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Original

ESTILO DE VIDA SEDENTARIO Y RIESGO DE DIABETES TIPO 2 EN JÓVENES TURCOS

SEDENTARY LIFESTYLE AND TYPE 2 DIABETES RISK IN TURKISH YOUTH

ESTILO DE VIDA SEDENTÁRIO E RISCO DE DIABETES TIPO 2 EM JOVENS TURCOS

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INVESTIGACIÓN DE LOS NIVELES DE COMPORTAMIENTO SEDENTARIO DE INDIVIDUOS JÓVENES EN TÉRMINOS DE RIESGO DE DIABETES MELLITUS TIPO 2: UN ESTUDIO TRANSVERSAL EN TURQUÍA

RESUMEN

Objetivo: Investigar los niveles de sedentarismo (SE) en jóvenes y su asociación con el riesgo de desarrollar diabetes mellitus tipo 2 (DM2).

Métodos: Este estudio transversal incluyó a 385 estudiantes universitarios en Turquía (edad media = 20,25 ± 2,12 años; 68,8 % mujeres). Los datos se recopilaron mediante el Cuestionario de Comportamiento Sedentario (SBQ) y la Escala Finlandesa de Riesgo de Diabetes (FINDRISC). Un análisis de potencia a priori confirmó la idoneidad del tamaño muestral. Los análisis estadísticos incluyeron pruebas no paramétricas, correlación y regresión lineal múltiple para identificar predictores independientes del riesgo de DM2.

Resultados: El tiempo diario promedio de sedentarismo fue de 8,72 ± 4,32 horas. Según FINDRISC, el 62,6% bajo, 25,2% leve, 6,0% moderado, 5,5% alto y 0,8% muy alto. El análisis de regresión mostró que el IMC (B = 0,54; p < 0,001), la edad (B = 0,38; p < 0,001) y el tiempo total de sedentarismo (B = 0,14; p = 0,002) fueron predictores independientes significativos de puntuaciones FINDRISC más altas, lo que explica el 30 % de la varianza (R^2 ajustado = 0,304). El tabaquismo no fue un predictor significativo. Sorprendentemente, las enfermedades crónicas y el uso regular de medicamentos se asociaron inversamente con las puntuaciones FINDRISC, posiblemente debido a una mayor concienciación sobre la salud.

Discusión: Aunque la mayoría de los estudiantes presentaban un bajo riesgo de diabetes mellitus tipo 2, los hallazgos indican que el sedentarismo prolongado sigue siendo un factor de riesgo modificable significativo. Estos resultados resaltan la necesidad de estrategias preventivas e intervenciones específicas entre los adultos jóvenes.

Conclusión: Los estudiantes universitarios en Turquía mostraron un tiempo de sedentarismo prolongado, pero la mayoría mantuvo un bajo riesgo de diabetes mellitus tipo 2. No obstante, un mayor tiempo de sedentarismo se asoció con una puntuación FINDRISC más alta. Estos hallazgos justifican estrategias preventivas centradas en la reducción del sedentarismo y el aumento de la actividad física.

Palabras clave: Sedentarismo; Diabetes mellitus tipo 2; Evaluación de riesgos; Estudiantes; Estudios transversales

INVESTIGATION OF SEDENTARY BEHAVIOR LEVELS OF YOUNG INDIVIDUALS IN TERMS OF TYPE 2 DIABETES MELLITUS RISK: A CROSS-SECTIONAL STUDY IN TURKEY

ABSTRACT

Objective: To investigate the levels of sedentary behaviour (SB) among young individuals and their association with the risk of developing Type 2 Diabetes Mellitus (T2DM).

Methods: This cross-sectional study included 385 university students in Turkey (mean age = 20.25±2.12 years; 68.8% female). Data were collected using the Sedentary Behaviour Questionnaire (SBQ) and the Finnish Diabetes Risk Score (FINDRISC). A priori power analysis confirmed the adequacy of the sample size. Statistical analyses included non-parametric tests, correlation, and multiple linear regression to identify independent predictors of T2DM risk.

Results: The average daily SB was 8.72±4.32 hours/day. According to FINDRISC, 62.6% were low, 25.2% mild, 6.0% moderate, 5.5% high, and 0.8% very high. Regression analysis showed that BMI (B=0.54, p<0.001), age (B=0.38, p<0.001), and total sedentary time (B=0.14, p=0.002) were significant independent predictors of higher FINDRISC scores, explaining 30% of the variance (adjusted R^2=0.304). Smoking was not a significant predictor. Unexpectedly, chronic disease and regular medication use were inversely associated with FINDRISC scores, possibly due to increased health awareness.

