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Impact of Screen-based Sedentary Behaviour Among Type 2 Diabetes Mellitus Patients on their Quality of Sleep and Glycaemic Control: A Systematic Review

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ABSTRACT

Introduction: *Nowadays, screen-based sedentary behaviors (SBSB) have become a notably concerning subset of sedentary behavior among all age groups. SBSB is linked to disrupted sleep quality, negatively affecting Type 2 Diabetes Mellitus (T2DM) management. Poor sleep exacerbates insulin resistance and glycaemic control, emphasizing the need for targeted intervention. This review investigates the impact of SBSB on sleep quality in T2DM patients.* ***Methods:*** *A systematic review followed PRISMA guidelines, using databases such as PubMed, Scopus, ScienceDirect, Google Scholar, and Cochrane Library. Studies published between 2019 and 2024 assessing SBSB and sleep quality in T2DM patients were included. The snowball technique was used to enhance the thoroughness of the literature search. The retrieved papers were screened separately by three reviewers according to the eligibility criteria, in phases including title, abstract, and full text. The potential for bias in the included papers was evaluated separately using the critical evaluation checklist from the Joanna Briggs Institute critical appraisal tools. Data from included studies were extracted and presented in the table for analysis by the authors.*

Results: *Out of 360 articles, including abstracts searched and retrieved from the database, 16 studies were reviewed, revealing that prolonged SBSB contributes to poor sleep quality through mechanisms such as circadian rhythm disruption and delayed sleep onset. Poor sleep was associated with reduced insulin sensitivity and worsened glycaemic control. Interventions like reducing sedentary time and incorporating physical activity or sleep hygiene practices significantly improved health outcomes. However, the studies displayed variability in methodologies, and many findings relied on self-reported data, limiting direct comparisons.*

Conclusion: *This review highlights the impact of prolonged exposure of SBSB, especially before bedtime, on sleep quality and T2DM management. Multifactorial interventions, including reducing screen time, promoting physical activity, and improving sleep hygiene, are essential for improving health outcomes.*

Keywords: *Screen-based sedentary behavior, Type 2 Diabetes Mellitus, Sleep quality, Circadian rhythm disruption, Glycaemic control*

INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a significant and growing public health issue, with approximately 463 million adults globally affected, a number expected to rise to 700 million by 2040 (International Diabetes Federation, 2019). T2DM is characterized by persistent hyperglycaemia due to insufficient insulin production or resistance, leading to severe complications such as cardiovascular disease, nephropathy, and neuropathy (Henson *et al.*,

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2020). Alongside these physical problems, individuals with T2DM often suffer from inadequate sleep quality, which complicates disease management by worsening insulin resistance and glycaemic control (Ruiz-Burneo *et al*., 2022; Algethami *et al*., 2024).

Screen-based sedentary behavior (SBSB) has been linked to T2DM (T2DM), and sleep disturbances. Prolonged screen exposure, especially before bedtime, can negatively affect sleep quality due to blue light emission, which disrupts melatonin production and alters circadian rhythms (You, C. & Cui, Y. 2024). The quality of sleep, which includes aspects such as duration, efficiency, and disturbances, is essential for the regulation of metabolic and hormonal processes. Research indicates a U-shaped association between sleep duration and the risk of T2DM, suggesting that both inadequate and excessive sleep may elevate the chances of negative health outcomes (Bao *et al*., 2015). However, modern sedentary lifestyles, particularly those involving prolonged screen time, have emerged as a significant disruptor of sleep. Screen-based sedentary behaviours (SBSB), such as television watching and mobile device use, have been linked to delayed sleep onset, reduced sleep efficiency, and melatonin suppression, especially when screens are used in the evening (Blume *et al*., 2019; Xie *et al*., 2020). These disruptions are particularly concerning for T2DM patients, as poor sleep exacerbates the metabolic dysfunctions associated with the condition (Kuo *et al*., 2021). Despite growing awareness of the impact of SBSB on health, the specific relationship with sleep quality in T2DM patients remains under explored. Existing studies have focused predominantly on general or adolescent populations, leaving gaps in understanding how screen time affects this high-risk group (Henson *et al*., 2020; Lee *et al*., 2023). This systematic review seeks to address this gap by synthesizing evidence on the effects of SBSB on sleep quality among T2DM patients, with a focus on mechanisms such as circadian rhythm disruptions and mental stimulation. By providing insights into these relationships and identifying potential interventions, this study aims to enhance diabetes management and overall health outcomes for individuals with T2DM.

