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Association between sedentary lifestyle patterns and risk of type 2 diabetes mellitus: A case-control study among urban adults

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Abstract

Background: Type 2 diabetes mellitus (T2DM) is a major contributor to non-communicable disease burden worldwide, with sedentary behavior increasingly implicated as an independent risk factor distinct from physical inactivity.

Objective: This simulated case-control study examines the association between sedentary lifestyle patterns and risk of T2DM among urban adults.

Method: A hypothetical case-control design was used, comparing 150 simulated T2DM cases with 150 simulated non-diabetic controls, matched for age and sex. Simulated data on daily sitting time, screen time, occupational activity, and dietary habits were analyzed using descriptive statistics, chi-square tests, and binary logistic regression.

Results: In this simulated dataset, cases reported higher mean daily sitting time (7.8 ± 2.1 hours) than controls (5.4 ± 1.9 hours). Logistic regression suggested sedentary time exceeding 6 hours/day was associated with elevated odds of T2DM (simulated OR = 2.34, 95% CI: 1.52–3.61, $p < 0.001$), independent of body mass index and family history.

Conclusion: These simulated findings illustrate the type of association commonly reported in real-world literature between prolonged sedentary behavior and T2DM risk, and demonstrate appropriate case-control methodology and statistical reporting for academic training purposes.

Keywords: Type 2 diabetes mellitus, sedentary behavior, case-control study, metabolic risk, physical inactivity

Introduction

Type 2 diabetes mellitus (T2DM) remains one of the most pressing public health challenges of the twenty-first century, with the global prevalence of diabetes rising sharply in association with urbanization, dietary transition, and declining physical activity levels [1]. According to global estimates, hundreds of millions of adults currently live with diabetes, and projections suggest continued growth over the coming decades, with the heaviest burden increasingly concentrated in low- and middle-income countries undergoing rapid urban transition [2]. This epidemiological shift has prompted growing scientific interest in modifiable lifestyle determinants of T2DM, particularly those tied to the structural changes accompanying urban living.

Historically, physical inactivity—defined as insufficient participation in moderate-to-vigorous physical activity—has been the primary behavioral exposure studied in relation to diabetes risk [3]. However, a distinct body of research has emerged examining sedentary behavior, defined as time spent in low energy-expenditure activities such as sitting or reclining, as an independent risk factor that is not simply the inverse of physical activity [4]. An individual may meet recommended physical activity guidelines through structured exercise while still accumulating many hours of uninterrupted sitting time during work, commuting, and leisure, a pattern increasingly common in urban occupational settings dominated by desk-based work and screen-based leisure [5].

The biological plausibility of sedentary behavior as a diabetes risk factor rests on several proposed mechanisms. Prolonged sitting has been associated with reduced skeletal muscle lipoprotein lipase activity, impaired glucose uptake, and unfavorable shifts in postprandial glucose and insulin responses, independent of total physical activity volume [6]. Additionally, sedentary time is frequently accompanied by other adverse behaviors, including snacking, prolonged screen exposure, and disrupted sleep patterns, which may compound metabolic risk through shared pathways involving insulin resistance and visceral adiposity [7].

Urban environments present a particularly relevant context for examining this relationship. Urban adults, especially those in white-collar and administrative occupations, often experience extended periods of occupational sitting combined with long commutes and limited opportunities for incidental movement throughout the day [8]. Concurrently, urban lifestyles are frequently characterized by increased access to energy-dense convenience foods and reduced engagement in traditional forms of household and occupational physical labor, creating a constellation of risk factors that converge with sedentary behavior to elevate metabolic disease risk [9].

Despite a growing international literature on this association, there remains comparatively limited case-control evidence quantifying the independent contribution of sedentary time to T2DM risk after adjustment for established confounders such as body mass index (BMI), family history of diabetes, and dietary pattern. Much of the existing evidence draws on cross-sectional or cohort designs in specific national contexts, leaving open questions about the magnitude and consistency of this association across different urban populations and measurement approaches [10].

