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Factors associated with screen time: a binational study across the Mexico-US migration gradient

Factores asociados al tiempo de pantalla: un estudio binacional a lo largo del gradiente de migración México-Estados Unidosp

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Abstract

Objective: This study aimed to assess whether screen time differs across combined migration-obesity and migration-smoking profiles among Mexican-born non-migrants living in Mexico, Mexican-born immigrants residing in the United States, and U.S.-born individuals of Mexican origin.

Materials and methods: We conducted a cross-sectional comparison using two national databases. Multinomial regression models were used to assess differences in screen time across combined migration-obesity and migration-smoking profiles. The study population was classified into three groups: U.S.-born individuals of Mexican origin, Mexican-born migrants residing in the United States, and Mexican-born non-migrants residing in Mexico.

Results: Migration status was significantly associated with screen time, with significant associations involving smoking and obesity. In adjusted analyses, U.S.-born individuals of Mexican origin who reported tobacco use or obesity had the highest Adjusted Relative Risk Ratio (ARRR) for spending more than 4 hours per day on screen time compared to the reference < 2 hours per day. Mexican immigrants in the U.S. Additionally, Mexican immigrants in the U.S. showed increased risks of obesity and smoking, along with higher screen time (> 4 vs. < 2hours/day), compared to non-migrants residing in Mexico.

Conclusions: This cross-sectional binational study highlights that migrant populations exhibit higher screen time combined with risk factors such as obesity and smoking. This profile reflects a risky pattern for Mexican populations migrating to the U.S., highlighting the need for binational public health strategies that address lifestyle impacts in the migration process.

Keywords: Sedentary behavior; Smoking; Obesity; Migration.

Resumen

Objetivo: Evaluar si el tiempo de exposición a pantallas difiere según los perfiles combinados de migración-obesidad y migración-tabaquismo entre personas nacidas en México que no han migrado y viven en México, inmigrantes nacidos en México que residen en los Estados Unidos y personas nacidas en los Estados Unidos de origen mexicano.

Materiales y métodos: Se realizó una comparación transversal de dos bases de datos nacionales. Se realizaron modelos de regresión multinomial para investigar las asociaciones entre estado migratorio, obesidad, tabaquismo y tiempo frente a pantallas. La población se clasificó en tres grupos: personas nacidas en Estados Unidos de origen mexicano, migrantes nacidos en México residentes en Estados Unidos, y personas nacidas en México no migrantes residentes en México.

Resultados: El estado migratorio mostró asociaciones significativas con el tiempo frente a pantallas, con interacciones relevantes con tabaquismo y obesidad. En los análisis ajustados, las personas nacidas en Estados Unidos de origen mexicano que reportaron tabaquismo u obesidad presentaron las mayores razones de riesgo relativo ajustadas (ARRR) para dedicar más de 4 horas diarias a pantallas, en comparación menos de 2 horas por día entre los migrantes mexicanos en Estados Unidos. Asimismo, los migrantes mexicanos mostraron mayor riesgo de obesidad y tabaquismo, junto con mayor tiempo frente a pantallas (> 4 vs. < 2 horas/día), respecto a los no migrantes residentes en México.

Conclusiones: Las conclusiones subrayan la importancia de intEste estudio transversal binacional evidencia que las poblaciones migrantes presentan mayor tiempo frente a pantallas combinado con factores de riesgo como obesidad y tabaquismo. Estos hallazgos reflejan un perfil de riesgo en las poblaciones mexicanas que migran a Estados Unidos y subrayan la necesidad de estrategias de salud pública binacionales que consideren el impacto de los estilos de vida en el proceso migratorio.

Palabras Claves: Conducta sedentaria; Tabaquismo; Obesidad, Migración.

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Introduction

Interventions targeting established risk factors such as tobacco use and sedentary behavior are essential to reduce the burden of diseases such as cancer and cardiovascular disease[1,2,3]. Cardiovascular disease rates are increasing in many populations worldwide. Although common risks of both diseases, such as smoking rates, have declined in many countries, it is still the top cause of preventable death in the U.S[2].

Recent scientific evidence from systematic reviews, observational studies, and controlled clinical trials published in the last five years reveals that cancer and cardiovascular diseases in adults share numerous modifiable and non-modifiable risk factors[4,5]. Central determinants include chronic systemic inflammation, metabolic disorders such as obesity, type 2 diabetes, dyslipidemia, and arterial hypertension, as well as behavioral factors like tobacco use, poor dietary patterns, and insufficient physical activity. In addition, prolonged sedentary behavior and exposure to cardiotoxic cancer therapies further amplify the risk of developing either pathology. Migrant studies, notably among Mexican adults residing in the United States, indicate that acculturation often results in increased sedentary lifestyles and unfavorable shifts in health habits, leading to an erosion of initial cardiovascular health advantages. These converging risk profiles underscore the need for integrated, population-specific prevention strategies targeting shared pathways and modifiable risk factors[6].