AIM AND OBJECTIVES

To evaluate the impact of screen-based sedentary behavior (SBSB) on sleep quality among Type 2 Diabetes Mellitus (T2DM) patients and explore its effects on glycemic control and overall diabetes management through retrieved data from published research articles.

To assess the relationship between prolonged screen time (sedentary behavior) and sleep duration in T2DM patients.

To investigate how poor sleep quality due to excessive screen time (screen-based sedentary behavior) affects insulin resistance and glycaemic control among T2DM patients.

METHODOLOGY

Study Design

This research presents a systematic review aimed at assessing the influence of screen-based sedentary behavior (SBSB) on sleep quality in individuals with Type 2 Diabetes Mellitus (T2DM). The methodology adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to maintain transparency and rigor (Haddaway et al., 2022). This review's protocol was registered in the **PROSPERO** database to improve credibility and reduce research duplication.

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Search Strategy
A comprehensive literature search was conducted using the following electronic databases: PubMed, Scopus, Google Scholar, ScienceDirect, and the Cochrane Library. Articles published within the last five years (2019–2024) were included to ensure the inclusion of up-to-date evidence. The search terms incorporated combinations of keywords and MeSH terms related to T2DM, SBSB, and sleep quality. Boolean operators (AND, OR, NOT) were employed to refine the search strategy. Keywords like "Type 2 Diabetes Mellitus," "sedentary behaviour," "screen time," "digital media use," and "sleep quality" will be applied to capture relevant studies comprehensively.

Eligibility Criteria
This systematic review includes studies published in English within the past five years that focus on patients with T2DM or related conditions, such as metabolic syndrome. Studies must focus on screen-based sedentary behaviors, such as television viewing, computer use, or smartphone usage, and provide sleep quality metrics through either subjective measure (e.g., questionnaires) or objective tools (e.g., actigraphy or polysomnography). Only primary research designs, including cross-sectional, cohort, case-control, clinical trials, observational studies, and case studies, were included.

The studies those that do not focus on T2DM populations, those unrelated to sedentary behavior or screen time, review articles (such as systematic reviews, narrative reviews, or meta-analyses), non-English publications, and studies published over five years ago were excluded from this review.

Study Selection
The study selection process comprised two phases. The titles and abstracts of retrieved articles were initially screened to eliminate irrelevant studies. The full texts of potentially relevant articles were reviewed to verify eligibility according to the established inclusion and exclusion criteria. Discrepancies in the selection process were addressed through deliberations among a panel of independent reviewers.

Data Extraction
Data were obtained from qualifying studies through a standardized extraction protocol. The form recorded details regarding the study's author(s), publication year, population characteristics, study design, methods, outcomes, and significant findings related to SBSB and sleep quality. Data extraction underwent independent verification by three reviewers to ensure both accuracy and consistency.

Quality Assessment
The methodological quality and risk of bias in the included studies were assessed utilizing the Joanna Briggs Institute (JBI) critical appraisal tools. This guaranteed the synthesis of only high-quality evidence in the review.

Data Synthesis and Analysis
Findings were synthesized narratively, highlighting common patterns and variations in the relationship between SBSB and sleep quality among T2DM patients. Quantitative data, where available, were summarized descriptively, and trends were identified.

RESULTS

Study Selection

A comprehensive search strategy was employed to identify relevant studies, including database searches and citation tracking. The article search was done by following the PRISMA guideline as shown by PRISMA flow-style diagram in Figure 1. A total of 360 records were initially identified: 194 from Scopus, 142 from PubMed, 2 from the Cochrane Library, and 22 from Google Scholar. Furthermore, 15 records were acquired via citation searching. Following the elimination of 48 duplicate records, 312 records were available for title and abstract screening. In this phase, 265 records were excluded: 28 were review articles, 159 were irrelevant to the research question, 76 addressed incorrect outcomes, and 2 were written in a language other than English.

