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Barriers to a healthy diet and physical activity in Mexican adults: results from the Mexican Health and Nutrition Survey

Gerardo A. Zavala¹  | Tom S. Ainscough² | Aura C. Jimenez-Moreno³

¹Department of Health Sciences,
University of York, York, UK

²UK Department for Education, London,
UK

³Evidera-PPD, London, UK

Correspondence

Gerardo A. Zavala, Seeborn Rowntree
Building, Heslington, York YO10 5DD, UK.
Email: gzavala@gmail.com

Abstract

This study aims to (1) identify the most prevalent perceived barriers for healthy eating and performing physical activity among adults in Mexico; and (2) determine the association between perceived barriers, with body mass index (BMI) categories, geo-demographic and socio-economic characteristics. We carried out a cross-sectional, secondary analysis of publicly available data from the *Mexican Health and Nutrition Survey* 2016. We extracted data from 6406 adults, aged 20–65 years, including: perceived barriers for healthy eating and for performing physical activity, BMI, residence area, region of Mexico, sex, age and socio-economic status. Logistic regression models were used to evaluate the association between perceived barriers with the categories of obesity, geographic and socio-demographic variables. Seventy-four point nine percent of the respondents were categorised as having either overweight or obesity, 80.5% reported at least one barrier to healthy eating and 78.3% at least one barrier to performing physical activity. Of the listed barriers, the most reported barriers were 'lack of affordability' (58.6%) for healthy eating and 'lack of time' (51.2%) for performing physical activity. Females (OR 1.27, 95% CI 1.11 to 1.46) and people with obesity (OR 1.19, 95% CI 1.01 to 1.41) were more likely to report barriers to a healthy diet; and females (OR 1.39, 95% CI 1.41 to 1.59), people with obesity (OR 1.41, 95% CI 1.19 to 1.69) and those living in rural areas (OR 1.49, 95% CI 1.30 to 1.72) were more likely to report barriers to performing physical activity. There was a high prevalence of reported barriers for healthy eating and performing physical activity. Females, people with obesity, and those living in rural areas are more likely to report barriers for healthy eating and for performing physical activity. Targeted health programmes and tailored interventions that address the barriers to a healthy lifestyle that these groups experience may encourage healthier lifestyle behaviours in a greater proportion of Mexican adults.

KEYWORDS

barriers, diet, lifestyle, Mexico, physical activity, socio-economic status

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INTRODUCTION

With around three-quarters of the population living with either overweight or obesity, Mexico has one of the highest rates of overweight and obesity in the world (Uribe-Carvajal et al., 2018), and for the past 20 years the Mexican government has been struggling, with very little success, to tackle this epidemic (Rüh, 2017). In Mexico, obesity is linked with more deaths than malnutrition and infectious diseases (Rtveladze et al., 2014) and represents a significant but modifiable burden for the public health system (Rtveladze et al., 2014).

Obesity is a multifactorial disease, resulting from a combination of poor diet, high intake of low nutrient, energy dense food, sedentary lifestyle and genetics (Streppel et al., 2005; Thorogood et al., 2011; Villalobos-Comparán et al., 2008; Wu et al., 2009; Zavala et al., 2013). Three of these four major factors can be targeted by lifestyle-change interventions. Evidence shows how lifestyle interventions are causally related to a multitude of health benefits, including sustainable weight loss, reduction in coronary heart disease (Wu et al., 2015), prevention of type 2 diabetes (Dunkley et al., 2014; Tuomilehto et al., 2001), reduced blood pressure (Whelton et al., 2002) and reduction in depression levels (Firth et al., 2019). There is also an economic incentive for governments to invest in policies and campaigns to promote these lifestyle interventions, with studies suggesting that every dollar invested returns over \$5 back to the economy through cost-savings and increases in productivity and quality of life (Richardson, 2012).

In order for strategies promoting lifestyle changes to be more effective, they should be comprehensive, tailored to local needs and achievable by those that the intervention is intended to benefit (Barker et al., 2018; Kushner & Ryan, 2014). Studies in hospital and community settings around the world have identified barriers and facilitators for a healthy diet and performing physical activity (AlQuaiz & Tayel, 2009; Kadariya & Aro, 2018; Kumar et al., 2016). However, currently, very little is known about the barriers faced by adults in Mexico to eating a healthy diet and performing physical activity, making this an important and necessary first step in developing more effective strategies for lifestyle change in Mexico.

The purpose of this study was to explore perceived barriers and facilitators to a healthy lifestyle in Mexico. As diet and exercise both play such a pivotal role in reducing the mortality rate of preventable diseases in Mexico (Rüh, 2017), these two aspects have been prioritised for this study. This work is intended to better equip policy makers and healthcare professionals to develop and implement more effective strategies for targeting unhealthy lifestyles in Mexican adults.

