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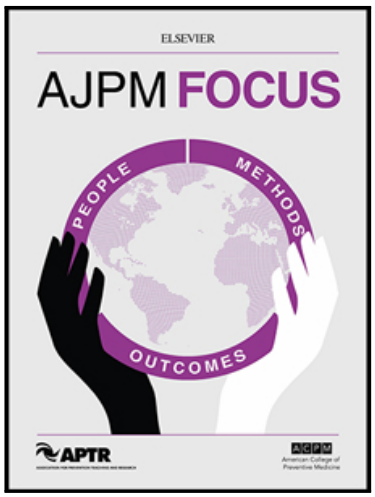

The trend in the prevalence of diabetes mellitus in the Mexican indigenous population from 2000 to 2018

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Highlights

- Mexican indigenous people are more likely to be diabetic than non-indigenous people.
- Since 2006, indigenous people have experienced an increase in obesity.
- Since 2006, indigenous people have experienced an increase in abdominal obesity.

- Indigenous students had lower education scores than non-Indigenous students.

Introduction. Diabetes is a worldwide public health problem. In Mexico, diabetes was the third leading cause of death in the total population in 2020. The indigenous people in Mexico are approximately 6%. This study aims to estimate trends in the diabetes prevalence from 2000 to 2018 in the group of Mexican indigenous language speakers and to analyze the main sociodemographic (age, educational and socioeconomic level, area of residence among others) and clinical (age of diabetes onset, years with diabetes and BMI among others) characteristics of this group.

Study design. This cross sectional study included participants aged 20 years and older from four National Health Surveys; 2000 to 2018. We presented the analyses for indigenous and nonindigenous strata. Logistic models adjusted were used to estimate the trend of diabetes in the study period.

Results. We found a significant increase in the prevalence of diabetes in the indigenous group. This trend in the Odds ratio was maintained when adjusting for age, sex, waist circumference, and area of residence. For the study period, the prevalence change in diagnosed diabetes in the indigenous group was greater than that in the non-indigenous group, 6.4 [4.1,8.8] and 3.3 [2.5,4.1], respectively. We also found a significant prevalence change in undiagnosed diabetes for the indigenous group 7.7 [1.3,14.6].

Conclusions. In contrast to non-indigenous populations, our main result reveals an increased probability of being diabetic in the indigenous population from 2006 to 2018. It is necessary to clarify the origin of the accelerated change in diabetes prevalence among the indigenous population in Mexico.

Keywords: Diabetes, Indigenous population, Trends, Prevalence, Population-based survey, Mexico

Introduction

Diabetes is a global public health problem; it has been estimated that approximately 463 million (9.3%) adults aged 20-79 years were living with diabetes worldwide in 2019, and this number is expected to increase to approximately 578 million (10.2%) by 2030 and 700 million (10.9%) by 2045. An estimated 4.2 million deaths among adults in the same age group are attributable to diabetes. Globally, diabetes is estimated to contribute to 11.3% of deaths.[1]

It was recently reported that 10.3% of Mexican adults had been diagnosed with type 2 diabetes.[2] A significant number of people living with diabetes unknown their condition; data from the Encuesta Nacional de Salud y Nutrición 2006 showed that 7.07% of Mexicans did not know they had diabetes.[3] Diabetes has been associated with heart failure[4], rheumatic diseases[5], musculoskeletal disorders[6], increased risk of fracture[7], colorectal cancer[8], among many other negative health-related outcomes.

The increase in energy density of Mexican eating patterns [9] and sedentary lifestyles[10] have been identified as the most important causes of diabetes. Both causes are often associated with the biological inability to adapt to aspects of urban culture.[11]

Mexico has seen an increase in the number of metropolitan areas in recent years.[12] However, there is still a significant percentage of the population living in areas with less than 2,500 inhabitants.[13] The traditional areas where the indigenous population is concentrated are located in the most rugged areas of the country, with the most difficult access and deficient communication systems. Nevertheless, the indigenous population is present in almost all municipalities and the country's entities.[14] In 2020, there were 7,364,645 indigenous people aged three years and older speaking an indigenous language in Mexico, representing 6% of the total population.[15]