After the screening process, 47 records were identified for full-text retrieval, but 18 reports could not be accessed due to unavailability. A total of 29 records were evaluated for eligibility, with 14 records excluded due to various reasons: duplicates (n = 3), incorrect interventions (n = 2), unavailability of full texts (n = 6), or lack of focus on diabetes (n = 8). A total of 16 studies were included in the systematic review, consisting of 15 identified through database searches and 1 from citation searching.

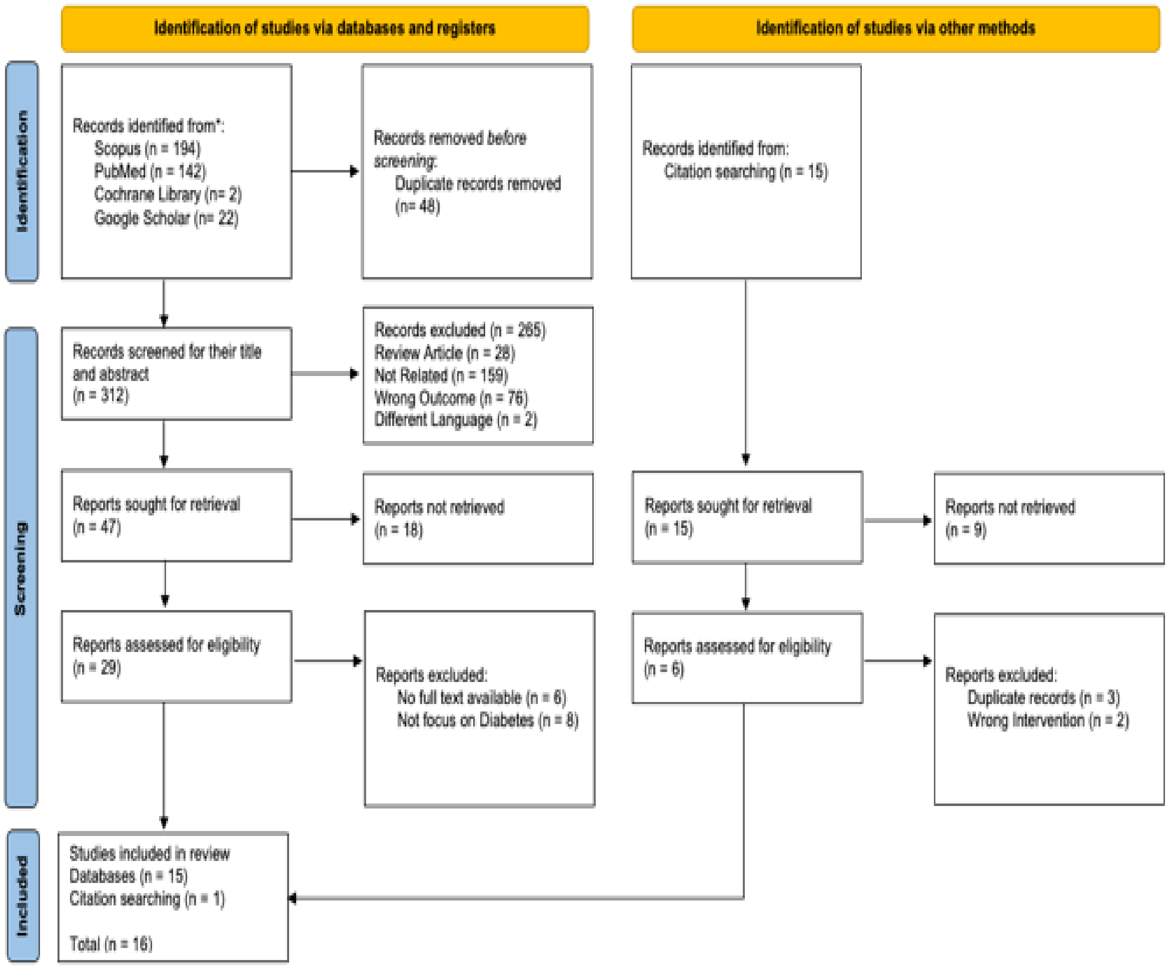

Fig. 1. PRISMA flow diagram of articles selection process (Haddaway et al., 2022)