The aims of this study are to (1) identify and describe the most prevalent perceived barriers for healthy eating and performing physical activity among adults in Mexico; and (2) determine whether perceived barriers are associated with socio-economic, geo-demographic and anthropometric characteristics of respondents.

METHODS

Study design

This is a cross-sectional study using data from the 2016 *National Health and Nutrition Survey (ENSANUT)* (ENSANUT, 2016) conducted in Mexico, which is the latest publicly available data with information about perceived barriers for healthy eating and performing physical activity. *ENSANUT* is an open-access database lead by the National Public Health Institute and the Secretary of Health in Mexico (Romero-Martínez et al., 2017). Since 2006, this project has collected data from representative samples of Mexican households regarding health, nutrition and healthcare utilisation outcomes with the aim of identifying potential targets for health interventions in the population. The National Public Health Institute Ethics Review Board approved the 2016 *ENSANUT* survey, including further analysis of recorded data, with informed consent obtained from all participants. The present study is reported in line with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (Von Elm et al., 2007).

Study sample

The total sample of *ENSANUT* includes a probability sample of over 5000 households in Mexico, representing all geographical regions of the country. This sample is estimated to represent the entire Mexican population, including both urban and rural areas. From the total number of households, 9408 adults were selected with a 91% response rate. Only 6653 adults between 20 and 65 years were asked the questions about barriers for healthy eating and performing physical activity and of these, 247 were missing anthropometric information giving a total number of 6406 participants eligible for the current study. The sample size was estimated using as reference the prevalence of type 2 diabetes of the previous *ENSANUT* survey (2012), which allows estimating the prevalence of diabetes in adults (10%) with a 97.5% confidence. A detailed description of the sampling procedures and survey methodology has been described elsewhere (Romero-Martínez et al., 2017).

Perceived barriers to healthy eating and performing physical activity

The barriers to healthy eating and performing physical activity were asked face-to-face as part of the *ENSANUT* 2016 household questionnaire, using a pre-tested instrument of seven items as presented in [Table 2](#) (Pérez-Noriega et al., 2009). The answer to each question could be “yes”, “no”, or “I do not know”. Missing answers were recorded as “I do not know”.

Covariates

A number of variables were also extracted from the *ENSANUT* 2016 household questionnaire to be included as covariates and to support the stratification of our sample. These variables included: sex (male, female), age (years), residence area (rural, urban), socio-economic status (SES), height and weight to allow calculation of body mass index (BMI) and self-reported history of type 2 diabetes (yes, no). Height and weight were measured by trained personnel. Weight was measured using a digital scale with an accuracy of 100g and height with a stadiometer with an accuracy of 2mm (Pelletier, 1992). Diabetes was considered as a co-variable because it is known that people with type 2 diabetes tend to change their perception about barriers for a healthy lifestyle (Kadariya & Aro, 2018; Marcy et al., 2011).

Sample subgroups were formed based on BMI, SES, sex, residence area and age. BMI classification followed the World Health Organisation classifications of underweight (BMI < 18.49), normal weight (BMI = 18.5–24.9), overweight (BMI = 25–29.9), obesity (BMI > 30). The SES index was constructed using standard procedures (Gutiérrez, 2013), combining eight variables that assessed the household characteristics and available services and classified the sample into three groups: low, medium and high. The eight SES variables included: construction materials of the building's floor, ceiling, and walls; rooms used for sleeping; access to drinking water in the household; vehicle ownership; ownership of household (e.g. refrigerator, washing machine, microwave, stove, boiler) and electrical (e.g. television, radio, telephone, and computer) goods (Gutiérrez, 2013). Residence area was defined as either rural (less than 2500 inhabitants in the town) or urban (more than 2500 inhabitants in the city or town) and was also categorised based on the region of Mexico in which respondents lived (Northern, Central, Mexico City [CDMX] and Southern). Age was divided into four groups: 20–25, 26–35, 36–50, 51–65.

Statistical analysis

Descriptive statistics were used to report sample demographics. Means and interquartile (IQ) ranges were

used to describe continuous variables and total count and percentages were used to describe categorical variables. Multivariate logistic regression models were used to test the association between perceived barriers for healthy eating and performing physical activity with the categories of obesity, geographic and socio-demographic variables. The dependent binomial variables were “any barrier for a healthy diet” and “any barrier for physical activity”, the independent categorical variables were the BMI categories introduced as dummies with normal weight as the reference category. We adjusted the model for sex (male/female); region (urban/rural); age categories introduced as dummies with the 20–25 years group as the reference; region of Mexico introduced as dummies with Mexico City as the reference category; and SES introduced as dummies with lower SES as the reference. The results are presented as Odds Ratio (OR) and 95% confidence intervals (95% CI) and a *p* value < 0.05 was considered statistically significant. The R “survey” package (version 3.5.2) was used to account for the complex survey design of *ENSANUT*, and the sampling weights were used in all the analyses.

