targeting posture variation and exposure reduction are recommended.

Keywords
low back pain; musculoskeletal disorders; occupational health; prolonged standing; workers

Introduction

Work is central to the lives of individuals, organisations, and society at large. In many occupational settings, workers are required to maintain a standing position for extended periods with little opportunity to sit or ambulate during their shifts.[1] The Fifth European Survey of Working Conditions estimated that 47% of workers spend more than 75% of their working hours on their feet.[2] Although comparable national data for Indonesia remain unavailable, this figure is broadly consistent with estimates from Australia, where approximately 62% of the workforce stands for most of the working day.[3] Occupations such as those in manufacturing, healthcare, retail, food and beverage services, and education commonly require sustained standing, and roles including cashiers, pharmacists, and cooks are structurally incompatible with seated work.[4] A worker who stands for more than half of the working shift is generally considered to be engaged in prolonged standing,[1] an exposure that has been associated with an elevated risk of several adverse health outcomes, including low back pain.[5]

Low back pain has emerged as one of the leading causes of disability worldwide. The World Health Organization identifies it among the three conditions most responsible for years lived with disability, affecting four out of every five individuals at some point during their lives.[6] In 2020, the global burden of low back pain was estimated at 619 million cases, a figure projected to rise to approximately 843 million by 2050.[7] In Indonesia, the Ministry of Health has reported that 18% of the population experience low back pain and that between 3% and 17% of hospital visits are attributed to this condition.[8] The National Safety Council documented approximately 1,700,000 occupationally related low back pain cases globally, representing 22% of the world's working population.[9] An analysis drawing on Global Burden of Disease data further established that occupational factors accounted for 22.1% of all low back pain occurrences globally in 2021.[10]

Low back pain is a multifactorial musculoskeletal condition that affects virtually every segment of the population and ranks among the most prevalent causes of work-related disability. Its incidence increases with advancing age and is higher in women.[5] Based on symptom duration, low back pain is classified as acute (less than six weeks), subacute (six to twelve weeks), or chronic (more than twelve weeks).[11] Contributing factors span individual, occupational, and psychosocial domains. Beyond age and sex, individual risk factors include obesity, smoking, and sedentary behaviour, while occupational contributors include excessive workload and poor ergonomic conditions. Psychosocial stressors such as depression and anxiety are similarly implicated in its aetiology.[5]

Evidence regarding the relationship between prolonged standing and low back pain is mixed. A laboratory-based systematic review of 25 studies demonstrated that sustained standing induces low back pain symptoms in healthy individuals unaccustomed to prolonged static postures.[3] An observational study among restaurant workers identified a statistically significant association between prolonged standing and low back pain,[12] whereas a subsequent cross-sectional study found no such relationship.[13] This inconsistency is primarily attributable to the lack of a consensus operational definition of prolonged standing—durations in the literature range from as little as 10 minutes to over four hours. The predominance of cross-sectional designs further limits the capacity to establish temporal

or causal inference. An earlier narrative review examined the relationship between prolonged standing and low back pain but was not restricted to a specific occupational population and lacked a standardised quality appraisal methodology.[9] The absence of rigorous risk-of-bias evaluation in that review may have allowed lower-quality studies to disproportionately influence its conclusions.

Despite the high occupational demand for prolonged standing across numerous sectors and the well-documented prevalence of low back pain among workers, a comprehensive systematic review focused specifically on this association—guided by standardised appraisal methods and restricted to occupational populations—has not been published. The present study therefore aimed to systematically synthesise the available evidence on the association between prolonged standing and low back pain among workers, with methodological quality assessed using a validated appraisal instrument.

Methods

This study employed a systematic literature review design, conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The review was not prospectively registered in PROSPERO. A systematic literature search was conducted across five electronic databases: Google Scholar, PubMed, ProQuest, Scopus, and ScienceDirect, using Publish or Perish (PoP) software to facilitate retrieval. The search strategy combined Medical Subject Headings (MeSH) terms and free-text keywords using Boolean operators (AND, OR, NOT): ("prolonged standing" OR "berdiri lama") AND ("low back pain" OR "nyeri punggung bawah") AND ("workers" OR "pekerja"). The literature search was last updated in February 2026.