Observational studies have found that, for most non-communicable diseases, the risks are determined more by the country to which a person migrates, rather than their birth country[7]. There is evidence indicating the impact of migration on the health of the immigrant population, which warrants further inquiry[8] Previous studies have found that during the migration process to the U.S., immigrants may be exposed to lifestyle choices that include increased tobacco use, unhealthy diets, and greater sedentary behaviors[8,9], On the other hand, for the Latino population, migration to the U.S. implies achieving a higher socioeconomic level, access to healthcare, and lifestyle changes[8,10] Among Latinos living in the United States, the population of Mexican origin is the largest, comprising57% of Latinos residing in the U.S, increasing 5% between 2019 and 2024[11].

The approach of health selection could help compare the health of recent immigrants to that of the native population in the host country[12]. Some studies have suggested that, when assessing health selection, a comparative analysis with individuals remaining in the country of origin is warranted[13]. The immigration process itself is a significant determinant of health[14]. In the context of immigration, specific populations are disproportionately affected by the escalating obesity epidemic, particularly immigrants from Mexico to the United States. Both Mexico and the United States rank among the countries with the highest adult obesity rates worldwide. In Mexico, obesity has the most severe impact, reducing life expectancy by 4.2 years compared to the OECD average of 2.7 years. Meanwhile, the United States is projected to allocate nearly 14% of its health budget to obesity and overweight-related conditions, significantly higher than the OECD average of 8.4% of total health expenditures[15]. However, the cumulative impact of combined conditions such as obesity and smoking during the migration process, as well as their influence on sedentary behaviors (e.g., screen time),

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remains insufficiently understood[14]. To address this, it is critical to distinguish between physical inactivity and sedentary behavior; the former refers to insufficient movement, whereas the latter involves low-energy waking behaviors (< 1.5 METs) performed in a seated or reclining posture[16]. Within this context, screen time has emerged as a key indicator to quantify specific, highly prevalent domains of this sedentary lifestyle in modern populations.

Social inequalities play a significant role in shaping obesity and related health behaviors. According to the National Health Survey (ENSANUT) 2022–2023, obesity prevalence in Mexico was reported at 36.9–37.1%[17], while current tobacco use stood at 19.5%[18]. In contrast, data from the CDC's National Health and Nutrition Examination Survey (NHANES, 2017–2020) indicate that among Mexican-origin adults living in the United States, obesity rates significantly increase, exceeding 44%[19].

This cross-border disparity underscores the profound impact of environmental and lifestyle transitions on health. In 2024 further noted that while U.S. nativity is associated with higher levels of moderate-to-vigorous physical activity, it also correlates with a marked decline in dietary quality compared to recent immigrants[20]. However, despite these known shifts, recent published data on smoking prevalence and sedentary behavior specifically among Mexican Americans and Mexican migrants remain scarce. Notably, high screen time acts as a major contributor to total sedentary behavior, showing a consistent inverse trajectory with physical activity levels across diverse global populations[21].

This suggests that while information may be collected through national surveys, it is not consistently analyzed or disseminated. In addition, sedentary behaviors—particularly prolonged screen time— represent an emerging risk factor that interacts with obesity and tobacco use, yet remain underexplored in both national and binational analyses, underscoring the need for targeted research and publications. To address these gaps, this study aimed to assess whether screen time differs across combined migration-obesity and migration-smoking profiles among Mexican-born non-migrants living in Mexico, Mexican-born immigrants residing in the United States, and U.S.-born individuals of Mexican origin. By utilizing this binational approach, we aim to provide a more nuanced understanding of how the U.S. environment influences sedentary lifestyles compared to the behavioral benchmarks of the population in Mexico.

Materials and methods

Data were derived from parallel cross-sectional surveys of the civilian, non-institutionalized populations in both countries (U.S. National Health and Nutrition Examination Survey (NHANES) 2011–2012 and the Mexican National Health and Nutrition Survey (Encuesta Nacional de Salud y Nutrición, ENSANUT) 2012. These publicly accessible and harmonized records provide a unique opportunity for cross-national comparison, maintaining their scientific relevance for binational health research regardless of the original survey dates.

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Regarding the U.S. sample, NHANES conducted household screenings for approximately 11,500 residences and 13,431 individuals per year, resulting in 9,756 completed interviews. 22 This study specifically focused on a subsample of 505 adults (aged 20-69) who self-identified as 'Mexican American.' In comparison, the Mexican ENSANUT constitutes one of the nation's most comprehensive health databases, encompassing 50,528 households from an initial sample of 89,000 individuals. Our analytical framework utilized data from 10,729 adults who provided complete responses to sociodemographic and physical activity modules. Given that ENSANUT surveys all household members across all age groups, it was methodologically essential to restrict our sample to participants with a homologous demographic profile who provided complete, valid data for the specific variables under study (screen time, sedentary behavior, and smoking status). Detailed methodological procedures for ENSANUT have been described in depth in a study [23].