RESULTS

Sample characteristics

As shown in [Table 1](#), a total of 6406 participants were included; 68.1% were females, the average age of participants was 39 years old (IQR 30 to 47) and half of the sample (50.5%) lived in rural areas.

Perceived barriers to healthy eating and performing physical activity

Eighty percent of the population reported at least one barrier for healthy eating ([Table 2](#)). ‘Lack of money to buy healthy foods’ was the most commonly reported barrier (58.6%), followed by ‘Lack of knowledge on how to prepare healthy food’ (38.5%) and ‘Lack of time’ (28.1%). The least frequently reported barrier (22.2%) was ‘Don't like healthy foods’.

Seventy eight percent of the population reported at least one barrier to performing physical activity as part of their usual lifestyle ([Table 2](#)). ‘Lack of time’ was the most commonly reported barrier (51.2%), followed by ‘lack of motivation’ (33.6%), and ‘lack of safe and adequate spaces to practice physical activity’ (33.1%). The least common reported barrier was ‘dislike of physical activity’ with a similar <20% report across all subgroups.

Only 0.9% of the sample answered “I do not know” and 0.6% refused to answer the questions about barriers.

TABLE 1 Demographic characteristics of the sample according to BMI classification system

	Normal weight ^a (n = 1605; 25.0%)		Overweight (n = 2457; 38.4%)		Obesity (n = 2344; 36.6%)		Total (n = 6406)	
	n	%	n	%	n	%	n	% ^c
Sex								
Females	1007	23.1	1607	36.8	1747	40.1	4361	68.1
Males	598	29.2	850	41.6	597	29.2	2045	31.9
Age								
Age (years) ^b	35	25–44	39	30–48	40	33–49	39	30–47
20–35 years	905	33.6	995	36.9	796	29.5	2696	42.1
36–50 years	461	18.0	1021	39.9	1075	42.0	2557	39.9
51–65 years	239	20.7	441	38.2	470	41.0	1153	18.0
Diabetes diagnosis	64	16.0	177	29.3	219	54.8	400	6.2
Area								
Rural area	842	26.1	1268	39.2	1125	34.6	3235	50.5
Urban area	767	24.0	1197	37.5	1231	38.5	3195	49.5
Region								
North	332	23.9	504	36.3	555	39.8	1391	21.7
Centre	557	26.8	834	40.2	686	33.0	2077	32.4
Mexico City	161	22.5	288	40.1	268	37.4	717	11.2
South	555	25.0	831	37.4	835	37.6	2221	34.7
Socio-economic status								
Low	637	28.9	847	38.4	721	32.7	2205	34.4
Middle	510	23.3	814	37.2	867	39.6	2191	34.2
High	458	22.8	796	39.6	756	37.6	2010	31.4

^aNormal weight and underweight.

^bValues presented as inter quartile range.

^cColumn percentages.

Association between perceived barriers with obesity and socio-demographic variables

Body mass index classification

The barriers with largest difference between overweight/obese BMI groups and the healthy BMI group were ‘Lack of motivation’ for physical activity (38.4% by the overweight BMI group vs. 29.8% by the normal BMI group) and ‘Lack of motivation’ for healthy eating (28.8% vs. 24.7%) (Table S1). People with obesity were significantly more likely to report experiencing barriers to a healthy diet (OR 1.2, 95% CI 1.1 to 1.4) and to performing physical activity (OR 1.4, 95% CI 1.2 to 1.7) than those with a normal BMI (Table 3).

Sex (male, female)

Overall, males reported slightly lower prevalence of barriers than females (80.3% to 83.8% for healthy eating; and 76.5% to 83.4% for performing physical activity). This was confirmed with the multivariable model that showed

females to be significantly more likely to report any barrier than males (OR 1.3, 95% CI 1.1 to 1.5). Females' responses were at least 5% higher for the following barriers: ‘Lack of money to buy healthy food’, ‘Physical activity is not a priority in the family’, ‘health related issue’ and 10% higher for ‘lack of motivation to perform physical activity’. Males showed higher scores (by 4.1%) only on the variable of ‘Prefer snacks and processed food’ (Table S1).

Self-reported history of diabetes

From the total number of participants that reported a confirmed diagnosis of type 2 diabetes, 16.0% had a normal weight, 29.3% had overweight and 54.8% obesity. ‘Lack of money to buy healthy food’ remained the most common barrier to healthy eating among those with diabetes (67.0%) (Table S1).