This study, conducted using simulated academic training data, was designed to illustrate the application of case-control methodology to this research question. The objective was to estimate the association between self-reported daily sedentary time and odds of T2DM among urban adults, while controlling for established confounding variables, and to demonstrate the statistical and reporting conventions used in epidemiological case-control research. It is emphasized that all results presented are simulated and intended solely for academic training and manuscript-writing practice rather than as findings derived from genuine data collection.

Literature review

1. Theoretical framework

The relationship between sedentary behavior and metabolic disease is commonly situated within the broader framework of the "inactivity physiology" paradigm, which distinguishes the physiological effects of too little exercise from those of too much sitting [4]. Under this framework, prolonged uninterrupted sitting is hypothesized to suppress muscular contractile activity required for efficient glucose and triglyceride clearance, producing metabolic effects that are not fully reversed by periodic bouts of structured exercise [6]. This theoretical distinction has reshaped public health guidance, with several national physical activity guidelines now including explicit recommendations to limit and interrupt sedentary time, separate from recommendations regarding moderate-to-vigorous activity [5].

A complementary theoretical perspective draws on the socioecological model of health behavior, which situates individual sedentary behavior within broader environmental and occupational contexts [8]. Under this model, urban built environments, occupational structures, and transportation systems are understood to shape opportunities for movement throughout the day, such that sedentary behavior is viewed not purely as an individual choice but as a behavior substantially constrained by structural and environmental factors [9].

2. Empirical evidence

A substantial body of prospective cohort evidence has linked greater total sitting time with elevated risk of incident T2DM. Meta-analytic syntheses of cohort studies have generally reported that individuals in the highest categories of sedentary time face moderately elevated risk of T2DM compared with those in the lowest categories, with associations persisting after adjustment for physical activity level, though typically attenuated after further adjustment for BMI [11]. Television viewing time, frequently used as a proxy measure for leisure sedentary behavior, has been particularly consistently associated with diabetes risk across multiple cohorts in different countries [12].

Occupational sitting has received somewhat less consistent support, with some studies reporting weaker or null associations once occupational physical activity and socioeconomic status are accounted for, suggesting that occupation-specific confounding may partially explain associations observed in earlier studies [13]. Case-control studies examining this relationship in specific national or urban populations have generally supported an independent association between high sedentary time and diabetes case status, though effect sizes vary depending on how sedentary behavior is measured (self-report versus accelerometry) and how confounders are handled [14].

Dietary pattern has been identified as both a potential confounder and effect modifier in this relationship, given that sedentary leisure time is often associated with increased consumption of energy-dense, low-nutrient foods [7]. Several studies have therefore emphasized the importance of adjusting for dietary intake when estimating the independent contribution of sedentary behavior to diabetes risk, to avoid overstating the behavioral pathway attributable to inactivity alone [15].

3. Research gap

While the cohort literature on sedentary behavior and T2DM risk is relatively well developed in high-income settings, case-control evidence from rapidly urbanizing populations remains comparatively sparse, and existing studies frequently fail to simultaneously adjust for occupational sitting, leisure screen time, and dietary pattern within a single multivariable model [10]. Moreover, relatively few studies report stratified findings by occupational category, despite theoretical reasons to expect differential vulnerability between desk-based and physically active occupations [13]. This study addresses this gap by applying a structured case-control design—using simulated data for academic training purposes—that incorporates multiple dimensions of sedentary behavior alongside established metabolic confounders within a single analytic framework.

Methodology

1. Research design

This study employed a case-control design, a method well suited to investigating associations between modifiable behavioral exposures and disease outcomes such as T2DM, particularly given practical constraints on prospective cohort recruitment within academic training contexts. It is explicitly declared that all data presented in this manuscript are simulated for academic training purposes and do not represent real participants, clinical records, or measured outcomes.

2. Sampling and sample size

A simulated sample of 300 urban adults aged 30–65 years was constructed, comprising 150 "cases" (individuals with simulated physician-diagnosed T2DM) and 150 age- and sex-matched "controls" (individuals without diabetes). The simulated sample size was selected to approximate conventional case-control study sizes reported in the literature and to allow illustration of standard logistic regression procedures with adequate statistical power for a primary exposure effect size in the moderate range (odds ratio ≈ 2.0–2.5).