By harmonizing these national health surveys, we aimed to: 1) assess whether screen time prevalence differs based on migration history; and 2) determine if the co-occurrence of obesity and smoking status exacerbates the likelihood of high screen time exposure across three distinct populations: Mexican migrants in the U.S., residents of Mexico, and U.S.-born individuals of Mexican descent. The following sections outline the standardized measurement of our primary variables and covariates for both countries.

Measurement of screen time and physical activity (ST): The Global Health Activity Questionnaire (GPAQ), developed by the World Health Organization and used in the NHANES (2011-2012)[24]. We used the Spanish version of the International Physical Activity Questionnaire (IPAQ)tool for measuring physical activity and time spent sitting[25].

The GPAQ questionnaire demonstrated moderate validity and reliability compared to device-based measures, such as accelerometers[26], and its capability to assess physical activity and sedentary behavior[27].

According to frequency, duration, type, and intensity of PA, we calculated three domains of PAto estimate vigorous physical activity in minutes per week and moderate physical activity in minutes per week. These were combined to generate variable of minutes of moderate to vigorous PA per week, considering the compendium of PA to coding PA as moderate and vigorous[28].

We based our sedentary variable on time sitting at work, transportation use, time spent watching television, and time spent in front of a computer or other electronic device. Using this composite, we estimated the time sitting per day in front of the screen[24].

Two questions from the GPAQ measured screen time (ST). The questions asked about the hours spent watching TV and playing computer games in the last 30 days. In addition, we estimated hours per day using a computer or playing computer games outside of work or school as the variable.

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At ENSANUT 2012, the International Physical Activity Questionnaire (IPAQ) assessed physical activity and screen time[25]. We also evaluated the validity and reliability of the IPAQ short form against objective measurement using accelerometers. These showed acceptable reliability and relatively fair validity for physical activity in a Mexican sample[25] and sedentary behavior[29].

The IPAQ asks for the time spent on vigorous and moderate activities, as well as walking, in the previous 7 days. This information enabled us to calculate physical activity in three PA domains, estimating the total number of minutes of moderate to vigorous activity per day.

At ENSANUT, two questions assessed sedentary time: 1) hours per day spent in activities in front of a screen, watching TV and/or movies, and 2) hours per day spent playing video games and/or with the computer, from Monday to Friday and during the weekend. We calculated the total amount of time spent sitting as the number of hours per day spent sitting.

Data from GPAQ at NHANES and IPAQ at the ENSANUT calculated hours/day spent in screen time (ST) according to the following categories: 1) < 2hrs/day; 2) 2 to <4 hrs/day, and 3) > 4 hrs/day. The categories, based on other studies, assessed the associations among sedentary behaviors, including time spent in front of a screen, particularly watching TV[30] with obesity and metabolic syndrome[31].

Migration status: This variable was categorized into three distinct groups based on the participants' place of birth and current country of residence: (1) Non-migrants, comprising Mexican nationals born and living in Mexico; (2) Mexican immigrants, defined as Mexico-born individuals who have relocated to the United States; and (3) Mexican Americans, encompassing individuals of Mexican ancestry born and residing in the U.S.

Body Mass Index: Anthropometric data, specifically height (m) and weight (kg), were collected in both NHANES32 and ENSANUT[23] following standardized clinical protocols. BMI was subsequently calculated using the standard formula kg/m². To this analysis, obesity was classified as a BMI threshold of 30 consistent with international guidelines[33].

Smoking: In the present study, we considered participants as smokers if they answered affirmatively to the question: " Have you smoked at least 100 cigarettes in your life?" for both national surveys, NHANES[32] and ENSANUT[23].

Covariates were selected a priori based on literature precedence and conceptual plausibility regarding their association with the analyzed behavioral profiles. Accordingly, we included sociodemographic characteristics associated with health status, such as age, gender, educational attainment, and employment status. Participants were classified as having type 2 diabetes mellitus, hypertension, or hypercholesterolemia if they self-reported a prior diagnosis of any of these conditions by a health professional.

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Despite modeling migration status, obesity, and smoking separately on-screen time as continuous variables allow estimation of independent associations, our objective was to examine combined migration-health risk profiles. Therefore, we joined the national data bases of both countries and analyzed the data together to explore the associations through combined categories created to characterize joint migration-health risk profiles rather than to estimate the independent effects of migration status, obesity, or smoking. The following categories were generated to assess the joint association, 1) obesity and migration status: a) non-migrant, non-obese, b) non-migrant with obesity, c) Mexican immigrants to the U.S., non-obese, d) Mexican immigrants to the U.S. with obesity, e) Mexican Americans, non-obese, f) Mexican Americans with obesityand2) tobacco and migration status(Table 1): a) non-migrant, b)non-smoking, non-migrants who smoke, c) Mexican immigrant to the U.S., non-smoking, d) Mexican immigrant to the U.S. who smoke, e) Mexican-Americans, non-smoking, f) Mexican-Americans who smoke. No evidence of multicollinearity was observed among the covariates included in the models (all Variance Inflation Factors -VIF- values < 5).