Age (years)

There were no significant differences in the overall likelihood to report barriers between the different age

TABLE 2 Perceived barriers for a healthy diet and an performing physical activity and awareness of the public healthy lifestyle promotional campaign

	Normal weight (n = 1605)		Overweight (n = 2457)		Obesity (n = 2344)		Total (n = 6406)	
	n	%	n	%	n	%	n	%
Healthy diet								
Do not like healthy foods	373	23.2%	542	22.1%	505	21.5%	1420	22.2%
Lack of knowledge on how to prepare healthy food	624	38.9%	931	37.9%	911	38.9%	2466	38.5%
Healthy food is not a priority in the family	458	28.5%	718	29.2%	766	32.7%	1942	30.3%
Prefer snacks and processed food	414	25.8%	601	24.5%	651	27.8%	1666	26.0%
Lack of time	429	26.7%	690	28.1%	681	29.1%	1800	28.1%
Lack of money to buy healthy food	908	56.6%	1415	57.6%	1432	61.1%	3755	58.6%
Lack of motivation	397	24.7%	625	25.4%	676	28.8%	1698	26.5%
At least 1 of the above	1262	78.6%	1949	79.3%	1944	82.9%	5155	80.5%
Performing physical activity								
Prefer sedentary activities	457	28.5%	682	27.8%	677	28.9%	1816	28.3%
Lack of safe and adequate spaces for performing physical activity	506	31.5%	811	33.0%	801	34.2%	2118	33.1%
Lack of time	760	47.4%	1280	52.1%	1241	52.9%	3281	51.2%
Physical activity is not a priority in the family	436	27.2%	694	28.2%	750	32.0%	1880	29.3%
Do not like to perform physical activity	254	15.8%	420	17.1%	471	20.1%	1145	17.9%
Health related issues	408	25.4%	644	26.2%	755	32.2%	1807	28.2%
Lack of motivation	479	29.8%	774	31.5%	900	38.4%	2153	33.6%
At least 1 of the above	1191	74.2%	1916	78.0%	1912	81.6%	5019	78.3%

groups. There was a change observed in the perceived barriers of preference associated with higher age categories, with a decrease in the prevalence of 'Prefer snacks and processed food' and an increase in the prevalence of reporting 'lack of money to buy healthy food' (Table S1).

Residence area (rural, urban and geographical regions)

There was an even distribution of BMI subgroups represented in the urban and rural based respondents (Table 1). People living in rural areas were significantly more likely to report any barrier for performing physical activity (OR 1.5, 95% CI 1.3 to 1.7) (Table 3), with the largest differences shown in the barriers of 'lack of safe and adequate areas' (difference of 10.3%) and 'lack of

time' (difference of 11.2%). On the other hand, no differences in the overall prevalence of perceived barriers for a healthy diet were identified (Table S1).

There were also differences between the different geographical regions of the country. The northern region of Mexico presented the highest prevalence of overweight and obesity (76.1%) (Table 1). When reporting barriers to performing physical activity, the most obvious differences were identified for the barrier of 'lack of safe and adequate areas' with Mexico City (the highest) reporting 40.9% versus the southern region (the lowest) reporting 29.4%, and the barrier 'lack of time', with Mexico City reporting 62.5% versus 50.3% for the southern region. For barriers to healthy eating, those in Mexico City reported 'Lack of money to buy healthy food' the least (51.7%), and the respondents from the southern region reporting this the most (61.5%) (Table S1).

TABLE 3 Multivariable model assessing the likelihood to report at least one barrier for a healthy diet or performing physical activity

	Reporting at least one barrier for a healthy diet			Reporting at least one barrier for performing physical activity		
	OR	95% CI	p	OR	95% CI	p
Sex (female)	1.27	1.11 to 1.46	<0.01	1.39	1.21 to 1.59	<0.01
BMI categories						
Underweight	1.26	0.63 to 2.52	0.52	0.78	0.43 to 1.43	0.42
Normal BMI (ref)	—	—	—	—	—	—
Overweight	1.01	0.85 to 1.19	0.93	1.23	1.05 to 1.45	0.01
Obesity	1.19	1 to 1.42	0.04	1.41	1.19 to 1.67	<0.01
Age						
20 to 35 (ref)	—	—	—	—	—	—
36 to 50	1.07	0.92 to 1.24	0.38	0.87	0.75 to 1.01	0.06
51 to 65	1.19	0.98 to 1.46	0.08	0.84	0.69 to 1.01	0.07
Type 2 diabetes (positive)	1.13	0.85 to 1.49	0.40	1.29	0.98 to 1.7	0.07
Area						
Urban (ref)	—	—	—	—	—	—
Rural	1.07	0.92 to 1.23	0.39	1.49	1.3 to 1.72	<0.01
Region						
Mexico City (ref)	—	—	—	—	—	—
North	1.26	0.98 to 1.59	0.06	0.66	0.51 to 0.83	<0.01
Centre	1.05	0.83 to 1.30	0.69	0.63	0.51 to 0.81	<0.01
South	1.16	0.93 to 1.44	0.19	0.63	0.5 to 0.84	<0.01
Socio-economic status						
Low (ref)	—	—	—	—	—	—
Med	0.87	0.73 to 1.03	0.11	1.12	0.96 to 1.3	0.16
High	0.57	0.47 to 0.68	<0.01	1.40	1.18 to 1.67	<0.01

Abbreviations: BMI, body mass index; CI, Confidence Interval; OR, Odds Ratio; ref, reference category.