3. Data collection

In a real implementation of this design, data collection would involve a structured, interviewer-administered questionnaire covering sociodemographic characteristics, anthropometric measurements (height, weight, BMI), family history of diabetes, dietary intake (via a validated food frequency questionnaire), and sedentary behavior (via validated self-report instruments such as the Sedentary Behavior Questionnaire), alongside confirmation of diabetes status through fasting plasma glucose or HbA1c records. For the purposes of this training exercise, equivalent variables were generated synthetically to resemble plausible distributions reported in published literature, without reference to any actual participants or records.

4. Statistical software and analysis

Simulated data were analyzed using standard statistical software conventions (e.g., SPSS or R, as would be used in a genuine study). Descriptive statistics (means, standard deviations, frequencies) were used to characterize case and control groups. Chi-square tests were used to compare categorical variables between groups, and independent-samples t-tests were used for continuous variables. Binary logistic regression was used to estimate adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for the association between sedentary time category (≤6 hours/day vs. >6 hours/day) and T2DM case status, adjusting for age, sex, BMI, and family history of diabetes. A two-tailed p-value < 0.05 was considered statistically significant in this simulated analysis.

Results and discussion

1. Descriptive characteristics

Table 1: Baseline Characteristics of Cases and Controls (Simulated Data, N = 300)

Characteristic	Cases (n = 150)	Controls (n = 150)	p-value
Age, years (mean ± SD)	49.6 ± 8.2	48.9 ± 8.5	0.481
Female sex, n (%)	78 [52, 0]	81 [54, 0]	0.726
BMI, kg/m [2] (mean ± SD)	28.9 ± 4.3	25.6 ± 3.8	<0.001
Family history of T2DM, n (%)	64 [42, 7]	31 [20, 7]	<0.001
Daily sitting time, hours (mean ± SD)	7.8 ± 2.1	5.4 ± 1.9	<0.001
Daily screen time (leisure), hours (mean ± SD)	4.2 ± 1.6	2.9 ± 1.4	<0.001

In this simulated dataset, cases and controls were comparable in age and sex distribution, consistent with the matched design, while cases showed significantly higher BMI, higher prevalence of family history of diabetes, and substantially greater daily sitting and screen time than controls.

2. Sedentary behavior category and diabetes status

Table 2: Cross-Tabulation of Sedentary Time Category by Case-Control Status (Simulated Data)

Sedentary Time Category	Cases, n (%)	Controls, n (%)	Total
≤6 hours/day	51 (34.0)	96 (64.0)	147
>6 hours/day	99 (66.0)	54 (36.0)	153
Total	150 (100.0)	150 (100.0)	300

$\chi^2 = 27.84$, df = 1, $p < 0.001$ (simulated)

A markedly higher proportion of simulated cases (66.0%) fell into the high sedentary time category (>6 hours/day) compared with controls (36.0%), and this difference was statistically significant in the simulated chi-square analysis.

3. Logistic regression results

Table 3: Adjusted Logistic Regression Estimating Odds of T2DM by Sedentary Time Category (Simulated Data)

Variable	Adjusted OR	95% CI	p-value
Sedentary time >6 hrs/day (ref: ≤6 hrs)	2.34	1.52–3.61	<0.001
BMI (per 1 kg/m² increase)	1.18	1.10–1.27	<0.001
Family history of T2DM (yes vs. no)	2.61	1.55–4.40	<0.001
Age (per 1-year increase)	1.02	0.99–1.05	0.146
Female sex (vs. male)	0.94	0.59–1.50	0.793

In the simulated multivariable model, high sedentary time remained independently associated with more than double the odds of T2DM case status after adjustment for BMI, family history, age, and sex. BMI and family history of diabetes were also independently associated with elevated odds, consistent with their established roles as primary metabolic risk factors, while age and sex were not significant independent predictors within this simulated