Discussion: Although the majority of students were at low risk of T2DM, the findings indicate that prolonged sedentary behavior remains a significant modifiable risk factor. These results highlight the need for preventive strategies and targeted interventions among young adults.

Conclusion: University students in Turkey exhibited prolonged sedentary time, yet the majority remained at low risk of T2DM. Nevertheless, increased SB was

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associated with a higher FINDRISC score. Preventive strategies focusing on reducing SB and increasing physical activity are warranted.

Keywords: Sedentary Behavior; Diabetes Mellitus, Type 2; Risk Assessment; Students; Cross-Sectional Studies

INVESTIGAÇÃO DOS NÍVEIS DE COMPORTAMENTO SEDENTÁRIO DE INDIVÍDUOS JOVENS EM TERMOS DE RISCO DE DIABETES MELLITUS TIPO 2: UM ESTUDO TRANSVERSAL NA TURQUIA

RESUMO

Objectivo: Investigar os níveis de comportamento sedentário (CS) entre os jovens e a sua associação com o risco de desenvolver Diabetes Mellitus Tipo 2 (DM2).

Métodos: Este estudo transversal incluiu 385 estudantes universitários na Turquia (idade média = 20,25 ± 2,12 anos; 68,8% mulheres). Os dados foram recolhidos através do Questionário de Comportamento Sedentário (SBQ) e do Finlandês de Risco para Diabetes (FINDRISC). A análise de poder a priori confirmou a adequação do tamanho da amostra. As análises estatísticas incluíram testes não paramétricos, correlação e regressão linear múltipla para identificar os preditores independentes de risco para a DM2.

Resultados: O tempo médio diário de comportamento sedentário foi de 8,72 ± 4,32 horas. De acordo com o FINDRISC, 62,6% baixo, 25,2% leve, 6,0% moderado, 5,5% alto e 0,8% muito alto. A análise de regressão mostrou que o IMC (B = 0,54, p < 0,001), a idade (B = 0,38, p < 0,001) e o tempo total de sedentarismo (B = 0,14, p = 0,002) foram preditores independentes significativos de pontuações FINDRISC mais elevadas, explicando 30% da variância (R^2 ajustado = 0,304). O tabagismo não foi um preditor significativo. Inesperadamente, as doenças crónicas e o uso regular de medicamentos foram inversamente associados às pontuações FINDRISC, possivelmente devido a uma maior consciencialização sobre a saúde.

Discussão: Embora a maioria dos estudantes apresentasse um baixo risco de DM2, os achados indicam que o comportamento sedentário prolongado continua a ser um fator de risco modificável significativo. Estes resultados realçam a necessidade de estratégias preventivas e intervenções direcionadas entre os jovens adultos.

Conclusão: Os estudantes universitários na Turquia apresentaram tempo sedentário prolongado, mas a maioria permaneceu com baixo risco de DM2. No entanto, o aumento do SBQ foi associado a uma pontuação FINDRISC mais elevada. Estratégias preventivas com foco na redução do SBQ e no aumento da atividade física são necessárias.

Palavras-chave: Comportamento Sedentário; Diabetes Mellitus Tipo 2; Avaliação de Risco; Estudantes; Estudos Transversais

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INTRODUCTION

There has been a rapid change in the lives of individuals due to the impact of technological developments and modernisation. These rapid changes have significantly reduced the physical activity levels of individuals. The effects of these developments, along with the recent novel coronavirus (COVID-19) pandemic is undeniable. In late 2019, the COVID-19 pandemic increased time spent by individuals at home and accelerated the adoption of a sedentary lifestyle, which has continued in the post-pandemic era. Consequently, there has been a rapid rise in sedentary behaviour among individuals (Cardoso et al., 2023). Sedentary behaviour (SB) encompasses activities that involve sitting or lying down while conscious and typically result in less than 1.5 metabolic equivalents of energy expenditure (Owen et al., 2010). Due to its prevalence in society, SB has become a popular topic of investigation in the literature.

The World Health Organization (WHO) has reported that one in four adults and 81% of adolescents fail to meet the recommended levels of physical activity (WHO, 2024a). Numerous studies have demonstrated the detrimental effects of high rates of SB on human health (Garc et al., 2022; Huang et al., 2022; Panahi et al., 2018). Sedentary behaviour has been linked to an increased the incidence of non-communicable cardiovascular diseases, diabetes mellitus, hypertension and various cancers (Park et al., 2020). It is also recognized as the fourth leading risk factor for mortality, with approximately 3.2 million deaths each year attributable to SB (WHO, 2023). However, it is important to note that SB is a modifiable risk factor for chronic diseases (Garc et al., 2022).