Socio-economic status

Normal BMI was most common among those in the low SES group (28.9%) and least common in the high SES group (22.8%) (Table 1). The low SES group reported the highest frequency (69.8%) of 'lack of money to buy healthy food' as a barrier to healthy eating, whilst less than half of the high SES group reported experiencing this as a barrier. The high SES group were 1.4 times more likely to report barriers to performing physical activity as compared with the lowest SES group (95% CI 1.2 to 1.7) (Table 3), with the largest differences between these groups shown in the barriers of 'lack of safe and adequate areas' (difference of 8.0%) and 'lack of time' (difference of 9.8%) (Table S1).

DISCUSSION

This study offers a detailed description of the perceived barriers to the adoption of a healthy diet and performing physical activity in the Mexican adult population. Nearly

80% of adults in Mexico face at least one barrier to a healthy diet or physical activity. 'Lack of money to buy healthy food' was the major barrier for healthy eating and 'Lack of time' was the most common reported barrier for performing physical activity. We found that the social and demographic characteristics of the participants influenced the distribution of these barriers.

Both as a whole cohort and as independent sub-groups, 'Lack of money to buy healthy food' was the more frequently reported barrier to healthy eating. These findings differ from research conducted in high-income countries (HIC). For instance, studies in the UK and Singapore found that cynicism about government health messages, family influence and a rejection of healthy food on the grounds of poor taste and inability to satisfy appetite were the most common barriers for a healthy diet (Gough & Conner, 2006; Lim et al., 2019). A systematic review published in 2017 found that the most common barriers to healthy eating in HICs were male "apathy" and "boredom" towards healthy diets, unhealthy diet of friends and family, expected consumption of unhealthy foods in certain situations,

relative low cost of unhealthy foods, increased cost of fruits and vegetables and lack of time to plan (Kasprzak et al., 2021; Munt et al., 2017; Theobald & White, 2021). Studies in low and middle-income countries (LMICs), or in vulnerable populations from HICs, are more in line with our findings. One study of low income adults with type 2 diabetes in the US found that the most common barrier to healthy eating was healthy food being too expensive, observed in 60% of responses (Marcy et al., 2011). A qualitative study in immigrants, also in the US, showed that all participants reported the high cost of healthy food as an important structural barrier to eating healthy meals (Tiedje et al., 2014).

The information regarding barriers for physical activity in healthy populations is limited, with most studies evaluating barriers qualitatively and not reporting prevalence rates. Similarly to our study, 'lack of time' has been found to be an important barrier to performing exercise in other LMICs and for Mexican immigrants in the US (Bautista et al., 2011; Lawton et al., 2005). One of the factors that might influence the lack of time in LMICs could be the high amount of social events and family commitments (Andajani-Sutjahjo et al., 2004; Mahmood et al., 2021) and the long commuting times due to heavy traffic in urban regions or long distances in rural regions (Paudel et al., 2021). Another explanation might be the longer working days that have been reported as a cause of lack of time in quantitative studies in LMICs. This is supported by statistics and studies showing that LMICs countries have longer working hours as compared to HICs (Paudel et al., 2021).

We found vulnerable groups from the Mexican population that might benefit from strategies designed specifically to overcome the most prevalent barriers for a healthy lifestyle. Participants with overweight and obesity were more likely to report barriers for both physical activity and a healthy diet. Collaborative care approaches including nutritional education and easy to follow physical activity programmes have been shown to be effective in helping this population to overcome barriers and engage in healthier behaviours (Anderson et al., 2009), and may prove useful in Mexico. However, context considerations such as the high temperatures in some regions of the country need to be considered, since people with obesity have consistently reported dislike for physical activity as a barrier because it is uncomfortable and involves sweating and physical discomfort (Baillot et al., 2021).

Despite the lack of association between a diagnosis of type 2 diabetes and overall reported barriers for a healthy diet and physical activity, we found that lack of money to buy healthy food and health related issues for performing physical activity were specific barriers for people with a reported diagnosis of type 2 diabetes which is in line with previous findings in this population (Kadariya & Aro, 2018; Marcy et al., 2011). Information about adequate physical activity routines and nutritional education (including information about

affordable healthier food options) provided as part of diabetes management might be an effective strategy to overcome this barrier in Mexico.