To explore the joint association of migration status, obesity, and smoking with screen time, we performed multinomial regression analysis using '<2 hours per day' as the base outcome. We first estimated unadjusted models, followed by adjusted models to calculate Adjusted Relative Risk Ratios (ARRRs). These ARRRs assess the main exposures while holding all other variables constant. The final models controlled sociodemographic characteristics, weekly minutes of moderate-to-vigorous physical activity, body mass index (BMI), and comorbid health conditions (including high blood pressure, diabetes, and hypertriglyceridemia.

Results

Table 1 shows the socio-demographic characteristics of the study population. Mexican immigrants living in the U.S. were older than the other two groups—non-migrants and U.S.-born Mexican Americans—with an average age of 43.2 years. They also exhibited a higher employment rate (66.8%), as well as elevated prevalence of type 2 diabetes (13.4%) and high cholesterol levels (26.5%). U.S.-born Mexican Americans had the highest average body mass index (BMI) at 30.9, and a greater proportion (43.7%) reported having smoked at least 100 cigarettes in their lifetime. In contrast, the non-migrant Mexican population had lower educational attainment compared to their immigrant counterparts.

Table 2 displays socio-demographic characteristics stratified by immigration status and time spent in screen time (ST). Higher levels of smoking and BMI were associated with increased ST and greater acculturation. Among U.S.-born Mexican Americans who reported more than 4 hours of ST per day, the highest average BMI was observed (31.4), and 51.3% reported having smoked at least 100 cigarettes in their lifetime

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Table 1. Socio-demographic and health status variables by migration status (NHANES 2011-2012 and ENSANUT 2012)

Socio-demographic and health status variables	**Non migrant** (living in Mexico) **(%)**	**Mexican immigrant to the US (%)**	**Mexican Americans** (US Born of Mexican Origin) **(%)**
Gender			
Female	60.8	44.6	51.1
Male	39.2	55.3	48.8
Age			
Mean (SD)	41.6 (13.3)	43.2 (12.5)	41.7 (15.4)
Age categories			
20-29 years	21.4	15.4	29.9
30-49 years	49.4	50.6	35.6
50-69 years	29.2	33.9	34.5
Education level			
Less than high school	78.4	66.8	27.6
High school and higher	21.6	33.2	72.4
Occupation			
Employed	50.6	66.8	63.8
Unemployment	49.4	33.2	36.2
Health risk conditions			
Diabetes	9.1	13.4	10.3
High blood pressure	15.2	20.2	32.2
High Cholesterol	12.9	26.5	25.9
Smokers	**29.9**	**32.4**	**43.7**
Body Mass Index	**28.7 (5.5)**	**29.5 (5.4)**	**30.9 (6.6)**
Minutes of moderate- vigorous physical activity per week	131.9 (110.6)	105.1 (154.8)	104.4 (122.7)

Note: NHANES (U.S. National Health and Nutrition Examination Survey). ENSANUT (Encuesta Nacional de Salud y Nutrición).S.D. (Standard Deviation) U.S. (United States)*Smokers: have smoked at least 100 cigarettes during the life.
Source: Own elaboration.

Table 2. Socio-demographic characteristics and health status variables according to migration status in Mexico and in the US, and screen time

Socio-demographic and health status variables	**Non migrant** (living in Mexico) **(%)**			**Mexican immigrant to the US (%)**			**Mexican-Americans** (U.S. Born o Mexican Origin) **(%)**		
	Screen time per day								
	< 2hrs	*2 to < 4 hrs*	*≥ 4hrs*	*< 2hrs*	*2 to < 4 hrs*	*≥ 4hrs*	*< 2hrs*	*2 to < 4 hrs*	*≥ 4hrs*
Gender	57.9	27.8	*14.3*	*38.7*	*44.7*	*16.6*	*16.7*	*35.6*	*47.7*
Female	60.5	26	13.5	42.5	40.7	16.8	12.4	42.7	44.9
Male	53.9	30.4	15.6	35.7	47.9	16.4	21.2	28.2	50.6
Age									
Mean (SD)	43.6 (13.1)	40.1 (13.4)	36.7 (12.7)	43.8 (12.2)	42.2 (12.7)	44.3 (13.1)	36.5 (13.6)	44.5 (14.9)	41.4 (15.9)
Age categories									
20-29 years	43.5	33.4	23.1	33.3	51.3	15.4	25	23.1	51.9
30-49 years	58.8	27.2	13.9	37.5	46.1	16.4	16.1	40.3	43.6

To be continued...