When individuals incorporate SB into their lifestyles, it is observed that their bodies experience functional impairments in the metabolism of carbohydrates, fats, and proteins. These metabolic dysfunctions are characterised by elevated plasma triglyceride levels, increased lipoprotein concentrations, and reduced insulin sensitivity (Ormazabal et al., 2018). Reduced insulin sensitivity can lead to Diabetes Mellitus (DM), a chronic metabolic disorder that necessitates ongoing medical management due to either insulin deficiency or dysfunction of the insulin-secreting β cells. Patients with DM and their relatives bear physical, psychosocial, mental, and economic burdens (Turkish Society of Endocrinology and Metabolism, 2018; Jia et al., 2023; Saeedi et al., 2019).

In studies conducted by WHO, it was reported that in 2019, two million people died from DM and DM-related kidney diseases, with a 13% increase in DM-related mortality rates in low- and middle-income countries (WHO, 2024b). These rates indicate a rapid global increase in the prevalence of DM. Type 2 Diabetes Mellitus (T2DM), a subtype of DM, accounts for the majority of this prevalence. The risk of T2DM is also rising in Turkey, reflecting the global trend. It has been reported that approximately 7 million individuals aged 20 to 79 in Turkey are living with DM, which accounts for approximately 15% of the total population (Turkish Ministry of Health, General Directorate of Health Promotion, 2020).

In T2DM, it is crucial to identify risk factors that may occur in advance in order to reduce the risk of acute complications and mitigate long-term costly sequelae (Turkish Society of Endocrinology and Metabolism, 2018). Conducting studies on young individuals, who constitute the majority of the country's population, can help identify these potential risk factors. Assessing the risk of T2DM in young individuals is important for early diagnosis and treatment. University students are among the most appropriate and accessible examples of young individuals in the society. When examining the lifestyle habits of university students, it becomes evident that this age group experiences a high level of sedentary behaviour, as they spend a significant portion of their time studying (Cotten et al., 2016). In fact, several studies have found that university students tend to have more sedentary time than individuals who work at a desk (Cotten et al., 2016; Moulin et al., 2017). However, studies evaluating sedentary behaviour in relation to validated diabetes risk scores among young adults in Turkey are scarce, highlighting a critical research gap.Therefore, university students in Turkey, where young people study, were selected as the study group for this study. It was aimed to determine the risk of T2DM and SB of university students in Turkey and to examine whether there is a relationship between them. It is hoped that this study will contribute to future research by identifying factors that may influence the

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development of T2DM, targeting high-risk groups, and informing strategies for its prevention and treatment.

METHODS

Study Design

This study aims to determine the SB levels of young individuals in Turkey and to investigate whether they are at risk of developing T2DM. To achieve these objectives, specific research questions were formulated, including: What are the SB levels and T2DM risk among young individuals in Turkey? Is there a relationship between SB levels and T2DM risk?
This study was designed as a cross-sectional study, employing a quantitative research method, in line with the established objectives. The manuscript has been prepared in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology guidelines.

Setting

The study was conducted over a six-month period, from December 1, 2022, to May 1, 2023. Data were collected both face-to-face and online (via Google Forms).

Participants

A priori power analysis using GPower 3.1 software indicated that a minimum of 348 participants would be required to detect a small effect size (r=0.15) with 80% power at a significance level of α=0.05. The final sample of 385 students thus provided sufficient statistical power. A total of 406 students responded to this invitation; however, 21 did not complete the survey. Therefore, the final analysis was based on data from 385 students.
The inclusion criteria for the study were being a university student in Turkey and aged 17 years or older. The exclusion criteria included having Type 1 DM, a desire to withdraw from the study, or any disability that prevented completion of the questionnaires.

Variables

The primary variables of the study were sedentary behaviour (measured with SBQ) and Type 2 diabetes mellitus risk (measured with FINDRISC). Additional variables included age, gender, body mass index (BMI), chronic diseases, medication use, smoking and exercise habits, academic year, and programme of study.

Data Sources / Measurement

Three different data collection forms were used to gather data for this study. These forms included the Personal Information Form, the Sedentary Behaviour Questionnaire (SBQ), and the Finnish Diabetes Risk Score (FINDRISC).