Older ages are also more likely to report barriers for physical activity and unhealthy diet. Older people are more likely to have injuries or debilitating conditions that prevent them from performing physical activity (Manaf, 2013; Nicklett & Kadell, 2013) and face more challenges related to accessibility and affordability to healthy food (Nicklett & Kadell, 2013). People living in rural areas were also more likely to report barriers for physical activity.

Programmes and interventions to promote a healthy lifestyle and physical activity should prioritise the accessibility of fruits and vegetables. For instance a study in the US found that a brief clinic-based intervention was associated with a nearly fourfold increase in uptake of a supplemental nutrition assistance programmes (Cohen et al., 2017), as well as clinically and statistically significant increases in produce consumption. Results suggested sustained behaviour change, even once the financial incentive was no longer available. Providing information about healthy food incentives is a low-cost, easily implemented intervention that may increase produce consumption among low-income patients (Koeneman et al., 2011). In addition, interventions should be tailored according to the socio-demographics, socio-economic status and education of the targeted population.

Strengths and limitations

One of this study's strengths is that it includes a large sample size which is representative of the Mexican population. In addition, the survey was performed face-to-face, which has been shown to be more reliable than self-completed surveys. Moreover, the sample size allowed us to perform specific analyses. Some limitations of this study need to be addressed. The cross-sectional design of the study does not allow to draw any conclusions on the direction of causality between the perceived barriers for physical activity and healthy eating with socio-demographic and anthropometric measurements. The survey was representative for the Mexican population at a household level, however there were more female than male respondents, which might have implications for the interpretation and representativeness of the results. The prevalence of barriers might also have been underestimated due to biases resulting from the differential characteristics of non-respondents compared to respondents (Studer et al., 2013). Future longitudinal studies are needed in Mexico to assess the causality of these relationships. Finally, the categories of barriers were decided a priori in the survey and no option for open answers was given.

CONCLUSION

There was a high prevalence of reported barriers for healthy eating and performing physical activity, with 'lack of resources' and 'lack of time' being the most common barriers. Females, people with obesity and those living in rural areas experienced more barriers. Targeted health programmes and tailored interventions that focus on the relevant barriers for a healthy lifestyle may contribute to encourage healthier lifestyle behaviours in Mexico.

CONFLICT OF INTEREST

The authors report no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in [National Institute of Public Health (Mexico)] at <https://ensanut.insp.mx/encuestas/ensanut2016/index.php>