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Study Characteristics and Synthesis

The systematic review included 16 studies conducted across various regions, including Brazil, Morocco, Qatar, the Netherlands, the United Kingdom, and Saudi Arabia, with publication years spanning from 2021 to 2024, as illustrated in Table 1. The majority of the studies (n = 11) employed cross-sectional designs, whereas fewer studies utilized longitudinal cohort (n = 4) and retrospective cohort (n = 1) methodologies. The sample sizes varied from 37 participants in a small longitudinal cohort study to 471,686 participants in a large prospective cohort study. The studies examined the associations among sedentary behaviors, physical activity, sleep patterns, and mental health in individuals with or at risk of T2DM.

Galvão et al. (2023) found that replacing 60 minutes of sedentary time with moderate-to-vigorous physical activity (MVPA) reduced diabetes prevalence by 19%, while substituting MVPA with sedentary behavior increased diabetes risk by 22%. Similarly, Brakenridge et al. (2024) showed that reducing sitting time and incorporating light physical activity (LPA) or MVPA improved fasting plasma glucose and HbA1c levels, with notable cardiometabolic benefits. Covenant et al. (2024) reported significant improvements in depressive symptoms (PHQ-9: -3.6%) and physical function (DASI: +1.2%) by substituting sedentary time with MVPA or sleep.

Albers et al. (2023) observed a U-shaped relationship between sleep duration and diabetes risk, with both short (5 hours, OR: 2.6) and long (12 hours, OR: 1.8) sleep durations increasing T2DM risk. Algethami et al. (2024) found that T2DM patients experienced significantly poorer sleep quality than controls (median score: 21 vs. 25, $p < 0.001$). Similarly, Ruiz-Burneo et al. (2022) reported that T2DM patients had a 2.2-fold higher prevalence of sleep difficulties compared to non-diabetic individuals.

Sukik et al. (2023) reported that more than 4 hours of SBSB daily increased the likelihood of severe depressive symptoms by 115%, and Laidi et.al. (2022) highlighted that 53% of T2DM patients experienced worsened sleep quality during the COVID-19 lockdown. Wang *et al.* (2024) identified a 17% increased risk of T2DM with heavy blue light exposure (HR: 1.17), while Dartora *et al.* (2023) highlighted a 1.3-hour increase in daily screen time and reduced physical activity during the COVID-19 pandemic. Additionally, García-Hermoso *et al.* (2023) reported a 15%-18% reduction in T2DM risk among adolescents adhering to movement guidelines, emphasizing the long-term benefits of healthy lifestyles.

Risk of Bias and Quality Assessment

The quality and risk of bias for the included studies were assessed using the Joanna Briggs Institute (JBI) critical appraisal checklists tailored for cross-sectional (Figure 2) and cohort (Figure 3) studies. A total of 16 studies were evaluated, consisting of 8 cross-sectional studies and 8 cohort studies. No articles were identified as exhibiting a high risk of bias.

Three cohort studies (18.7%) exhibited a moderate risk of bias, whereas five cohort studies (31.3%) demonstrated a low risk of bias. In the analysis of cross-sectional studies, seven studies (43.8%) were classified as having a low risk of bias, while only one study exhibited a moderate risk of bias (6.2%). The risk of bias and quality assessment data for each article were re-evaluated and effectively addressed through discussion, resulting in an average score determined by two independent reviewers.

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Table 1: Characteristics of included Studies in this Review