- **Personal Information Form**: consisted of questions regarding age, gender, BMI, chronic diseases, medication use, smoking and exercise habits, as well as details about the participant's academic year and programme.

- **Sedentary Behaviour Questionnaire (SBQ)**: comprised 22 questions in total (11 weekday, 11 weekend). Each question offered nine response options (ranging from "None" to "6 hours or more"). Times were converted into hours, summed for weekdays and weekends, and calculated as averages (weekday × 5, weekend × 2). Total sedentary behaviour (h/day) was calculated as the weighted daily mean: (weekday×5 + weekend×2)/7. Higher scores indicated greater sedentary behaviour (Kara et al., 2021).

- **Finnish Diabetes Risk Score (FINDRISC)**: consists of eight questions (age, BMI, waist circumference, exercise, diet, hypertension status, glucose history, family history). Risk categories: low <7, mild 7–11, moderate 12–14, high 15–20, very high >20 (Lindström et al., 2003). Cut-off ≥7 points.

Bias

Since self-report questionnaires were used, potential biases such as recall bias and social desirability bias may have influenced the accuracy of responses. To minimize potential bias in the study, data were

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collected anonymously. Participants were informed that there were no right or wrong answers to reduce response pressure. Standardized online and paper-based forms were used to ensure consistency across participants. Both online and face-to-face data collection were implemented to reduce selection bias.

Study Size

A priori power analysis using GPower 3.1 software indicated that a minimum of 348 participants would be required. The final sample size was 385 students, ensuring adequate power.

Permissions / Ethical Considerations

Written ethical permission for the study was obtained from Yozgat Bozok University Ethics Commission on November 16, 2022, under decision number 38/19. Additionally, since the study was conducted at Yozgat Bozok University a study permit specific to the institution, numbered 113097 and dated December 15, 2022, was obtained from the Yozgat Bozok University Rectorate. Permission to use the SBQ and FINDRISC, which were utilized in the study, was obtained from the original authors. Furthermore, data collection from the volunteer students who participated in the study was conducted in accordance with the principles outlined in the Declaration of Helsinki. Prior to participation, the students were provided with comprehensive information about the study, and written informed consent was obtained.

Statistical Methods

The data obtained in the study were analysed using IBM SPSS Statistics v25. Descriptive statistical techniques were employed to assess the data. The normality of the data was tested using kurtosis and skewness values. For variables that did not follow a normal distribution, the difference between two groups was determined using the Mann-Whitney U test, while differences between more than two groups were assessed using the Kruskal-Wallis H test. Post-hoc pairwise comparisons following Kruskal–Wallis were performed using Dunn–Bonferroni tests.To examine the relationship between continuous variables, Spearman correlation analysis was used for data that did not exhibit a normal distribution. In addition, multiple linear regression analysis was performed to identify the independent predictors of the FINDRISC score. Because FINDRISC includes age, BMI and physical activity components, including these variables as predictors may introduce circularity; results were interpreted with caution. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The mean age of participants was 20.25±2.12 years; 68.8% were female, 65.7% had normal BMI, and most were first-year students. The majority were non-smokers (78.4%), non-exercisers (74%), and without chronic disease (89.6%) or regular medication use (91.4%). Walking (51.7%) and fitness (34.5%) were the most common exercise types (Table 1).

According to FINDRISC, 62.6% were low, 25.2% mild, 6.0% moderate, 5.5% high, and 0.8% very high risk. The mean FINDRISC score was 5.90±4.42. Students reported a total sedentary time of 8.72±4.32 hours/day (weekday: 6.31±3.17; weekend: 2.41±1.33).

Table 1: Sociodemographic and clinical characteristics of students

Characteristics		Number	Percentage
Gender	Female	265	68.8
	Male	120	31.2
Age (year)	17-20	250	64.9
	21- 22	98	25.5
	23+	37	9.6
BMI (kg/m^2)	Below 18.5:Weak	47	12.2
	18.5-24.9:Normal weight	253	65.7
	25-29.9:Overweight	77	20.0
	30-34.9:Obesity1st degree	8	2.1
Academic Year	First Year	208	54.0
	Second Year	146	37.9

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	Third Year	16	4.2
	Fourth Year	15	3.9
Marital Status	Single	381	99.0
	Married	4	1.0
Smoking Habits	Yes	83	21.6
	None	302	78.4
Exercise Habits	Yes	100	26.0
	None	285	74.0
Exercise types	Walking	45	51.7
	Volleyball	11	12.6
	Football	6	6.9
	Fitness	30	34.5
	Boxing /Kick boxing	3	3.4
	Other	3	3.5
Chronic Disease	Yes	40	10.4
	None	345	89.6
Regular Medication Use	Yes	33	8.6
	None	352	91.4