ORCID

Gerardo A. Zavala  <https://orcid.org/0000-0002-9825-8725>

REFERENCES

- AlQuaiz, A.M. & Tayel, S.A. (2009) Barriers to a healthy lifestyle among patients attending primary care clinics at a university hospital in Riyadh. *Annals of Saudi Medicine*, 29, 30–35.
- Andajani-Sutjahjo, S., Ball, K., Warren, N., Inglis, V. & Crawford, D. (2004) Perceived personal, social and environmental barriers to weight maintenance among young women: a community survey. *The International Journal of Behavioral Nutrition and Physical Activity*, 1(1), 15.
- Anderson, L.M., Quinn, T.A., Glanz, K., Ramirez, G., Kahwati, L.C., Johnson, D.B. et al. (2009) The effectiveness of worksite nutrition and physical activity interventions for controlling employee overweight and obesity: a systematic review. *American Journal of Preventive Medicine*, 37(4), 340–357.
- Baillot, A., Chenail, S., Barros Polita, N., Simoneau, M., Libourel, M., Nazon, E. et al. (2021) Physical activity motives, barriers, and preferences in people with obesity: a systematic review. *PLoS One*, 16(6), e0253114.
- Barker, M., Dombrowski, S.U., Colbourn, T., Fall, C.H.D., Kriznik, N.M., Lawrence, W.T. et al. (2018) Intervention strategies to improve nutrition and health behaviours before conception. *The Lancet*, 391(10132), 1853–1864.
- Bautista, L., Reininger, B., Gay, J.L., Barroso, C.S. & McCormick, J.B. (2011) Perceived barriers to exercise in Hispanic adults by level of activity. *Journal of Physical Activity & Health*, 8(7), 916–925.
- Cohen, A.J., Richardson, C.R., Heisler, M., Sen, A., Murphy, E.C., Hesterman, O.B. et al. (2017) Increasing use of a healthy food incentive: a waiting room intervention among low-income patients. *American Journal of Preventive Medicine*, 52(2), 154–162.
- Dunkley, A.J., Bodicoat, D.H., Greaves, C.J., Russell, C., Yates, T., Davies, M.J. et al. (2014) Diabetes prevention in the real world: effectiveness of pragmatic lifestyle interventions for the prevention of type 2 diabetes and of the impact of adherence to guideline recommendations: a systematic review and meta-analysis. *Diabetes Care*, 37(4), 922–933.
- Encuesta Nacional de Salud y Nutrición de Medio Camino (ENSANUT) (2016) *Ensanut MC 2016* (internet). Cuernavaca: INSP, 2016. Available at : <https://www.gob.mx/cms/uploads/attachment/file/209093/ENSANUT.pdf>
- Firth, J., Marx, W., Dash, S., Carney, R., Teasdale, S.B., Solmi, M. et al. (2019) The effects of dietary improvement on symptoms of depression and anxiety: a meta-analysis of randomized controlled trials. *Psychosomatic Medicine*, 81(3), 265–280.
- Gough, B. & Conner, M.T. (2006) Barriers to healthy eating amongst men: a qualitative analysis. *Social Science & Medicine*, 62(2), 387–395.
- Gutiérrez, J.P. (2013) Household socioeconomic classification in the National Health and nutrition survey 2012. *Salud Pública de México*, 55(Suppl 2), S341–S346.
- Kadariya, S. & Aro, A.R. (2018) Barriers and facilitators to physical activity among urban residents with diabetes in Nepal. *PLoS One*, 13(6), e0199329.
- Kasprzak, C.M., Sauer, H.A., Schoonover, J.J., Lapp, M.M. & Leone, L.A. (2021) Barriers and facilitators to fruit and vegetable consumption among lower-income families: matching preferences with stakeholder resources. *Journal of Hunger & Environmental Nutrition*, 16(4), 490–508.
- Koenen, M.A., Verheijden, M.W., Chinapaw, M.J.M. & Hopman-Rock, M. (2011) Determinants of physical activity and exercise in healthy older adults: a systematic review. *The International Journal of Behavioral Nutrition and Physical Activity*, 8(1), 142.
- Kumar, J., Adhikari, K., Li, Y., Lindshield, E., Muturi, N. & Kidd, T. (2016) Identifying barriers, perceptions and motivations related to healthy eating and physical activity among 6th to 8th grade, rural, limited-resource adolescents. *Health Education*, 116(2), 123–137.
- Kushner, R.F. & Ryan, D.H. (2014) Assessment and lifestyle management of patients with obesity: clinical recommendations from systematic reviews. *JAMA: The Journal of the American Medical Association*, 312(9), 943–952.
- Lawton, J., Ahmad, N., Hanna, L., Douglas, M. & Hallowell, N. (2005) 'I can't do any serious exercise': barriers to physical activity amongst people of Pakistani and Indian origin with type 2 diabetes. *Health Education Research*, 21(1), 43–54.
- Lim, R.B.T., Wee, W.K., For, W.C., Ananthanarayanan, J.A., Soh, Y.H., Goh, L.M.L. et al. (2019) Correlates, facilitators and barriers of healthy eating among primary care patients with prediabetes in Singapore—a mixed methods approach. *Nutrients*, 11(5), 1014.
- Mahmood, A., Nayak, P., Kok, G., English, C., Manikandan, N. & Solomon, J.M. (2021) Factors influencing adherence to home-based exercises among community-dwelling stroke survivors in India: a qualitative study. *European Journal of Physiotherapy*, 23(1), 48–54.
- Manaf, H. (2013) Barriers to participation in physical activity and exercise among middle-aged and elderly individuals. *Singapore Medical Journal*, 54(10), 581–586.
- Marcy, T.R., Britton, M.L. & Harrison, D. (2011) Identification of barriers to appropriate dietary behavior in low-income patients with type 2 diabetes mellitus. *Diabetes Therapy: Research, Treatment and Education of Diabetes and Related Disorders*, 2(1), 9–19.
- Munt, A.E., Partridge, S.R. & Allman-Farinelli, M. (2017) The barriers and enablers of healthy eating among young adults: a missing piece of the obesity puzzle: a scoping review. *Obesity Reviews: An Official Journal of the International Association for the Study of Obesity*, 18(1), 1–17.
- Nicklett, E.J. & Kadell, A.R. (2013) Fruit and vegetable intake among older adults: a scoping review. *Maturitas*, 75(4), 305–312.
- Paudel, S., Owen, A.J. & Smith, B.J. (2021) Exploration of physical activity barriers and facilitators among adults in Kathmandu, Nepal. *Qualitative Health Research*, 31(6), 1183–1195.