Indigenous people, representing 5 percent of the world population and 10 percent of the world's poorest people, continue to be disproportionately poorer, less educated, and in worse health conditions than non-indigenous groups.[16] Disparities in Mexico's indigenous population in terms of basic and crucial development indicators have been shown; although development indicators have improved for the indigenous population, when we compare indigenous and non-indigenous people, the gap in socio-economic and development indicators persists.[17]

In addition, it has been reported that the prevalence of diabetes by previous medical diagnosis has been higher in urban localities than in rural localities; however, the difference has shortened over time, reporting 9.5% vs. 9.2% in 2016, respectively.[18] It is

noteworthy that a high rural component is located in the south of Mexico and is the region where many indigenous language speakers are concentrated.[19]

This study aims to estimate trends in the prevalence of diabetes from 2000 to 2018 in the Mexican indigenous language-speaking population and to analyze the main sociodemographic and clinical characteristics of this population group. We hypothesized that in recent years the change in the prevalence of diagnosed diabetes in the indigenous population is greater than in the non-indigenous population.

Methods

Design and study population

We used data set from the National Health Survey (ENSA) 2000 and the National Health and Nutrition Surveys (ENSANUT) 2006, 2012, and 2018. All of them are national, cross-sectional, and population-based surveys. For this report, we included the information of people aged 20 years or older with a complete questionnaire and biochemical analyses. All surveys were stratified, and probability sampling was used with national representation. We used the linguistic perspective as a proxy for indigenism. We classified an individual as indigenous if he or she responded affirmatively to the question ¿(NOMBRE) habla alguna lengua indígena (dialecto)? "Does she/he speak any indigenous language?" making a distinction between people who speak an indigenous language and those who speak only Spanish (no/yes).

Measures

Diabetes. We considered that an individual had a previous diagnosis of diabetes if he/she answered "yes" to the questionnaire question "Has any doctor told you that you have diabetes?". For undiagnosed diabetes, we considered if the individual answered “NO” to the previous question and had a fasting serum glucose equal to or greater than 126 mg/dL with at least eight hours of fasting; or had glycosylated hemoglobin levels equal to or greater than 6.5%. All measurements were performed under standard procedures.

Sociodemographic variables. Table 1 was built to show the general characteristics of the study population. Age was categorized into three groups: 20-39, 40-59, and 60 and

over. For educational level, four categories were considered: elementary school or less, junior high school, high school, and bachelor's degree or more. The social security variable was divided into two categories: no [no security category] and yes [any security category: Instituto Mexicano del Seguro Social [IMSS], Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado [ISSSTE], private insurance, Seguro Popular [As of 2020, it has been replaced by the Instituto Nacional de Salud para el Bienestar -INSABI and, Others (Pemex, Defensa Nacional, Marina Nacional)]. For the region, the same classification as the one applied in the surveys of this study was used: North [Baja California, Baja California Sur, Coahuila, Chihuahua, Durango, Nuevo León, Sonora, Tamaulipas], Center [Aguascalientes, Colima, Estado de México, Guanajuato, Jalisco, Michoacán, Morelos, Nayarit, Querétaro, San Luis Potosí, Sinaloa, Zacatecas, and Mexico City), and South [Campeche, Chiapas, Guerrero, Hidalgo, Oaxaca, Puebla, Quintana Roo, Tabasco, Tlaxcala, Veracruz, Yucatán]. Finally, regarding the area of residence, two categories were considered: rural [<2500 inhabitants] and urban [≥ 2500 inhabitants].[13]

Health-related variables. A descriptive analysis was performed to present an overview of the disease in this population, including people with diabetes, both previously diagnosed by a physician and those who were not. Table 2 shows the distribution (frequencies and 95% confidence intervals) of diabetes by health characteristics stratified by the indigeneity group for each survey. We estimated the age of diabetes onset by subtracting the time of diabetes diagnosis from the current age. The former information was obtained from the questionnaire question, "How long ago were you told you had diabetes?".