No.	*Authors*	*Type of Study*	*Site/Country*	*Methodology/Result*	*Conclusion*
1	*(Galvão et al., 2023)*	*Cross-sectional*	*Bahia, Brazil*	*473 older adults were assessed. Hypothetical substitution of SB with MVPA reduced diabetes prevalence ratios (e.g., reallocation of 60 minutes lowered PR by 19%, P = 0.035). In contrast, replacing MVPA with SB increased diabetes risk (PR +22%, P = 0.035).*	*The findings underlined the benefits of reducing sitting time (screen time) and increasing physical activity to improve insulin sensitivity and diabetes management.*
2	*(Laidi et al., 2022)*	*Cross-sectional*	*Morocco*	*100 diabetic patients were assessed during COVID-19 lockdown. Bedtime and wake-up times were delayed, but sleep duration remained similar (~8.5 hours). 53% reported deteriorated sleep quality, linked to age (50-65 years, P = 0.02). Anxiety was present in 29% of patients, more frequent in women (P = 0.04).*	*These findings suggested that while screen exposure and anxiety did not directly influence sleep deterioration, age and pandemic-related lifestyle disruptions play a critical role in affecting sleep health in diabetic populations.*
3	*(Sukik et al., 2023)*	*Cross-sectional*	*Qatar*	*2386 adults with T2DM; SBSB >4 hours/day linked to 115% higher odds of severe depressive symptoms (PHQ-9).*	*The findings underscored the importance of reducing SBSB as a potential strategy to improve mental and sleep health outcomes in T2DM populations.*
4	*(Albers et al., 2023)*	*Cross-sectional*	*Netherland*	*5561 participants aged 40 to 75 years were recruited. A U-shaped association was identified between sleep duration and the risk of T2DM. Short sleep duration (5 hours: OR 2.6) and long sleep duration (12 hours: OR 1.8) were linked to elevated odds of T2DM.*	*The findings emphasized the critical role of adequate sleep in mitigating diabetes-related risks and provided valuable baseline data for understanding sleep patterns in type 2 diabetes patients.*
5	*(Algethami et al., 2024)*	*Cross-sectional*	*Taif, Saudi Arabia*	*547 T2DM patients and 267 controls were evaluated using the Sleep Quality Questionnaire (SQQ). Individuals with T2DM exhibited inferior sleep quality, as indicated by a median score of 21 compared to 25 (P < 0.001). Poor sleep correlated with female gender (P = 0.002), unmarried status*	*Education on sleep hygiene and comprehensive diabetes management are essential for improving outcomes. These results highlighted a notable disparity in sleep quality*

				(P = 0.023), and unemployment (P = 0.023).	*between diabetic and non-diabetic populations.*
6	*(Brakenridge et al., 2024)*	*Cross-sectional*	*Netherland*	*2388 participants aged 40–75 years (684 with T2DM) were studied using thigh-worn activPAL monitors. Reducing sitting time and increasing standing, LPA and MVPA were associated with optimal glycaemic control and cardiometabolic risk. Specifically, replacing 30 min of sitting with LPA or MVPA significantly improved fasting plasma glucose and HbA1c, especially for individuals with T2DM.*	*These findings emphasized the importance of reducing sedentary behavior and increasing physical activity and sleep duration to improve health outcomes in individuals with T2DM.*
7	*(Covenant et al., 2024)*	*Cross-sectional*	*Leicester, Nottingham, Derby, and Lincoln, United Kingdom*	*808 participants; replacing sedentary time with sleep or MVPA showed significant improvements in physical and psychological outcomes (e.g., PHQ9: -3.6%, DASI: +1.2%).*	*The findings highlighted the importance of integrating sleep with MVPA in T2DM treatment strategies, suggesting that increasing sleep by 30 minutes could serve as a more achievable intervention goal for enhancing well-being in this population.*
8	*(Ruiz-Burneo et al., 2022)*	*Cross-sectional*	*Tumbes, Peru*	*1604 participants aged 30–69 years. The prior diagnosis of T2DM was associated with a higher prevalence of sleep difficulties (PR: 2.20; 95% CI: 1.13–4.27) and diminished sleep quality (PR: 1.40; 95% CI: 1.05–1.92) in comparison to individuals without T2DM. No notable correlation with sleep duration.*	*This study suggested that managing sleep quality could be important for improving health outcomes in populations with chronic conditions like T2DM.*
9	*(Paing et al., 2020)*	*Longitudinal cohort*	*Scotland*	*37 adults with T2DM were assessed over 14 days using glucose monitors and activity trackers. Evening sedentary time (43.47 min/h) was significantly higher than morning (33.34 min/h) and afternoon (37.26 min/h). Interruptions to sedentary time in the evening were beneficially associated with improved post-dinner and bedtime glucose levels, as well as time in euglycaemia*	*The study emphasized the role of timing and dietary habits in managing sedentary behavior and glucose levels in T2DM patients.*