- Pelletier, D. (1992) Anthropometric standardization reference manual: abridged edition. Edited by T.G. Lohman, A.F. Roche, and R. Martorell. Vi 90 pp. Champaign, IL: human kinetics books. 1991. U.S. 15.00, Canada 18.50 (paper). *American Journal of Human Biology*, 4, 425.
- Pérez-Noriega, E., Salazar-González, B.C., Cruz-Quevedo, J.E., Soriano, M.M. & Árcaga-Domínguez, A. (2009) Step by step for exercising: transversal study in a 20 to 59 years population. *Revista de Enfermería del Instituto Mexicano del Seguro Social*, 17(2), 79–84.
- Richardson, A.K. (2012) Investing in public health: barriers and possible solutions. *Journal of Public Health*, 34(3), 322–327.
- Romero-Martínez, M., Shamah-Levy, T., Cuevas-Nasu, L., Gómez-Humarán, I.M., Gaona-Pineda, E.B. & Gómez-Acosta, L.M., et al (2017) Diseño metodológico de la encuesta nacional de salud y nutrición de medio camino 2016. *Salud pública de México*, 59, 299–305.
- Rtveladze, K., Marsh, T., Barquera, S., Sanchez Romero, L.M., Levy, D., Melendez, G. et al. (2014) Obesity prevalence in Mexico: impact on health and economic burden. *Public Health Nutrition*, 17(1), 233–239.
- Rüh, J.T. (2017) *Impact after implementation of an excise tax on cookies: evidence from Mexico* (Master thesis), University of Oslo.
- Streppel, M.T., Arends, L.R., van't Veer, P., Grobbee, D.E. & Geleijnse, J.M. (2005) Dietary fiber and blood pressure: a meta-analysis of randomized placebo-controlled trials. *Archives of Internal Medicine*, 165(2), 150–156.
- Studer, J., Baggio, S., Mohler-Kuo, M., Dermota, P., Gaume, J., Bertholet, N. et al. (2013) Examining non-response bias in substance use research—are late respondents proxies for non-respondents? *Drug and Alcohol Dependence*, 132(1), 316–323.
- Theobald, C. & White, A. (2021) British Nutrition Foundation Healthy Eating Week 2020—insights into the effect of COVID-19 on eating and activity habits of adults and children in the UK. *Nutrition Bulletin*, 46(2), 238–245.
- Thorogood, A., Mottillo, S., Shimony, A., Filion, K.B., Joseph, L., Genest, J. et al. (2011) Isolated aerobic exercise and weight loss: a systematic review and meta-analysis of randomized controlled trials. *The American Journal of Medicine*, 124(8), 747–755.
- Tiedje, K., Wieland, M.L., Meiers, S.J., Mohamed, A.A., Formea, C.M., Ridgeway, J.L. et al. (2014) A focus group study of healthy eating knowledge, practices, and barriers among adult and adolescent immigrants and refugees in the United States. *The International Journal of Behavioral Nutrition and Physical Activity*, 11(1), 63.
- Tuomilehto, J., Lindström, J., Eriksson, J.G., Valle, T.T., Hämäläinen, H., Ilanne-Parikka, P. et al. (2001) Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *The New England Journal of Medicine*, 344(18), 1343–1350.
- Uribe-Carvajal, R., Jiménez-Aguilar, A., MDC, M.-R., Salazar-Coronel, A.A. & Shamah-Levy, T. (2018) Perception of body weight and of the probability of developing obesity in Mexican adults. *Salud Pública de México*, 60(3), 254–262.
- Villalobos-Comparán, M., Flores-Dorantes, M.T., Villarreal-Molina, M.T., Rodríguez-Cruz, M., García-Ulloa, A.C., Robles, L. et al. (2008) The FTO gene is associated with adulthood obesity in the Mexican population. *Obesity*, 16(10), 2296–2301.
- Von Elm, E., Altman, D.G., Egger, M., Pocock, S.J., Gøtzsche, P.C. & Vandenbroucke, J.P. (2007) The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *Annals of Internal Medicine*, 147(8), 573–577.
- Whelton, S.P., Chin, A., Xin, X. & He, J. (2002) Effect of aerobic exercise on blood pressure: a meta-analysis of randomized, controlled trials. *Annals of Internal Medicine*, 136(7), 493–503.
- Wu, T., Gao, X., Chen, M. & Van Dam, R.M. (2009) Long-term effectiveness of diet-plus-exercise interventions vs. diet-only interventions for weight loss: a meta-analysis. *Obesity Reviews: An Official Journal of the International Association for the Study of Obesity*, 10(3), 313–323.
- Wu, Y., Qian, Y., Pan, Y., Li, P., Yang, J., Ye, X. et al. (2015) Association between dietary fiber intake and risk of coronary heart disease: a meta-analysis. *Clinical Nutrition*, 34(4), 603–611.
- Zavala, G., Long, K.Z., García, O.P., Caamaño Mdel, C., Aguilar, T., Salgado, L.M. et al. (2013) Specific micronutrient concentrations are associated with inflammatory cytokines in a rural population of Mexican women with a high prevalence of obesity. *The British Journal of Nutrition*, 109(4), 686–694.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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