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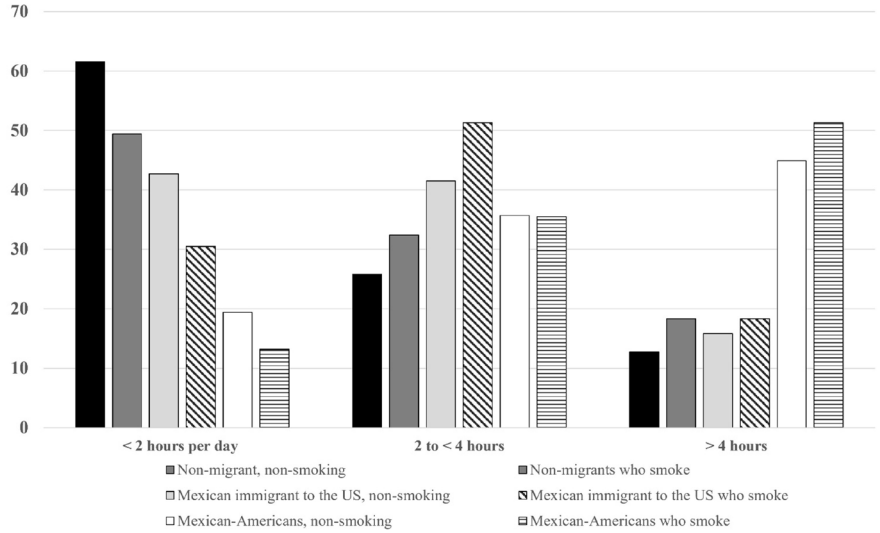
50-69 years	67	24.5	8.5	43	39.5	17.4	10	41.7	48.3
Education level									
Less than high school	62.6	26.1	11.3	39.6	48.5	11.8	16.7	41.7	41.7
High school and higher	40.9	33.8	25.3	36.9	36.9	26.2	16.7	33.3	50
Occupation									
Employed	55.9	28.9	15.1	40.8	44.9	14.2	16.2	40.5	43.2
Unemployment	59.9	26.5	13.5	34.5	44.1	21.4	17.5	26.9	55.6
Health risk conditions									
Diabetes	62.3	26.1	11.6	29.4	44.1	26.5	11.1	33.3	55.6
High blood pressure	61.2	26.8	12	43.1	39.2	17.6	16.1	37.5	46.4
High Cholesterol	58.8	28.7	12.5	32.8	41.8	25.4	8.9	26.7	64.4
Smokers*	49.3	32.4	18.3	30.5	51.2	18.3	13.2	35.5	51.3
Body Mass Index	28.7 (5.4)	28.7 (5.6)	28.8 (6)	28.9 (5.5)	29.7 (5.1)	30.3 (5.7)	29.6 (5.6)	31.2 (6.5)	31.4 (7.0)
Minutes of moderate-vigorous physical activity per week	138.7 (111.1)	129.5 (110.2)	109.4 (102.7)	121.4 (178.8)	100.7 (139.8)	78.8 (129.9)	129.8 (161.1)	115.3 (132.6)	87.4 (96.0)

Note: S.D. (Standard Deviation) U.S. (United States) *Smokers: have smoked at least 100 cigarettes during the life.
Source: Own elaboration.

Figure 1 illustrates the relationship between migration status, smoking, and screen time (ST). Among all groups, Mexican non-migrants who do not smoke reported the lowest daily screen time, with 61.6% spending less than 2 hours per day. In contrast, U.S.-born Mexican Americans who smoke exhibited significantly higher screen time: 51.3% spent more than 4 hours per day, while only 13.2% spent less than 2 hours.

Figure 1. Joint associations between smoking condition and migration status on screen time (hours per day). (NHANES 2011-2012 and ENSANUT 2012)



Note: National databases of both countries were joined to analyze the data together to explore the associations through combined categories created to characterize joint migration-health risk profiles. U.S. United States. U.S. United States. Percentage of screen time according to combined categories of smoking condition and migration status. Screen time cut-off points: < 2 hours/day; 2 to <4 hours/day and ≥ 4 hours/day (Dunstan, 2007).

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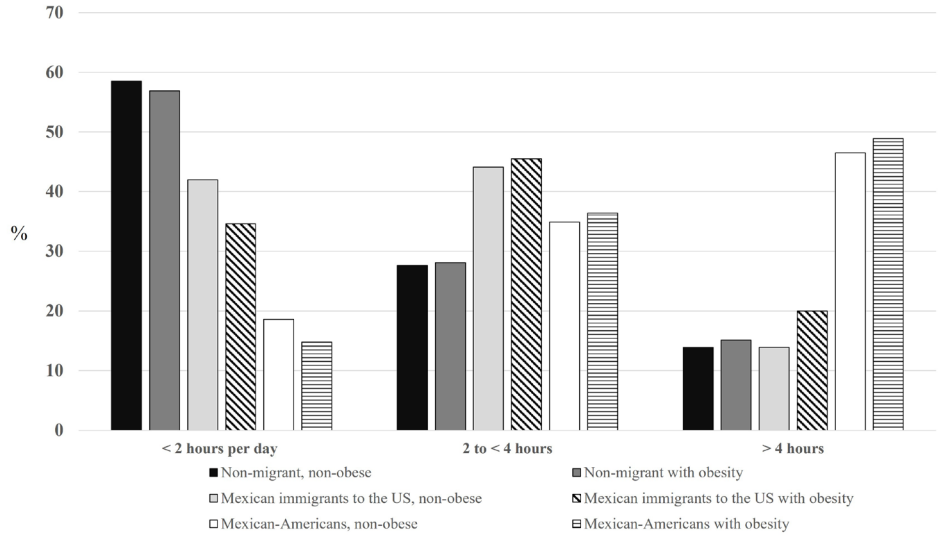
Figure 2 shows that Mexican Americans with obesity had the highest screen time, with 48.9% spending more than 4 hours of screen time per day, compared to only 14.8% among non-migrant Mexicans living in Mexico.