Studies were included if they: (1) were published between 2016 and 2026; (2) were written in Indonesian or English; (3) examined the association between prolonged standing and low back pain as a primary or secondary exposure in a working population; and (4) employed a cross-sectional study design. Studies were excluded if: (1) full-text access was unavailable; (2) they were published outside the defined period; (3) they were not written in Indonesian or English; (4) they were theses, dissertations, or literature reviews; (5) they did not examine the association between prolonged standing and low back pain among workers; or (6) they used designs other than cross-sectional.

Study selection proceeded through four sequential phases: (1) duplicate removal, (2) title screening, (3) abstract screening, and (4) full-text eligibility assessment, structured according to the Population, Exposure, Comparison, and Outcome (PECO) framework. The PECO elements were operationally defined as follows (Table 1). Screening was performed independently by two reviewers, with eligibility discrepancies resolved by consensus-based discussion. The selection process was documented using a PRISMA flow diagram.

Table 1. PECO Framework for Study Eligibility

Element	Definition
Population	Adult workers in any occupational sector
Exposure	Prolonged standing (defined as standing for >2 hours or a substantial proportion of the work shift)
Comparison	Workers with no or minimal prolonged standing exposure
Outcome	Prevalence or incidence of low back pain (LBP)

Methodological quality of each included study was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies, comprising eight criteria (D1–D8). Two reviewers independently rated each study, with disagreements resolved through discussion. The criteria addressed: (D1) clarity of inclusion criteria, (D2) detailed description of participants and setting, (D3) validity and reliability of exposure measurement, (D4) use of objective and standardised outcome criteria, (D5) identification of confounding factors, (D6) description of strategies to address confounding, (D7) validity and reliability of outcome measurement, and (D8) appropriateness of statistical analyses.

Data extracted from each included study comprised: first author and year of publication, country, study design, sample size, population characteristics, operational definition of prolonged standing, study objective, and main outcomes including statistical measures of association. Because of substantial heterogeneity in study populations and exposure definitions, a meta-analysis was not feasible; findings were therefore synthesised narratively using a qualitative approach. Statistical significance was defined as $p < 0.05$. Ethical approval was not required for this review, as it was based exclusively on previously published data.

Results

The database search yielded 739 records, of which 587 were successfully imported into Mendeley for screening. Following duplicate removal and title screening, 194 records proceeded to abstract screening. Of these, 47 articles met the abstract-level criteria and were retrieved in full text for eligibility assessment. A total of 39 studies were subsequently excluded on the grounds of restricted access (n = unavailable full text), ineligible study design or publication type, non-eligible language, or irrelevant outcomes. The remaining eight studies were subjected to JBI methodological appraisal; all met the minimum quality threshold (JBI scores: 5/8 to 8/8) and were included in the final synthesis (n = 8). The selection process is presented in Figure 1.