The means of weight in kilograms, stature in meters, and waist circumference in centimeters by sex were reported. BMI was calculated as a person's weight in kilograms divided by the square of the person's height in meters (kg/m2). Then, it was categorized using the WHO criteria (BMI: underweight less than 18.5; normal is 18.5-24.9, overweight is 25-29.9, and obese is ≥ 30 kg/m2).[20] Underweight and normal categories were grouped for analysis. Frequency for each BMI category was reported.

We used the cut-off point of waist circumference greater than 102 cm for men and 88 cm for women to define abdominal obesity and then estimated its proportion. To estimate the frequency of hypertriglyceridemia, hypertension, chronic kidney disease,

previous stroke, chronic heart failure, cerebral vascular disease, and depression, we considered the questionnaire question that inquired about the presence of this condition in the past or present, depending on the event asked.

Finally, participants were considered current smokers if they answered affirmatively to one of the questions in the questionnaire: Do you currently smoke tobacco every day? Do you currently smoke tobacco some days? They were considered current drinkers if they answered affirmatively to the question: Do you currently drink?

Statistical analyses

To describe the study population, non-indigenous and indigenous, according to socioeconomic characteristics, we obtained means and percentages with their confidence intervals, considering the variable type (quantitative or qualitative).

Change in the prevalence of diabetes (diagnosed diabetes, undiagnosed and total) by indigenous group, national level, and year of the survey was obtained with the coefficient from a logistic model. As well as we calculate the prevalence adjusted for age using the world population in 2010 by the direct method. [21]

In addition, we presented the health conditions related to diabetes and lifestyle habits with means and percentages with confidence intervals by the indigenous group.

Finally, for estimating diabetes prevalence trends from 2000 to 2018 by each indigenous group, we used multiple logistic models for estimating the adjusted risk of diabetes by year of the survey. Both models were adjusted for sex, age, waist circumference, and urbanity area. In the same way, we presented a graph with the predicted probabilities of having diabetes by indigenous group. Previously, bivariate models were constructed; the diagnosis of diabetes and the year of the survey were fixed, and then each variable was included one by one in the models to identify possible confounding factors. The variables considered were those with $p<0.20$ in the bivariate analysis.

The goodness-of-fit of the models was assessed with the Hosmer-Lemeshow test. We considered a significance level of $p<0.05$ and a 95% CI in all cases. For all analyses, we considered the effect of the complex sample design, using the survey module (svy) of the Stata® software, v.15 (Stata Corp, College Station, Texas, USA).

Ethical considerations

All surveys considered in this report were approved by the Ethics, Research, and Biosafety Commissions of the National Institute of Public Health. Participants signed an informed consent form after the survey procedures were explained to them. [22–25]

Results

This study included 73 744 participants (45 021, 5 829, 9 732 and 13 162 for 2000, 2006, 2012, and 2018 National Surveys considered, respectively). This sample represented 247.2 million people aged 20 years and older for the whole period. The indigenous stratum had 6 576 participants, representing 16.0 million Mexican adults.

The non-indigenous group had a lower frequency of adults aged 60 and over than the indigenous group for all surveys (12.1% vs. 14.2%, 14.7% vs. 19.2%, 15.0% vs. 19.1% and 19.8% vs. 23.6% for 2000, 2006, 2012 and 2018 surveys, respectively). (Table 1).

Regarding educational level, for both the non-indigenous and indigenous groups, the category of primary or less showed the highest frequencies; however, there was a wide difference between them (44.9% vs. 77.3%, 47.8% vs. 82.1%, 39.9% vs. 75.5%, and 29.3% vs. 65.0% for 2000, 2006, 2012, and 2018 surveys, respectively).

For the non-indigenous group, the third tertile of socioeconomic level reported the highest frequency (38.9%, 41.6%, 44.4%, and 40.1%, for 2000, 2006, 2012, and 2018 surveys, respectively); in contrast, for the indigenous group, the first tertile presented the highest prevalence (79.0%, 74.9%, 66.5%, and 74.3%, for 2000, 2006, 2012 and 2018 surveys, respectively).