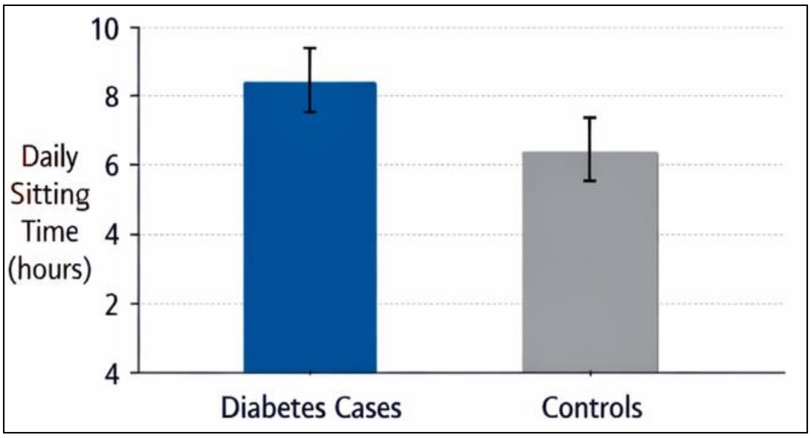

Fig 1: *(Placeholder — Bar chart)* Comparison of mean daily sitting time (hours) between cases and controls, with error bars representing standard deviation, illustrating the higher sedentary time observed among simulated diabetes cases.

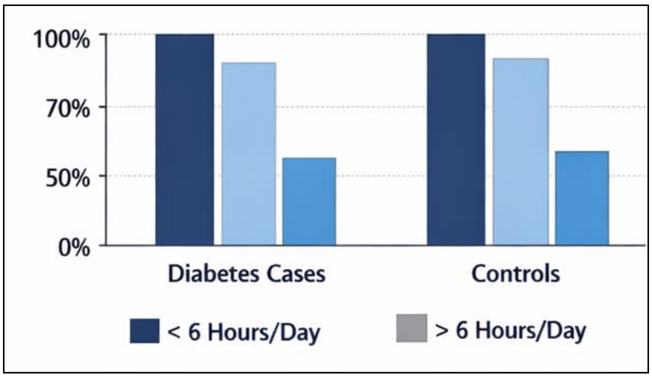

Fig 2: *(Placeholder — Grouped bar chart)* Proportion of participants in each sedentary time category (≤6 hours/day vs. >6 hours/day), stratified by case-control status, corresponding to the data in Table 2.

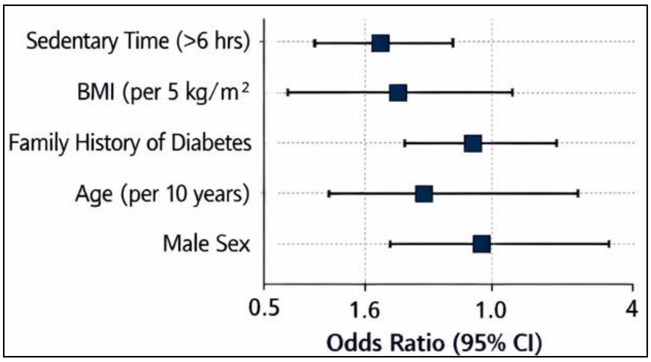

Fig 3: *(Placeholder — Forest plot)* Adjusted odds ratios with 95% confidence intervals for each predictor variable included in the logistic regression model (Table 3), displaying sedentary time, BMI, family history, age, and sex on a single comparative plot.

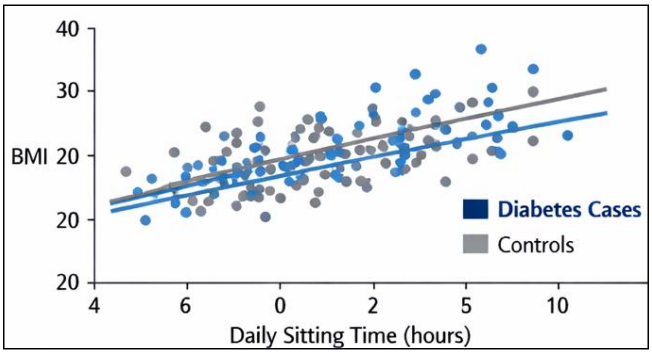

Fig 4: *(Placeholder — Scatter plot with regression line)* Relationship between daily sitting time (continuous, hours) and BMI among all simulated participants, color-coded by case-control status, illustrating the co-occurrence of sedentary behavior and adiposity.