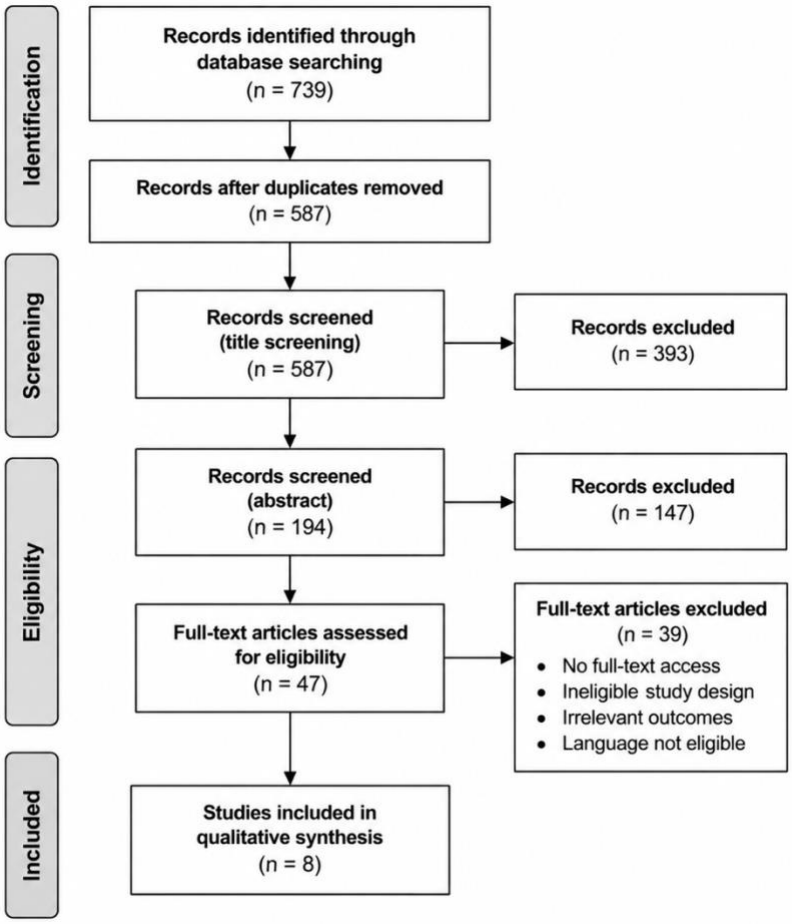

Figure 1. PRISMA Flow Diagram of Study Selection

The included studies demonstrated high methodological quality, with JBI scores ranging from 5/8 to 8/8. Seven of the eight studies (87.5%) attained a score of 7/8 or higher, placing them in the "high quality" or "above average" categories. Strengths common across studies included clearly defined inclusion criteria, detailed descriptions of participants and settings, and the use of appropriate statistical analyses. A notable and consistent methodological limitation was the measurement of exposure: 87.5% of studies relied on self-reported data rather than objective or validated instruments to quantify prolonged standing. Despite this limitation, no studies were excluded on grounds of low methodological quality. The overall low risk of bias and consistency of findings across the high-quality studies support a moderate to high degree of certainty in the synthesised evidence. A detailed summary of the risk of bias assessment for each included study is presented in Table 1.

Tabel 1. Risk of Bias Visualisation Based on JBI Criteria (D1–D8)

Study (Author, Year)	D1	D2	D3	D4	D5	D6	D7	D8	Score	%	Quality
Gemedo et al., 2023	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	7/8	87.5	High
Madeni et al., 2024	Yes	Yes	No	No	Yes	Yes	No	Yes	5/8	62.5	Moderate
Yalew et al., 2022	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	7/8	87.5	High
Tsegay et al., 2021	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	7/8	87.5	High
Negash et al., 2022	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	7/8	87.5	High
Tesfaye et al., 2025	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	7/8	87.5	High
Locks et al., 2018	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8/8	100	High
Kebede et al., 2019	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	7/8	87.5	High

Legend: D1 = inclusion criteria clearly defined; D2 = study subjects and setting described in detail; D3 = exposure measured in a valid and reliable way; D4 = objective, standard criteria used for condition measurement; D5 = confounding factors identified; D6 = strategies to deal with confounding factors stated; D7 = outcomes measured in a valid and reliable way; D8 = appropriate statistical analysis used.
Quality classification: High = ≥75% (≥6/8 items fulfilled); Moderate = 50–74% (4–5/8 items fulfilled); Low = <50% (<4/8 items fulfilled).

The eight included studies were conducted across diverse geographical settings, with the majority originating from Ethiopia. Studies varied in sample size (n = 314 to n = 698) and occupational population, encompassing teachers, healthcare professionals, food service workers, hospital cleaners, hairdressers, and blue-collar workers. All studies used cross-sectional designs. The extracted data are summarised in Table 2.