Figure 2. Joint associations between obesity condition and migration status on screen time (hours per day). (NHANES 2011-2012 and ENSANUT 2012)



Note: National databases of both countries were joined to analyze the data together to explore the associations through combined categories created to characterize joint migration-health risk profiles. U.S. United States. Percentage of screen time according to combined categories of obesity condition and migration status. Screen time cut-off points: < 2 hours/day; 2 to <4 hours/day and ≥ 4 hours/day (Dunstan, 2007).

Table 3 presents the result from multinomial regression models, indicating that migration to the U.S. is associated with increased screen time. The relation was amplified when considering the joint association between migration status and smoking. Compared to non-smoking non-migrants, Mexican immigrants and U.S.-born Mexican Americans who smoked showed significantly higher relative risk ratio (RRR) of prolonged screen time. The strongest association was observed among U.S.-born Mexican Americans who smoked, with an Adjusted Relative Risk Ratio (ARRR) of 13.3 (95% CI: 6.5–27.5) for spending more than 4 hours per day on screen, and an ARRR of 5.12 (95% CI: 2.45–10.7) for 2 to < 0.001).

Table 4 shows adjusted regression models assessing the joint association of obesity and migration status on screen time. Mexican immigrants with obesity had an ARRR of 2.21 (95% CI: 1.27–3.83), while U.S.-born Mexican Americans with obesity had an ARRR of 9.76 (95% CI: 5.07–18.78), indicating a substantially higher risk of prolonged screen time compared to non-obese non-migrants. Migration status alone also increased risk: U.S.-born Mexican Americans who were not obese had an ARRR of 6.63 (95% CI: 3.61–12.15) ($p < 0.001$).

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Goodness-of-fit for the multinomial logistic regression models was evaluated using likelihood ratio and deviance statistics, comparing the fitted models with the corresponding null models. The likelihood ratio tests indicated that all multinomial logistic regression models provided a significantly better fit than the corresponding null models (all $p < 0.001$).

Table 3. Association of screen time according to migration status and smoking conditions

Migration and smoking status	Screen time per day			
	Unadjusted models		Adjusted models	
	2 to < 4 hours	*≥ 4 hours*	*2 to < 4 hours*	*≥ 4 hours*
	RRR (95% CI)	**RRR (95% CI)**	**ARRR (95% CI)**	**ARRR (95% CI)**
Non-migrant, non-smoking	*reference*	*reference*	*reference*	*reference*
Non-migrant who smoke	1.56 (1.41, 1.73) **	1.80 (1.59, 2.03)**	1.55 (1.38, 1.73)**	1.86 (1.61, 2.14)**
Mexican immigrant to the US, non-smoking	2.32 (1.66, 3.23)**	1.79 (1.15, 2.81)*	2.10 (1.50, 2.95)**	1.54 (0.97, 2.46)
Mexican immigrant to the US who smoke	4.01 (2.43, 6.60)**	2.91 (1.53, 5.56)*	3.75 (2.25, 6.25)**	2.75 (1.40, 5.38)*
Mexican-American, non-smoking	4.40 (2.51, 7.71)**	11.26 (6.54, 19.39)**	3.24 (1.83, 5.75)**	6.63 (3.75, 11.71)**
Mexican-American who smoke	6.44 (3.11, 13.35)**	18.97 (9.43, 38.16)**	5.12 (2.45, 10.70)**	13.31 (6.45, 27.46)**

* p< 0.01, p < 0.001. < 2 hours per day considering as the base outcome. (RRR) Relative Risk Ratio, (ARRR) Adjusted Relative Risk Ratio. Adjusted models: multinomial multivariate models are adjusted for age, sex, education level, employment status, moderate to vigorous physical activity per week, health conditions as diabetes, high blood pressure and high cholesterol levels.

Tabl 4. Association of screen time according to migration and obesity condition.