The Central region presented the highest concentration of the non-indigenous population (53.0%, 51.4%, 51.8%, and 51.0%, for 2000, 2006, 2012 and 2018 surveys, respectively), while the Southern region had the highest concentration of indigenous population (86.7%, 82.4%, 75.0% and 75.3%, for the 2000, 2006, 2012 and 2018 surveys, respectively).

The largest non-indigenous population was found in the urban area of residence (81.3%, 85.0%, 80.9%, and 80.3%, for 2000, 2006, 2012, and 2018 surveys, respectively); conversely, the highest concentration of indigenous population was found in the rural area of residence (57.8%, 53.2%, 57.9%, and 49.8%, for 2000, 2006, 2012, and 2018 surveys, respectively). Table 1.

Table 2 reports the change in the prevalence of diagnosed diabetes, undiagnosed diabetes, and total diabetes for the non-indigenous, indigenous, and the entire population. A positive and significant prevalence change was found for diagnosed

diabetes for the whole population and for the non-indigenous and indigenous groups (3.5%, 3.3%, and 6.4%, respectively). In the case of undiagnosed diabetes, a significant negative percentage change was observed for the non-indigenous group and for the total population (-2.8% and -2.2%, respectively). In contrast, for the indigenous group, it was significantly positive (7.7%). Data from the ENSA2000 survey was not available to estimate the prevalence of undiagnosed diabetes.

In table 3, a total of 8 992 participants living with diabetes were considered: 2 940 (2 778+162), 2 252 (2 067+185), 1 415 (1 258+157), and 2 385 (2 155+230) for 2000, 2006, 2012, and 2018 National Surveys, respectively. This represented 28.4 million people with diabetes aged 20 years and older for the whole period. The indigenous stratum had 734 participants in the period, representing 1.9 million indigenous adults with diabetes.

In the case of participants with previously diagnosed diabetes, the age of diabetes onset was less than 50 years in both groups. The mean time of diabetes diagnosis was slightly more than eight years. For the remaining variables, total diabetes was considered. The obesity category showed a significant increasing trend for both groups; however, in the indigenous group, this was higher (13.2%, 40.2%, 37.8%, and 52.1% for 2000, 2006, 2012, and 2018 surveys, respectively). A similar result was found for abdominal obesity (53.25%, 54.8%, 66.9%, and 65.7% for 2000, 2006, 2012, and 2018 surveys, respectively) (Table 3).

We found odds ratios for diabetes trends adjusted for each sociodemographic characteristic or anthropometrics stratified by indigenous group (Appendix); these trends (ORs) were similar when they were simultaneously adjusted for sex, age, waist circumference, and urbanity area. In the indigenous group, we found an increased risk of a person living with diabetes in recent years compared to the 2006 survey year, OR=1.77[1.03,3,3.03] for 2012 and OR=2.22[1.35,3.66] for the 2018 survey years. In contrast, for the no indigenous group we found lower risk (OR=0.73[0.65,0.88] for 2012 and OR= 0.82[0.70,0.97] for 2018) (Table 4). Also, the probability of having diabetes from 2006 to 2018 by the indigenous group was observed; a positive trend was found in the indigenous group, while a flat trend was observed in the non-indigenous group (Figure 1).

Discussion

The term diabetes describes a group of metabolic disorders characterized and identified by the presence of hyperglycemia in the absence of treatment. The long-term specific effects of diabetes include retinopathy, nephropathy, and neuropathy, among other complications.[26,27] Since the beginning of this century, mortality from this cause has been among the top three in Mexico; for example, in 2020, the leading cause of death was heart disease, with 220 thousand deaths, while there were just over 150 thousand deaths from diabetes (the third cause).[28]

Although the total prevalence of diabetes has remained stable during the last few years, it is possible to observe that undiagnosed diabetes has decreased during the study period. Both diagnosed and undiagnosed diabetes continue to represent a challenge for the health system.