	Minimum	Maximum	X	SD
Age	17.00	41.00	20.25	2.12
Height	146.00	193.00	166.70	8.45
Weight	39.00	130.00	62.27	13.42
BMI	14.15	36.26	22.28	3.65
Waist Circumference	50.00	130.00	78.61	14.74
FINDRISC score	0	21.00	5.90	4.42
Weekday SBQ (hours/day)	0	20.91	6.31	3.17
Weekend SBQ (hours/day)	0	8.73	2.41	1.33
Total SBQ (hours/day)	0	24.00	8.72	4.32

kg:kilogram, m:meter, X:mean, SD: Standard deviation, BMI:Body Mass Index. Multiple responses allowed; percentages may exceed 100% (denominator = exercisers, n=100)

FINDRISC scores were significantly higher in older students, those with higher BMI, chronic diseases, medication use, and in fourth-year or undergraduate department students while no differences were observed by gender, smoking, or exercise habits (Table 2).

Table 2: Comparison of FINDRISC score according to sociodemographic and clinical characteristics of students

Characteristics	**Median (Q1–Q3)**	**Test Statistic**	**p-value**	**Post-hoc Comparisons**
Gender	Female: 5.0 (3.0-8.0) Male: 5.0 (2.0–8.0)	z = –0.696	0.486	–
Age (years)	17–20:4.0 (2.0–7.0) 21–22: 5.0 (3.0–7.0) ≥23: 7.0 (4.0–14.0)	H = 13.986	0.001*	Group 3 > Groups 1,2
BMI (kg/m²)	Underweight: 4.0 (2.0-5.0) Normal: 4.0 (2.0-7.0) Overweight: 8.0 (6.0-12.0) Obese: 10.0 (7.0-13.0)	H = 73.706	<0.001*	Groups 3,4 > Groups 1,2
Academic Year	1st: 4.0 (2.0–7.0) 2nd: 5.0 (2.0–8.0) 3rd: 6.5	H = 14.021	0.003*	Group 4 > Group 1

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	(5.0–11.0) 4th: 7.0 (4.0–15.0)		
Chronic Disease	Yes: 7.0 (3.5–11.0) No: 5.0 (2.0–7.0)	z = – 2.289	0.022*

Note: Values are presented as Median (Q1–Q3). The Mann–Whitney U test (z) was used for two-group comparisons, and the Kruskal–Wallis test (H) for multiple-group comparisons. When significant differences were detected, Post-hoc pairwise comparisons were performed using Dunn–Bonferroni tests. *p < 0.05 was considered statistically significant. Group coding: For Age – Group 1: 17–20 years, Group 2: 21–22 years, Group 3: ≥23 years. For BMI – Group 1: Underweight, Group 2: Normal, Group 3: Overweight, Group 4: Obese. For Academic Year – Group 1: 1st year, Group 2: 2nd year, Group 3: 3rd year, Group 4: 4th year.

Sedentary time was significantly longer in smokers, students with chronic disease, and those on continuous medication, as well as older. No significant differences were found by gender, marital status, or academic year (Table 3).

Table 3: Comparison of the duration of SBQ according to sociodemographic and clinical characteristics of students (hours/day, Median [Q1–Q3])

Characteristics	Weekday Sedentary (h/day)	Weekend Sedentary (h/day)	Total Sedentary (h/day)
Gender	Female: 5.68 (4.09–7.61) Male: 5.91 (4.26–8.36)	Female:2.09 (1.41–3.09) Male:2.25 (1.53–3.30)	Female: 7.77 (5.91-10.59) Male: 7.97 (5.85–11.51)
Age (years)	17–20:5.80 (4.09–7.73) 21–22:5.23 (3.86–7.95) ≥23:6.36 (4.32–9.77)	17–20: 2.09 (1.45–3.05) 21–22: 2.09 (1.32–3.09) ≥23: 3.09 (2.00–3.55)	17–20: 7.76 (5.93–10.91) 21–22: 7.33 (5.45–11.25) ≥23: 9.61 (6.32–13.09)
Smoking	Yes:6.14 (5.00–8.64) No:5.57 (3.86–7.84)	Yes: 2.27 (1.77–3.32) No: 2.09 (1.36–3.09)	Yes: 8.48 (6.91–11.59) No: 7.63 (5.50–10.86)
Chronic Disease	Yes: 8.41 (5.23–10.23) No: 5.68 (4.09–7.50)	Yes: 3.05 (2.07–4.41) No: 2.09 (1.41–3.05)	Yes: 11.36 (7.23–14.30) No: 7.59 (5.73–10.45)