Migration and obesity condition	Screen time per day			
	Unadjusted models		Adjusted models	
	2 to < 4 hours	*≥ 4 hours*	*2 to < 4 hours*	*≥ 4 hours*
	RRR (95% CI)	**RRR (95% CI)**	**ARRR (95% CI)**	**ARRR (95% CI)**
Non-migrant, non-obese	*reference*	*reference*	*reference*	*reference*
Non-migrant with obesity	1.04 (0.94, 1.15)	1.11 (0.98, 1.25)	1.12 (1.01, 1.24)*	1.25 (1.10, 1.43)**
Mexican immigrant to the US, non-obese	2.22 (1.55, 3.18)**	1.39 (0.83, 2.33)	2.01 (1.39, 2.90)**	1.21 (0.71, 2.06)
Mexican immigrant to the US with obesity	2.78 (1.82, 4.26)**	2.43 (1.43, 4.13)**	2.62 (1.70, 4.04)**	2.21 (1.27, 3.83)**
Mexican-American non-migrant, non-obese	3.97 (2.16, 7.30)**	10.49 (5.85, 18.83)**	3.01 (1.62, 5.59)**	6.63 (3.61, 12.15)**
Mexican-American non-migrant with obesity	5.21 (2.73, 9.96)**	13.89, (7.43, 25.94)**	4.28 (2.21, 8.28)*	9.76 (5.07, 18.78)**

* p< 0.01, p < 0.001. < 2 hours per day considering as the base outcome. (RRR) Relative Risk Ratio, (ARRR) Adjusted Relative Risk Ratio Adjusted models: multinomial multivariate models are adjusted for age, sex, education level, employment status, moderate to vigorous physical activity per week, health conditions as diabetes, high blood pressure and high cholesterol levels.

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Discussion

Findings from this study show that obesity and smoking are two risky behaviors associated positively with engaging in sedentary behaviors such as screen time. The positive joint association of obesity and smoking with screen time is presumably related among Mexicans who migrated to the U.S. Among Mexican Americans, the results showed that their risk was higher when compared to Mexicans who were still living in Mexico.

By pooling two survey data sets involving people of Mexican origin, one from Mexico and the other from the United States, we were able to demonstrate that these associations varied across migration status. The combined categories were developed to operationalize a conceptual framework centered on risk-factor clustering across migration contexts, rather than to estimate the independent effects of migration status, obesity, and smoking. The joint associations were strongest among those who were born in Mexico and had not migrated.

According to the 2024 American Time Use Survey, watching TV is the leisure activity for which most of the population spends time, averaging 2.6 hours per day for those aged 15 years or older[34]. We found that on average, 51.3% of the Mexican Americans who also smoked, and 48.8% with obesity, spent more than 4 hours of ST, including viewing TV, on computers, and personal devices. These proportions were almost double that of the U.S.-born Mexican Americans compared to Mexican immigrants to the U.S. This may indicate that more acculturated groups are at most significant risk for inflammation.

Our study corroborated other's findings. A longitudinal study showed evidence of increasing risks when factors like obesity, tobacco use, and time in front of the TV, where long with cancer and cardiovascular disease in an Australian Population[35]. This evidence suggests an association between sedentary behaviors, like watching TV, with cancer mortality for those who are also current smokers. The magnitude of the association between cardiovascular mortality and TV time among smokers was less clear apparent ever, the evidence assessing joint associations of sedentary behaviors particularly screen time and lifestyle risk factors in vulnerable populations is still limited in the U.S. and Mexico. Meanwhile, sedentary behaviors have been studied as factors that help increase obesity in the U.S. population. Screen-time, like excessive time spent on video and computer games and new technological devices, and watching TV, are common sedentary behaviors in the U.S. adolescents linked to risk factors as high blood pressure rates and high cholesterol[36].

The influence of migration under an acculturation approach has been studied widely and cannot be compared directly with the results of this study because our measurement of a construct of acculturation was not feasible[37]. The results are indicative of the association between migration and health behaviors. One research examined 26 studies on smoking cessation American and Mexican in the US concluded that acculturation is positively related to smoking cessation behaviors[38]. However, the impact of acculturation in health risk behaviors is not limited to populations of Hispanic

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origin or those who are living in the U.S. On the other hand, prior epidemiological literature has shown that a longer duration of residence in the host country is associated with a higher risk of smoking, particularly among immigrant women including countries in North America and Europe, potentially reflecting the impact of acculturation[37].

Evidence from our representative national databases of both countries adds to the scarce literature on bi-national research on this topic. Consistent with the behavioral shifts noted by Rolle et al., [20] regarding nativity and health, there remains a critical need to investigate the combination of modifiable risk factors like smoking and screen-time-based sedentary behavior. As our results suggest, examining the joint association of these behaviors is vital to elucidate the full impact of the U.S. environment on the health trajectory of Mexican immigrants and their U.S.-born counterparts.

Future research is needed on improving measurement tools for sedentary behaviors, as well as providing a wider assessment of various health conditions. Some of these factors may occur concomitantly among at risk populations (smoking, obesity, and sedentary lifestyle). In addition, more longitudinal studies are needed to assess the evolution over time of risk factors and how they are influenced by migration. These results offer scientific evidence which could be useful to inform early intervention. For example, prevention programs could differentiate among migrant vs U.S. born populations. This could be a factor to consider in the promotion of better health behaviors to prevent highly prevalent diseases related to lifestyle factors, such as cancer and cardiovascular disease. This is particularly relevant for eliminating disparities among vulnerable populations who migrate to the U.S. for better life conditions. As we strive for health equity in cancer prevention and control, examining what changes and what stays the same, in the process of adaptation to the new country and its culture, and what may reduce risk, is critical to maintain the health of vulnerable populations and to decrease the cancer and cardiovascular disease burden throughout the Americas.