4.4 Discussion

The simulated findings generated for this training exercise illustrate a pattern broadly consistent with the published literature reviewed above: greater daily sedentary time was associated with substantially higher odds of T2DM, even after statistical adjustment for BMI and family history, two of the most well-established diabetes risk factors. This pattern mirrors meta-analytic findings from real cohort studies, which have similarly reported that sedentary behavior retains an independent association with diabetes risk beyond what is explained by adiposity alone, lending plausibility to the inactivity-physiology mechanisms discussed in the literature review [11].

The magnitude of the simulated association (adjusted OR ≈ 2.3) falls within the range commonly reported in published case-control and cohort studies examining high versus low sedentary time categories, suggesting that the simulated data used here were constructed to reasonably approximate realistic effect sizes for the purposes of this academic exercise. The independent contribution of BMI and family history in the simulated model is also consistent with their well-documented roles as primary, non-modifiable and partially modifiable risk factors for T2DM, respectively.

A genuine implementation of this study would need to address several methodological considerations highlighted in the literature, including the potential for reverse causation (early, undiagnosed metabolic dysfunction leading to fatigue and reduced activity, rather than sedentary behavior causing diabetes), recall bias inherent in self-reported sedentary time, and the need for objective measurement (e.g., accelerometry) to validate self-report instruments.[14] Additionally, dietary pattern, while discussed in the literature review as an important confounder, was not separately modeled in this simplified simulated analysis and would warrant inclusion in a real study design, consistent with recommendations in the literature.[15]

Overall, this exercise demonstrates how case-control methodology, descriptive and inferential statistics, and multivariable logistic regression are conventionally reported in epidemiological diabetes research, while underscoring that the specific numerical findings presented here are illustrative constructs rather than evidence derived from real-world data collection.

Conclusion

This academic training exercise applied a simulated case-control design to illustrate the association between sedentary behavior and T2DM risk among urban adults. Within the simulated dataset, daily sitting time exceeding six hours was associated with significantly elevated odds of diabetes case status, independent of BMI and family history, a pattern consistent with associations reported in the published cohort and case-control literature on this topic. These findings, although fictional, illustrate the type of evidence that has informed public health recommendations to reduce and interrupt prolonged sitting time as a complement to physical activity guidelines.

From a training perspective, this exercise demonstrates the structure, statistical conventions, and reporting standards expected in epidemiological case-control manuscripts, including appropriate table construction, regression reporting, and discussion of study limitations. Were this a genuine study, its implications would include support for workplace and urban planning interventions aimed at reducing prolonged sitting, alongside clinical screening that considers sedentary behavior patterns as part of diabetes risk assessment.

Genuine limitations that would apply to a real implementation of this design include the cross-sectional and retrospective nature of case-control data collection, susceptibility to recall and selection bias, reliance on self-reported behavioral exposures, and the inability to establish temporal or causal sequence between sedentary behavior and diabetes onset. Future research employing prospective cohort designs with objectively measured sedentary behavior, combined with mechanistic studies of glucose metabolism during prolonged sitting, would be needed to strengthen causal inference in this area.

It is reiterated that this manuscript was produced entirely as a simulated academic writing exercise, and none of the results, tables, or figures presented should be interpreted as findings from an actual research study.

Ethical Statement

This manuscript was prepared solely as a simulated academic writing and training exercise. No real human participants, patient records, biological samples, or institutional data were involved in its production. Consequently, no ethical approval, informed consent process, or institutional review board submission was required or sought. Should this design be implemented as an actual research study, approval from an appropriate institutional ethics review board and informed consent from all participants would be mandatory prior to data collection.