				(p < 0.05).	
10	*(Dartora et al., 2023)*	*longitudinal cohort*	*Brazil*	*1082 diabetic participants from ELSA-Brazil assessed during the pandemic (2020–2021). Sleep duration increased for 31% of individuals with initially short sleep; however, sedentary behavior rose by 1.3 hours per day for screen time and 1.4 hours per day for sitting or reclining activities. Physical activity declined by 270 MET-min/week, while alcohol consumption exhibited a slight reduction.*	*These findings emphasized the need to address sedentary behaviors, especially screen time, to mitigate health risks in diabetic populations.*
11	*(García-Hermoso et al., 2023)*	*longitudinal cohort*	*United States*	*Follow-up of 14,738 adolescents (1994-1996) to adulthood (2016-2018). Meeting 24-h movement guidelines in adolescence reduced odds of T2DM in adulthood by 15%-18%.*	*Interesting finding was highlighted in this study. Compliance with physical activity, screen time, and sleep recommendations during adolescence correlates with reduced likelihood of Type 2 Diabetes Mellitus and enhanced glucose regulation in adulthood.*
12	*(Henson et al., 2024)*	*Longitudinal cohort*	*Leicester, Nottingham, Derby, and Lincoln, United Kingdom*	*564 T2DM participants classified into subtypes (INS-D, INS-R, OB, AGE) via k-means clustering. Physical activity and sleep were assessed using accelerometers. OB sub-type had lower physical activity levels, poorer sleep efficiency (-2%), and higher sleep variability (+17.9 minutes) compared to AGE sub-type.*	*These findings highlighted the potential of targeted interventions, such as sleep hygiene education, chronotherapy, and physical activity programs, to improve sleep and wake patterns, insulin sensitivity, and energy regulation in T2DM patients, particularly those with obesity and early-onset diabetes*

13	*(Deng et al., 2022)*	*Mendelian Randomization (cohort)*	*United Kingdom*	*Analysis of 62,892 cases of T2DM and 596,424 controls utilizing genome-wide data. Inverse associations were identified for moderate physical activity (OR: 0.31; 95% CI: 0.18–0.54) and vigorous physical activity (OR: 0.27; 95% CI: 0.14–0.54) in relation to the risk of T2DM. Television viewing is associated with an increased risk of T2DM (OR: 2.35; 95% CI: 1.91–2.89). No notable correlation was found between computer usage and driving.*	*These findings emphasized the role of reducing TV viewing time and promoting physical activity, particularly moderate and vigorous intensities, to lower T2DM risk.*
14	*(Wang et al., 2024)*	*Prospective cohort*	*United Kingdom*	*471,686 participants; HR for T2D with heavy blue light exposure: 1.17 (95% CI: 1.12–1.23), $P < 0.05$.*	*The finding suggested a direct effect of blue light on glucose regulation, emphasizing the need for strategies to mitigate blue light exposure as a potential intervention to reduce T2DM risk.*
15	*(Aadahl et al., 2021)*	*Prospective cohort*	*Denmark*	*87,339 Danish adults were followed for 7.4 years on average. Replacing 30 minutes of SB with light-to-moderate physical activity (HR 0.96, 95% CI: 0.94–0.98) or vigorous physical activity (HR 0.82, 95% CI: 0.72–0.94) decreased the risk of diabetes onset. Substitution with sleep did not demonstrate a significant effect (HR 1.00, 95% CI: 0.97–1.02).*	*These findings highlighted the importance of addressing screen-based sedentary behaviors as part of interventions to improve both metabolic health and sleep quality in T2DM patients.*
16	*(Aadahl et al., 2021)*	*Retrospective cohort*	*Taiwan*	*166 adults with T2DM were assessed. 56.0% of respondents reported having poor sleep quality (PSQI >5). The prevalence of excessive daytime sleepiness (ESS ≥10) was 24.1%. Female gender (OR: 3.45) and ophthalmological issues (OR: 3.17) were associated with diminished sleep quality. Nephropathy demonstrated a significant association with excessive daytime sleepiness (OR: 3.78). Sweating while exercising decreased the likelihood of having poor-*	*Addressing sleep disturbances through lifestyle interventions may improve glycaemic control and overall health in T2DM patients.*

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				quality sleep (OR: 0.48).	