Several constraints must be acknowledged when interpreting these results. Primarily, the cross-national comparison is inherently limited using distinct assessment modules for sedentary behavior: the GPAQ in the NHANES dataset and the IPAQ in ENSANUT. Although these instruments utilize different methodologies, both are globally recognized and validated metrics for quantifying screen time, ensuring a reliable framework for this binational study. Even though differences in question wording, recall structure, and measurement procedures may have introduced variability in sedentary time estimates and may limit direct comparability between surveys. Therefore, cross-country comparisons should be interpreted with caution. Nevertheless, the use of nationally representative datasets and standardized threshold-based classifications strengthens the relevance of the findings for population health surveillance and health promotion.

Additionally, our characterization of migration status was restricted to birthplace and current residency. The absence of more nuanced variables, such as legal documentation status or validated acculturation scales, may limit the ability to capture the full psychosocial complexity of the migratory experience. Other limitation is that the study was designed to examine associations between

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migration-related characteristics, tobacco use, and combined movement behavior profiles, rather than to evaluate potential interactions among these factors. Consequently, the analyses did not assess whether the association between migration experience and screen time differed according to smoking status, nor whether duration of residence was independently associated with tobacco use. Future studies should explore these potential interaction pathways to better understand the complex relationships between migration, health behaviors, and sedentary lifestyles.

A potential limitation of this study is that we did not isolate the independent effects of smoking, obesity, or migration status on screen time. However, estimating the isolated contribution of each individual factor was beyond the scope of this research. Instead, our methodological approach allowed us to evaluate how screen time differs across these complex, combined risk profiles, offering a more integrated perspective on how these interconnected factors manifest in transnational populations.
Furthermore, it is important to acknowledge that the data utilized in this study was collected in 2012. While lifestyle patterns may have evolved since then, this specific timeframe provides a unique and necessary dataset that includes the precise metrics required for this binational comparison across all three groups. Finally, the cross-sectional nature of these data precludes the estimation of causality between migration and lifestyle shifts. While longitudinal measurements at the national level would be ideal to track these relationships over time, our results nonetheless offer critical and timely insights into the health trajectories of populations migrating from Mexico to the United States.

An important characteristic of this study is its focus on the identification of combined behavioral profiles rather than on isolated associations between individual movement-related behaviors and sociodemographic characteristics. This approach acknowledges that health behaviors rarely occur independently and provides a more comprehensive understanding of how sedentary behavior, physical activity, and related factors coexist within population subgroups.

Additionally, the use of threshold-based screen time categories aligned with international recommendations enhances the public health relevance of the findings. By identifying profiles that exceed recommended levels of daily screen exposure, the results may be more readily translated into surveillance strategies, health promotion initiatives, and targeted interventions than estimates based solely on marginal changes in continuous measures. This approach also facilitates comparability across studies and supports the development of evidence-based behavioral guidelines.

Conclusions

This study highlights the importance of examining screen time within the context of combined behavioral and migration-related profiles rather than as isolated behavior. Individuals of Mexican descent who were born in the United States and who also reported smoking or obesity were more likely to belong to profiles characterized by elevated screen time, suggesting a clustering of health-related risk factors within specific population subgroups. These findings underscore the need for public health

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strategies that move beyond single-risk approaches and instead consider the broader social, migration, and lifestyle contexts in which sedentary behaviors occur. Tailored interventions targeting high-risk behavioral profiles may contribute to more effective prevention efforts in transnational populations.

Conflict of interest

The authors declare no conflict of interest related to this work.

Ethical considerations

This study constitutes a secondary analysis of publicly available datasets from the National Health and Nutrition Examination Survey (NHANES) and the Encuesta Nacional de Salud y Nutrición (ENSANUT). Because all participant data are fully anonymized and de-identified prior to public release.

Use of artificial intelligence

The authors declare that they have not used any generative artificial intelligence applications, software, or websites in the writing of this manuscript, in the design of tables and figures, or in the analysis and interpretation of the results.

Authors' contributions

Conceptualization: K.G.C., L.B.G.; Data Curation: K.G.C.; Formal Analysis: K.G.C.; Investigation: K.G.C., L.B.G.; Methodology: K.G.C., L.B.G., N.M.; Project Administration: K.G.C., L.B.G.; Funding Acquisition: L.B.G., J.S.; Resources: L.B.G., J.S.; Software; L.B.G., N.M., J.S.; Supervision: L.B.G., J.S.; Validation: K.G.C., L.B.G., N.M.; Visualization: K.G.C., L.B.G., N.M., J.S.; Writing original draft: K.G.C.; Writing, review and editing: K.G.C. L.B.G., N.M., J.S.

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