Table 2. Characteristics and Main Outcomes of Included Studies

Author(s)/Year	Sample (n)	Exposure Definition	Objective	Main Outcomes
Gemedo et al. (2023)	602	Standing ≥50% of total working hours per shift	To assess factors associated with low back pain among teachers	Significant association: AOR = 2.31 (95% CI: 1.16–4.60); p < 0.05
Madeni et al. (2024)	438	Standing >1 h without a break	To examine occupational exposures among hospital cleaning workers	No significant association with LBP (p = 0.319)
Yalew et al. (2022)	420	Standing >4 h	To determine prevalence and associated factors of LBP among wait staff	Significant association: AOR = 8.82 (95% CI: 3.30–20.32); p < 0.001
Tsegay et al. (2021)	314	Standing in a confined area for ≥2 h while performing tasks	To assess factors associated with LBP among hairdressers	No significant association (p = 0.977; 95% CI: 0.35–2.99)
Negash et al. (2022)	423	Standing in a restricted space for ≥2 h without changing position	To assess prevalence and associated factors of LBP among healthcare professionals	Significant association: AOR = 2.61 (95% CI: 1.49–4.60); p < 0.01
Amensisa et al. (2025)	636	Standing in a restricted space for ≥2 h without changing position	To assess prevalence and associated factors of LBP among academic staff	Significant association: AOR = 1.63 (95% CI: 1.03–2.59); p = 0.036
Locks et al. (2018)	698	Uninterrupted standing for >10 min (objectively measured via accelerometer)	To investigate the association between static standing and LBP among blue-collar workers	Significant association (total day): AOR = 1.24 (95% CI: 1.05–1.46); p = 0.01; no significant association during work or leisure time separately
Kebede et al. (2019)	611	Standing for ≥2 h	To assess factors associated with LBP among primary school teachers	Significant association: AOR = 4.78 (95% CI: 3.75–9.32)

AOR = adjusted odds ratio; CI = confidence interval; LBP = low back pain.

Six of the eight included studies (75%) reported a statistically significant positive association between prolonged standing and low back pain ($p < 0.05$). The magnitude of effect varied considerably across studies, with adjusted odds ratios ranging from 1.24 (95% CI: 1.05–1.46) among blue-collar workers[14] to 8.82 (95% CI: 3.30–20.32) among wait staff.[15] Other significant associations were documented among healthcare professionals (AOR = 2.61),[16] high school teachers (AOR = 2.31),[17] primary school teachers (AOR = 4.78),[18] and academic staff (AOR = 1.63).[19] Two studies reported no significant association between prolonged standing and low back pain.[15,17] The high between-study heterogeneity in population characteristics and exposure definitions precluded meta-analytic pooling; a narrative synthesis was therefore performed.

Discussion

This systematic review synthesised evidence from eight cross-sectional studies examining the association between prolonged standing and low back pain among diverse working populations. The predominance of significant findings—75% of included studies—supports the notion that prolonged standing constitutes a meaningful occupational risk factor for low back pain, consistent with prior laboratory-based evidence demonstrating symptom provocation during sustained static postures.[3] However, the substantial variability in effect size (AOR: 1.24–8.82) warrants careful interpretation.

Among teachers, the evidence was particularly consistent. Gemedo et al. reported that 85.4% of high school teachers experienced low back pain, with those standing for at least 50% of their shift demonstrating a 2.31-fold increased risk compared with non-exposed colleagues (AOR = 2.31; 95% CI: 1.16–4.60).[14] This finding aligns with those of Kebede et al., who identified an even greater risk among primary school teachers (AOR = 4.78; 95% CI: 3.75–9.32), with 76.5% of the study population affected.[18] The particularly high burden in this occupational group is plausible given that classroom instruction inherently requires sustained static postures without structured ergonomic support.