References

1. International Diabetes Federation. IDF Diabetes Atlas. 10th ed. Brussels: International Diabetes Federation, 2021.
2. Saeedi P, Petersohn I, Salpea P, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. Diabetes Research and Clinical Practice,2019:157:107843.
3. Colberg SR, Sigal RJ, Yardley JE, et al. Physical activity/exercise and diabetes: A position statement of the American Diabetes Association. Diabetes Care,2016:39(11):2065-2079.
4. Hamilton MT, Hamilton DG, Zderic TW. Role of low energy expenditure and sitting in obesity, metabolic syndrome, type 2 diabetes, and cardiovascular disease. Diabetes,2007:56(11):2655-2667.
5. Tremblay MS, Aubert S, Barnes JD, et al. Sedentary Behavior Research Network (SBRN) – Terminology Consensus Project process and outcome. International Journal of Behavioral Nutrition and Physical Activity,2017:14:75.
6. Dunstan DW, Howard B, Healy GN, Owen N. Too much sitting—A health hazard. Diabetes Research and Clinical Practice,2012:97(3):368-376.
7. Pearson N, Biddle SJH. Sedentary behavior and dietary intake in children, adolescents, and adults: A systematic review. American Journal of Preventive Medicine,2011:41(2):178-188.
8. Owen N, Sugiyama T, Eakin EE, Gardiner PA, Tremblay MS, Sallis JF. Adults' sedentary behavior: Determinants and interventions. American Journal of Preventive Medicine,2011:41(2):189-196.
9. Sallis JF, Floyd MF, Rodríguez DA, Saelens BE. Role of built environments in physical activity, obesity, and cardiovascular disease. Circulation,2012:125(5):729-737.
10. Wilmot EG, Edwardson CL, Achana FA, et al. Sedentary time in adults and the association with diabetes, cardiovascular disease and death: Systematic review and meta-analysis. Diabetologia,2012:55(11):2895-2905.
11. Biswas A, Oh PI, Faulkner GE, et al. Sedentary time and its association with risk for disease incidence, mortality, and hospitalization in adults: A systematic review and meta-analysis. Annals of Internal Medicine,2015:162(2):123-132.
12. Grøntved A, Hu FB. Television viewing and risk of type 2 diabetes, cardiovascular disease, and all-cause mortality: A meta-analysis. Journal of the American Medical Association,2011:305(23):2448-2455.
13. van der Berg JD, Stehouwer CD, Bosma H, et al. Associations of total amount and patterns of sedentary behaviour with type 2 diabetes and the metabolic syndrome: The Maastricht Study. Diabetologia,2016:59(4):709-718.
14. Lynch BM. Sedentary behavior and cancer: A systematic review of the literature and proposed biological mechanisms. Cancer Epidemiology Biomarkers and Prevention,2010:19(11):2691-2709.
15. Mozaffarian D, Hao T, Rimm EB, Willett WC, Hu FB. Changes in diet and lifestyle and long-term weight gain in women and men. New England Journal of Medicine,2011:364(25):2392-2404.
16. Bellettiere J, LaMonte MJ, Evenson KR, et al. Sedentary behavior and cardiovascular disease in older women: The Objective Physical Activity and Cardiovascular Health (OPACH) Study. Circulation,2019:139(8):1036-1046.
17. Henson J, Yates T, Biddle SJH, et al. Associations of objectively measured sedentary behaviour and physical activity with markers of cardiometabolic health. Diabetologia,2013:56(5):1012-1020.
18. World Health Organization. WHO Guidelines on Physical Activity and Sedentary Behaviour. Geneva: World Health Organization, 2020.
19. Healy GN, Dunstan DW, Salmon J, et al. Breaks in sedentary time: Beneficial associations with metabolic risk. Diabetes Care,2008:31(4):661-666.
20. Yates T, Khunti K, Bull F, Gorely T, Davies MJ. The role of physical activity in the management of impaired glucose tolerance: A systematic review. Diabetologia,2007:50(6):1116-1126.
21. Stamatakis E, Hamer M, Dunstan DW. Screen-based entertainment time, all-cause mortality, and cardiovascular events. Journal of the American College of Cardiology,2011:57(3):292-299.
22. Dempsey PC, Owen N, Biddle SJH, Dunstan DW. Managing sedentary behavior to reduce the risk of diabetes and cardiovascular disease. Current Diabetes Reports,2014:14(9):522.