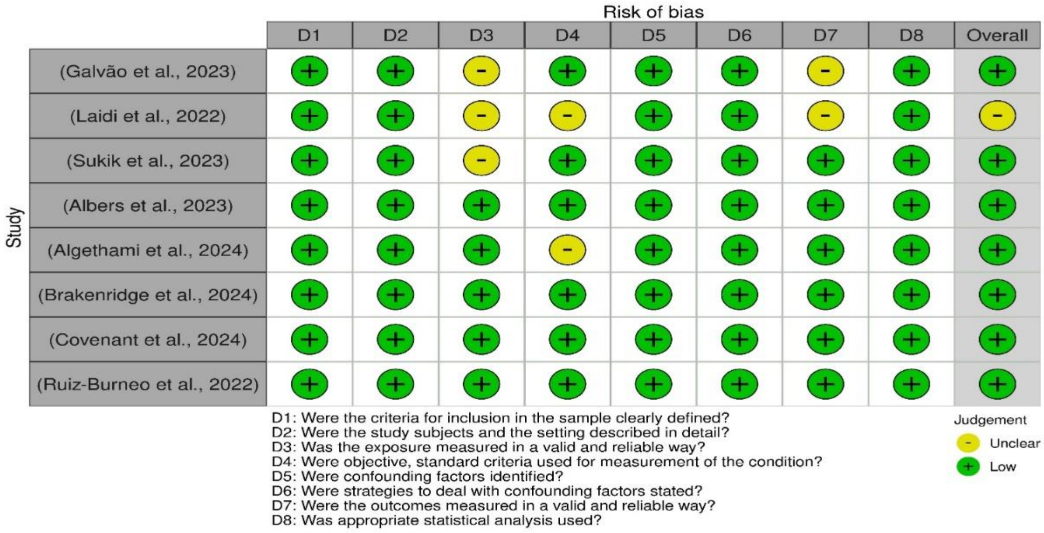

Fig. 2: Summary of quality assessments (Cross-Sectional) using JBI appraisal checklist (McGuinness & Higgins, 2020)

Fig. 3: Summary of quality assessments (Cohort) using JBI appraisal checklist (McGuinness & Higgins, 2020)

DISCUSSION

This systematic review examines the interconnections among screen-based sedentary life style behaviours, physical activity, sleep patterns, and mental health in the context of preventing and managing T2DM. The findings highlight the need for a multifactorial approach to address these lifestyle factors and reveal significant gaps in the existing literature.

The studies consistently demonstrated the detrimental effects of prolonged sedentary behavior and the beneficial effects of physical activity. Galvão et al. (2023) and Brakenridge et al. (2024) demonstrated that reallocating sedentary time to light or

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moderate-to-vigorous physical activity (LPA/MVPA) significantly improved glycemic control and reduced the prevalence ratios of diabetes. The results align with the work of Henson et al. (2020), which emphasized the significance of physical activity in improving insulin sensitivity and reducing the risk of diabetes. Although the results appear promising, many studies relied on self-reported measures of physical activity and sedentary behavior, which are prone to recall bias. Future research could enhance reliability by incorporating objective measures, such as accelerometers, to obtain more accurate data.

Moreover, sleep patterns have been identified as a significant factor influencing diabetes outcomes. Studies by Albers et al. (2023) and Algethami et al. (2024) revealed a U-shaped relationship between sleep duration and diabetes risk, suggesting that both inadequate and excessive sleep durations correlate with negative health outcomes. This supports the findings of Liu & Marques-Vidal (2023), who observed analogous trends in population-based studies. However, these studies did not fully explore the mechanistic pathways underlying this relationship. For instance, it remains unclear whether poor sleep quality exacerbates diabetes through hormonal dysregulation or behavioral changes such as increased sedentary behavior. Further research is needed to unravel these mechanisms, particularly through longitudinal or interventional studies.