Notes:Values are presented as Median (Q1–Q3). Weekday sedentary behavior: Average sedentary time during weekdays (Monday–Friday).Weekend sedentary behavior: Average sedentary time during weekends (Saturday–Sunday).Total sedentary behavior: Weighted daily mean = (weekday×5 + weekend×2)/7. Groups for Chronic Disease – 'Yes' indicates presence of at least one self-reported chronic condition; 'No' indicates absence of chronic disease. Smoking status – 'Yes' indicates current smokers; 'No' indicates non-smokers. Gender – Self-reported as female or male.

Correlation analysis revealed weak but significant positive associations between sedentary time and FINDRISC (weekday r=0.108, weekend r=0.127, total r=0.120; all p<0.05) (Table 4). Subgroup analyses showed stronger associations among students with chronic diseases (r=0.21, p=0.01) and overweight/obese students, and sensitivity analyses confirmed that the highest quartile of sedentary time had higher FINDRISC scores (p<0.01).

Table 4: The relationship between FINDRISC Score and SBQ

		FINDRISC Score	Weekday Sedentary	Weekend Sedentary	Total Sedentary
FINDRISC Score	r	1.000			
	p	.			
Weekday SBQ duration	r	0.108	1.000		
	p	0.034			
Weekend SBQ duration	r	0.127	0.855	1.000	
	p	0.012	0.000**	.	
Total SBQ duration	r	0.120	0.986	0.925	1.000
	p	0.019	0.000**	0.000**	.

p < 0.05; ** p < 0.01

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In multivariable regression, BMI (B=0.54), age (B=0.38), and total sedentary time (B=0.14) were the strongest independent predictors, explaining 30% of the variance (adjusted R^2=0.304). Gender, chronic disease, and medication use also reached statistical significance, though in unexpected inverse directions, while smoking was not significant (Table 5). These findings highlight the importance of sedentary time, BMI, and age as key contributors to elevated diabetes risk in young adults.

Table 5. Multiple Linear Regression Analysis Predicting FINDRISC Score

Predictor	B (Unstandardized)	SE	95%CI(Lower–Upper)	t	p
Constant	-11.836	2.216	-16.192 – -7.479	-5.341	<0.001
Total Sedentary Time (hours/day)	0.142	0.045	0.053 – 0.231	3.151	0.002
Age	0.378	0.091	0.199 – 0.558	4.139	<0.001
BMI	0.542	0.054	0.436 – 0.648	10.076	<0.001
Gender	-0.894	0.418	-1.716 – -0.072	-2.139	0.033
Chronic Disease	-1.723	0.695	-3.090 – -0.356	-2.478	0.014
Smoking	0.005	0.469	-0.917 – 0.926	0.010	0.992
Regular Medication Use	-1.550	0.741	-3.007 – -0.093	-2.092	0.037

Model Summary: Adjusted R^2 = 0.304, F(7, 377), p < 0.001.Note: Standardized β coefficients were also calculated, indicating BMI (β=0.41) as the strongest predictor, followed by age (β=0.29) and sedentary time (β=0.12). Other predictors (gender, chronic disease, regular medication use) had weaker β values (<0.10).

DISCUSSION

The risk of T2DM is a significant public health issue that has seen an increase in prevalence among young people and adults. Several factors, including genetics, physical and psychosocial conditions, lifestyle, and the environment, contribute to the risk of developing T2DM. Recent studies have reported a direct relationship between T2DM and SB (Hamilton et al., 2014). In this context, it is necessary to investigate the relationship between SB and T2DM in different populations. Risk factors should be determined for young individuals, whose numbers are high in the population of Turkey, for the prevention of T2DM. Although the correlations were weak, the consistency across weekday, weekend, and total sedentary time suggests a cumulative impact of prolonged SB on metabolic risk. Even small effect sizes at the individual level may accumulate to substantial public health consequences in populations where university students represent a significant demographic segment. While determining the risk factors, the role of physical activities of young individuals in the field of health is insufficiently studied in the literature (Dietz et al., 2020).In addition, a modifiable risk factor such as SB for T2DM can be prevented from threatening the health of young people. Therefore, this study aimed to evaluate the levels of SB among university students in Turkey in terms of their risk for T2DM.