A similarly elevated risk was demonstrated among food service workers. Yalew et al. reported that 69.3% of wait staff experienced low back pain, and those standing for more than four hours were nearly nine times more likely to report this complaint (AOR = 8.82; 95% CI: 3.30–20.32)—the highest effect size identified in this review.[15] Among healthcare professionals, Negash et al. found prolonged standing to be the second most prevalent occupational exposure (74.4%), associated with a 2.61-fold increased risk of low back pain (95% CI: 1.49–4.60).[16] Among academic staff, Amensisa et al. reported a lower but still statistically significant association (AOR = 1.63; 95% CI: 1.03–2.59), with approximately 55.9% of the sample reporting low back pain in the preceding twelve months.[19]

The pathophysiological basis for the association between prolonged standing and low back pain is multifactorial. Sustained static loading of the lumbosacral structures promotes joint hypomobility, pelvic retroversion, increased lumbar lordosis, and degenerative changes in the intervertebral discs. These postural adaptations generate myofascial tension and spasm in the paraspinal musculature, which may directly activate spinal nociceptors.[16] Furthermore, sustained muscular contraction reduces local perfusion, precipitating ischaemic conditions: deprived of adequate oxygen and glucose, muscle fibres shift toward anaerobic metabolism, resulting in lactic acid accumulation, progressive acidification, and heightened nociceptive sensitivity. This metabolic

cascade ultimately manifests as the dull aching and generalised back discomfort characteristic of prolonged-standing-related low back pain.[9,19,20]

The two studies that did not demonstrate a significant association offer important insights into the complexity of this relationship. Madeni et al. examined hospital cleaners—a population characterised by highly varied physical demands—and found that while low back pain was the most prevalent musculoskeletal complaint (42%), prolonged standing (>1 h without a break) was not independently associated with it (p = 0.319).[21] Instead, exposures including heavy lifting (47.3%), stair climbing (48.3%), and failure to take adequate breaks (46.1%) emerged as significant predictors. This pattern suggests that in occupations with multiple concurrent ergonomic stressors, the specific contribution of prolonged standing may be attenuated or masked when other exposures exert stronger independent effects.

Tsegay et al. similarly found no significant association among hairdressers (p = 0.977), despite 89.2% of workers reporting prolonged standing exposure and 50% experiencing low back pain.[17] In that cohort, static posture (47.3%), awkward posture (55.3%), and absence of rest breaks (47.7%) were more strongly associated with low back pain. Taken together, these findings suggest that in populations exposed to a complex constellation of ergonomic risk factors, prolonged standing may function as a contributing rather than a dominant determinant.

The study by Locks et al. warrants particular attention due to its methodological distinction: it was the only included study to use objective accelerometry rather than self-report to quantify standing time.[14] The authors stratified analyses by domain (work time, leisure time, and total day), finding that prolonged standing during work (95% CI: −0.07 to 0.46; p = 0.15) and leisure time (95% CI: −0.22 to 0.60; p = 0.36) were not independently significant, whereas total-day standing was (AOR = 1.24; 95% CI: 1.05–1.46; p = 0.01). This domain-specific heterogeneity likely reflects differences in biomechanical loading: occupational standing entails constrained trunk postures and task-specific arm movements, while leisure-time standing is typically interspersed with more varied postural transitions. The failure to account for these contextual differences in other studies may partially explain the divergence in reported findings.

A key contributor to the variability in findings across studies is the absence of a consensus operational definition for prolonged standing. Threshold durations ranged from 10 minutes to more than four hours across the eight studies, rendering direct comparisons unreliable. The reliance on self-reported exposure in 87.5% of studies introduces recall bias, whereby participants may systematically over- or underestimate their actual standing time. This limitation is particularly consequential given that self-reported and objectively measured standing durations have been shown to differ substantially.[14]

Population characteristics also appeared to moderate the association. Studies reporting significant associations tended to include workers aged 30 years or older with five to ten years of occupational experience—groups likely to have accumulated cumulative spinal loading over time. In contrast, populations with shorter tenure or younger age profiles may not yet have reached the threshold of structural or functional compromise at which prolonged standing translates to clinically manifest low back pain. Unmeasured confounders—including repetitive flexion, trunk rotation, manual material handling, and psychosocial stressors—coexisting with prolonged standing in high-risk occupations further complicate the isolation of standing as an independent risk factor.