Research by Sukik et al. (2023) and Laidi et al. (2022) demonstrates that mental health is a critical factor. These studies identified substantial correlations between prolonged SBSB, anxiety, and depressive symptoms in T2DM patients. The findings indicate that addressing mental health challenges is essential for enhancing overall diabetes management. Ruiz-Burneo et al. (2022) emphasized the psychological impact of diabetes, especially in the context of societal stressors such as the COVID-19 pandemic. The review findings support this perspective while revealing a gap which there are limited studies have investigated the effectiveness of integrated interventions that combine physical activity, sleep hygiene, and mental health support. This provides a basis for future research to evaluate multifactorial intervention models.

Although the review offers valuable insights, it is necessary to address several methodological limitations. The prevalence of cross-sectional designs in the studies analyzed restricts causal inference. Although longitudinal studies such as those conducted by García-Hermoso et al. (2023) and Paing et al. (2020) provided more robust evidence, the absence of prospective data undermines the capacity to establish temporal relationships between lifestyle factors and T2DM outcomes. Liu and Marques-Vidal (2023) identified comparable issues in their meta-analyses, highlighting the necessity for high-quality, long-term studies.

Next, the studies exhibited significant variability in their methodologies, especially regarding the measurement of exposures (e.g., sedentary behavior) and outcomes (e.g., glycemic control). Certain studies relied on self-reported data, which may introduce bias, whereas others employed objective measures, such as thigh-worn monitors. This variability complicates direct comparisons and may account for discrepancies in findings. Future research must emphasize standardized methodologies to guarantee consistency and enhance comparability among studies.

A lot of research did not adequately consider confounding factors, including socioeconomic status, comorbidities, and dietary habits, which can affect both lifestyle behaviors and diabetes outcomes. Ruiz-Burneo et al. (2022) highlighted the importance of these confounders in comprehending the multifactorial nature of T2DM. Blue light exposure, as identified by Wang et al. (2024), may interact with various environmental and behavioral factors, presenting a potential risk. The findings may oversimplify complex relationships if such interactions are not considered.

The results of this review are in close alignment with the socioecological model of diabetes prevention and management that Smiley & King (2019) have proposed. Specifically, the authors emphasize the importance of lifestyle factors—physical activity, sedentary behavior, and sleep—as critical intervention targets. This review enhances understanding by emphasizing emerging factors, including blue light exposure (Wang et al., 2024) and disruptions related to the pandemic (Laidi et al., 2022; Dartora et al., 2023). The findings indicate that traditional interventions may require adaptation to address changing lifestyle and environmental factors.

This review has identified numerous gaps that suggest potential areas for future investigation. Longitudinal and interventional studies are essential to establish causal pathways and assess the effectiveness of integrated interventions. Research should prioritize underrepresented populations, including individuals with comorbid conditions and those from low-income settings, to enhance the generalizability of findings. Further research is required to understand the long-term impacts of new risk factors, such as blue light exposure and lifestyle modifications related to the pandemic, on diabetes outcomes. Future research should prioritize the implementation of objective measurements and standardized protocols to enhance the reliability and comparability of results.

CONCLUSION

This systematic review highlights that prolonged exposure with screen-based sedentary behavior (SBSB) negatively impacts sleep quality and glycaemic control in T2DM patients, emphasizing the need for targeted interventions such as reducing screen time, increasing physical activity, and improving sleep hygiene to enhance diabetes management.

Thus, this review emphasizes the significant impact of lifestyle factors, including sedentary behavior, physical activity, and sleep patterns, on the management and prevention of T2DM. Extended periods of sedentary behavior and inadequate sleep quality correlate with deteriorated glycaemic control and heightened complications. Conversely, reallocating sedentary time towards physical activity and enhancing sleep quality can improve diabetes outcomes.

Reallocating prolonged screen time to physical activity and improving sleep quality can improve diabetes outcomes. The increasing influence of screen-based sedentary behavior (SBSB) and blue light exposure underscores the need for thorough, multifaceted interventions. The findings underscore the importance of reducing sedentary behavior, promoting physical activity, and addressing sleep and mental health concerns to improve the management of T2DM, notwithstanding methodological limitations. Further researches are suggested to focus on detailed causal pathways, standardized methodologies, and targeted interventions to improve diabetes management strategies.

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Conflict of Interest
The authors report no conflicts of interest associated with this study and have no financial affiliations with any organizations that may have an interest in the research. All authors have conducted a comprehensive review and reached a unanimous agreement regarding the submission of this manuscript.

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