In this study conducted in Turkey, the SB of the students were examined, and the total sedentary behaviour was calculated as 8.72±4.32 hours per day. Weekday sedentary behaviour was calculated as 6.31±3.17 hours per day, and weekend sedentary behaviour was calculated as 2.41±1.33 hours per day. These calculated data indicate that university students have a high duration of SB (Matthews et al., 2012) and that there is a difference in SB duration between weekends and weekdays. The shorter SB duration on weekends can be attributed to students engaging in more physical and social activities during that time, while longer periods of inactivity occur during class hours throughout the week. No significant differences were observed by gender, marital status, or academic year; however, sedentary time was longer among smokers, students with chronic disease, and those on continuous medication. A study involving 451 university students highlighted that SB durations did not vary based on sociodemographic characteristics such as gender, age, education program, and different

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academic year levels (Sutherland et al., 2023). Similarly, this study also found that university students exhibited prolonged durations of SB, consistent with previous research findings. However, a study conducted in Saudi Arabia reported that male university students engaged in more SB than female students, which contrasts with the findings of this study. This discrepancy may be attributed to variations in the social, economic, cultural, and individual lifestyle habits of the university students participating in the studies (Sutherland et al., 2023). In this study, it was found that sedentary periods were longer among students with chronic diseases, regular medication users, and smokers compared to other student groups (Alahmadi et al., 2024). In a study conducted in England, it was found that sedentary periods of those with chronic diseases and smokers were higher (Cao et al., 2022). The results of the studies support each other. This may be explained by the fact that students smoking in sitting position, students with chronic diseases and students who constantly use medication have higher sedentary time because they need more rest than other students. This may be due to the fact that students studying in undergraduate departments have more intensive and heavy courses and students study on weekends. This study conducted in Turkey, it was determined that 62.6% of university students had low risk, 25.2% had mild risk, 6% had moderate risk, 5.5% had high risk and 0.8% had very high risk according to the FINDRISC score. In a study conducted with 341 university students in Spain, it was reported that students had a low risk of T2DM (Alfageme-Garc et al., 2024). In a study conducted with 390 university students in Malaysia, more than two thirds of the student population was at a low risk level, while 23.8% had a slightly high risk, 5.6% had a moderate risk and 0.3% had a high risk (Aris et al., 2020). In a study conducted with 290 medical students in North India, 77% were in the low risk, 22% in the moderate and 1% in the high risk category (Singh et al., 2019). In various studies conducted in different countries, students were similarly found to be at low risk. The reason why similar results were observed in the studies may be explained by the fact that the sample group studied was young. However, in another study conducted with 740 students at Hail University in Saudi Arabia, more than half of the students had moderate and high risk of T2DM (Abd et al., 2023). This difference in results in the literature may be due to the different sociodemographic and health literacy levels of the students.

In this study in Turkey, FINDRISC scores did not show a difference in terms of gender and exercise habits of the students. In a study conducted in Saudi Arabia, it was found that male students had a higher risk of diabetes than female students (Abd et al., 2023). In the study conducted in North India, it was found that moderate and high diabetes risk was significantly associated with no/low physical activity in males (Singh et al., 2019). The results of the studies conducted in North India and Saudi Arabia were associated with a high risk of diabetes due to low physical activity level in male students. However, in this study conducted in Turkey, there was no difference between boys and girls in variables such as SB duration and exercise habits.

In this study, a statistically significant but weak association was found between the amount of time students spent engaging in SB and the risk of T2DM. Despite the modest effect size, the public health relevance should not be underestimated: given that university students represent a large proportion of the young adult population in Turkey, even small risk elevations may translate into a considerable future disease burden. Although effect sizes were small, such findings in young adults are of high public health relevance, since sedentary patterns established early in life often persist into adulthood, amplifying long-term metabolic risk. However, a meta-analysis of 10 studies (6 prospective) involving 505,045 participants found that the risk of T2DM associated with extended TV viewing time was 112% higher than that associated with minimal TV viewing time.20 The results of this study conducted in Turkey differ from those of the aforementioned meta-analysis. This discrepancy may be attributed to the fact that the studies included in the meta-analysis were conducted on different sample groups, which likely contributed to the varying outcomes. Our subgroup analyses suggest that the association between sedentary behaviour and T2DM risk may be stronger in students with chronic diseases and higher BMI, highlighting the importance of targeting high-risk subgroups. Sensitivity analyses further confirmed the robustness of our findings, as students with the highest sedentary time consistently showed elevated diabetes risk scores. Interestingly, chronic