The weight of evidence supports a clinically meaningful association between prolonged standing and low back pain, with implications for both preventive and therapeutic practice in occupational physiotherapy. Workplace policies should be recalibrated to reduce cumulative static spinal loading. For occupations permitting postural flexibility, alternating between sitting and standing every 30 minutes has been shown to attenuate trunk stiffness, redistribute intervertebral disc pressure, and reduce self-reported low back discomfort.[22] For workers in fixed-standing roles—such as food service and cleaning personnel—structured micro-breaks of two to five minutes every 30 to 60 minutes, incorporating targeted lower-limb and lumbar stretching or brief seated rest, are recommended to mitigate fatigue and musculoskeletal discomfort.[23] Sit-stand workstations should be considered where feasible, particularly in educational and healthcare environments. Work shift rotation and job task diversification offer additional organisational strategies to distribute postural load across muscle groups and reduce sustained static exposure.

This review has several methodological strengths. The search strategy was comprehensive, encompassing five major databases, and was guided by PRISMA methodology. All included studies demonstrated acceptable to high methodological quality (JBI scores: 5/8 to 8/8), and the diversity of occupational sectors represented—spanning healthcare, education, food services, and manual labour—enhances the breadth of evidence synthesised.

Several limitations should be acknowledged. All included studies used cross-sectional designs, which preclude the establishment of temporality or causality. The heterogeneity of exposure definitions across studies limits comparability and prevented meta-analytic synthesis. Reliance on self-reported standing time in the majority of studies introduces measurement error and susceptibility to recall bias. Furthermore, although several studies adjusted for key confounders, unmeasured ergonomic co-exposures—including repetitive trunk bending, awkward postures, and manual material handling—likely coexist with prolonged standing in many of the study populations, making it difficult to attribute the observed associations exclusively to standing exposure. Finally, the predominance of studies from Ethiopian settings may limit generalisability to other occupational and cultural contexts.

Future research should prioritise longitudinal cohort designs to establish the temporal relationship between prolonged standing and low back pain. Standardisation of the operational definition of prolonged standing—ideally validated against objective wearable sensor data—is essential to enable cross-study comparisons. Randomised controlled trials evaluating targeted interventions, including scheduled micro-breaks, ergonomic workstation modifications, and sit-stand protocols in occupational settings, are warranted to inform evidence-based preventive practice.

Conclusion

This systematic review provides evidence that prolonged standing is positively associated with low back pain among workers across multiple occupational sectors, with six of eight included studies (75%) demonstrating statistically significant associations. The strength of this association, however, varies considerably depending on the operational definition and measurement approach used to quantify prolonged standing, the presence of concurrent ergonomic exposures, and the demographic and occupational characteristics of the study population. Based on the OCEBM 2011 criteria, this review provides Level 3 evidence with a moderate degree of certainty, supported by high JBI methodological quality scores across the included studies.

From a clinical and public health perspective, these findings underscore the need for proactive workplace interventions targeting postural variation, exposure reduction, and ergonomic redesign—particularly in sectors where prolonged standing is structurally unavoidable. Practical strategies such as sit-stand workstations, structured micro-break protocols, and shift rotation policies should be incorporated into occupational health programmes to mitigate cumulative spinal loading and reduce the burden of

work-related low back pain. Future research employing longitudinal designs, objective exposure measurement, and standardised outcome metrics will be necessary to establish causality and refine evidence-based prevention guidelines.

Author Contribution

Vania Damara Khairunnisa: Conceptualization, Data curation, Writing original draft, Writing review and editing.
Bernadeth Novita Budisusilowati: Writing review and editing.

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Conflict of Interest Statement

The authors declare no conflict of interest.

Funding Sources

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Ethics Statement

Ethical approval was not required for this systematic review, as it draws exclusively on data from previously published studies.

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