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disease and regular medication use were inversely associated with FINDRISC scores in the regression analysis. One possible explanation is that students with chronic conditions or those on regular medications may have already received medical advice, leading to increased health awareness and more frequent monitoring of diet and lifestyle. Consequently, their reported diabetes risk may appear lower compared to peers without chronic disease, despite their underlying health issues. Another explanation could be related to reporting bias, as individuals with chronic diseases may underreport sedentary time or overreport healthy behaviours due to social desirability. Additionally, the relatively small subgroup of students with chronic diseases or medication use may have influenced the statistical direction of the associations. These findings should therefore be interpreted with caution, and future studies with larger and more diverse populations are warranted to clarify the role of chronic disease and medication in shaping T2DM risk among young adults.Overall, this inverse association was unexpected but insightful, suggesting that increased health awareness and medical guidance among these groups may partially explain the lower FINDRISC scores observed.Additionally, the younger mean age of our participants may explain the weaker associations, as metabolic dysfunction may not yet have fully developed. Another study suggests that it is not yet clear whether very high levels of SB influence the risk of T2DM, as many factors are thought to affect T2DM, and SB alone cannot be solely blamed. Additionally, it has been proposed that the relationship between SB and early-onset T2DM may differ from the relationship between SB and late-onset T2DM (Scandiffio et al., 2021). Therefore, the relationship between the risk of T2DM and SB may vary due to differences in the mean age of participants across the studies conducted in the literature. To our knowledge, this is among the first studies in Turkey to examine sedentary behaviour in relation to a validated diabetes risk score in young adults.

Limitations

This study has certain limitations that should be acknowledged. First, it was conducted at a single university, which may limit the generalizability of the findings to all young adults in Turkey. Second, the cross-sectional design prevents causal inference between sedentary behaviour and the risk of T2DM. Third, both the SBQ the FINDRISC relied on self-reported data, which may be subject to recall bias and social desirability bias. Additionally, as FINDRISC already contains age, BMI and activity, the regression model may involve overadjustment bias, affecting coefficient interpretation.In addition, objective measures such as accelerometers were not used due to resource limitation. Finally, potential confounders such as dietary patterns, sleep quality, and family history of chronic diseases were not comprehensively assessed, which may have influenced the observed associations.

Strengths

This study also has several notable strengths. First, it was conducted with a relatively large sample size of 385 university students, which provided adequate statistical power to detect meaningful associations. Second, validated and reliable instruments (the SBQ and FINDRISC) were used, ensuring robust measurement of both sedentary behaviour and T2DM risk. Finally, data collection was performed using both face-to-face and online surveys, which enhanced participation rates and reduced selection bias. These methodological strengths support the reliability and generalizability of the study findings within the context of the study population.

CONCLUSIONS

In conclusion, this study found that young individuals in Turkey exhibit high levels of SB while having a relatively low risk of T2DM. To promote physical activity among university students, institutions should implement targeted interventions, including awareness-raising training programmes on physical activity. Additionally, integrating compulsory courses on physical activity and health into university curricula across all disciplines may be beneficial. Universities can also be designed as active and health-conscious environments, leveraging advancements in technology to facilitate this transformation. At a policy level, universities should also adopt structural approaches, including compulsory physical activity courses across faculties, redesign of campuses to encourage walking and cycling, and integration of mobile health applications for sedentary behaviour tracking. Such measures

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would not only foster healthier habits in students but also provide a scalable model for nationwide diabetes prevention programs. Such strategies may also align with the WHO Global Action Plan on Physical Activity 2018–2030. Considering that habits developed during young adulthood often persist into adulthood, early preventive interventions may have long-term benefits in reducing the national burden of T2DM.

Innovative approaches, such as mobile technology-based simulations that promote physical activity, can be introduced for young individuals. Furthermore, artificial intelligence tools may be utilised to support students in adopting healthier lifestyles. These strategies could serve as preventive measures against the potential risk of T2DM associated with prolonged SB. However, as the study sample was limited to a single university, the findings cannot be generalised to the broader population. The cross-sectional design prevents causal inference, and the reliance on self-reported measures may have introduced reporting bias. Future multicenter longitudinal studies should include accelerometer-based objective measurement tools to more accurately measure sedentary time and validate self-report data. Future research should include participants from multiple universities across Turkey to enhance the generalisability of the results. Moreover, the development of targeted programmes, campaigns, or curricula aimed at increasing physical activity among university students is recommended. Additionally, future studies should assess students' health literacy levels to provide a more comprehensive understanding of the factors influencing their lifestyle behaviours.

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