This study is the first to analyze the trend in the prevalence of diabetes among the Mexican indigenous population. We found an increased risk of having diabetes in this group as the survey year rose. In contrast, among the non-indigenous group, we did not find an increased risk, which is indicative of the differential behavior of the disease between indigenous groups. Diabetes type 2 is associated with several risk factors, including genetics and the interaction between genetics and environmental factors. Based on the findings of previous studies, some of the variants associated with the presentation of type 2 diabetes (T2D) in the Mexican mestizo population have been identified. Some of these are related to insulin resistance and insulin secretion. However, the variants found do not explain the high prevalence in the population. Sanchez-Pozos and Mejívar recommend carrying out additional studies to find new genetic markers for predicting diseases as well as new therapeutic targets.[29] In an analysis of samples from eleven indigenous groups, GranadosSilvestre et al. identified the T130I polymorphism in the HNF4A gene. This polymorphism is associated with the presence of elevated levels of triglycerides and with the early onset of T2D in mestizo Mexicans. In addition, the high frequency of the T130I polymorphism in Mexican indigenous populations reveals a diabetogenic background, which contributes to the high prevalence of T2D in the Mexican population.[30]

In a systematic review, Esparza-Romero et al. reported the prevalence of diabetes mellitus in different indigenous groups in Mexico. The highest prevalence was reported among Mixtecs from Baja California (26.2%) and Yaquis from Sonora (18.3%) to the lowest was in Tepehuanos (0.83%) and Mazatecs (2.0%).[31] Other researchers have

obtained a high prevalence of diabetes in indigenous populations of Mexico, such as in San Quintin, Baja California (21.8%) (diagnosed and undiagnosed diabetes included).[32] Between November 2012 and October 2017, 2,596 Mexican Amerindians from 73 indigenous communities of 60 different ethnic groups participated in a cross-sectional study at INMEGEN. This research only included people who identified themselves as indigenous, had parents and grandparents born in the same community, and spoke the native language. Mendoza-Caamal et al., found that a prevalence of T2D previously diagnosed was 13.7% (95% CI 12.4–15.1) in females 14.3% (95% CI 12.7–16) and in males 12.3% (95% CI 10.1–14.8). The overall prevalence of elevated FG (≥100 mg/dl or previous diagnosis of type 2 diabetes) was 27.9% (95% CI 26.1–29.6%), with an increase with age, up to 40% in adults from 41 to 70 years old, and no difference between genders.[33] The differences obtained in the previously listed studies were also due to the definition used to determine a person as indigenous, self-identified as indigenous, or speaker of an indigenous language, and the definition of diabetes, with diagnosis and without a diagnosis, that is, by the blood glucose result from a blood sample, that not all the studies included.

On the other hand, the correlation between education and health is well-established and well-studied; some studies have even estimated the causal effect of education on health.[34] Because of this, we highlighted that in our study, the indigenous group continues to have the lowest education grades. Although this percentage has decreased by about ten percentage points during the study period, more is needed. In 2018, more than half of this population was in the lowest educational category, 65.0% [60.5,69.3]. Whereas among the non-indigenous population, less than one-third were in this category, 29.3% [28.0,30.7]. These results are in line with the socioeconomic situation, where the indigenous population is concentrated in the first tertile for the entire study period. This means that 3 out of 4 indigenous adults were in this category. Our results coincide with those reported by Juárez-Ramírez et al., who conducted a study of 556 Mexican participants with 35% indigenous population; they found that illiteracy was higher in indigenous and rural localities than in urban ones.[35] In addition to lower schooling, other risk factors have been reported that are associated with T2D in indigenous Mexicans, including age, female status, family history of diabetes, obesity, hypertension, and larger waist/hip ratios.[31] We found similar results to theirs, except in the case of age, which can be explained by their cross-sectional studies, which may have

underrepresented older participants because they included 66% of non-probability samples.[31]

An inverse association between socioeconomic status and type 2 prevalence had previously been claimed.[36] However, in our analysis, this association could not be established. We report a lower prevalence of diabetes in the early years of the study among the poorest people, which is the indigenous group. Interestingly, for the last year of the survey, the prevalence in this group was higher than that of the non-indigenous group, suggesting that factors other than socioeconomic status could affect the prevalence of diabetes more.

According to our results, the trend of obesity among the indigenous group in Mexico has significantly increased from 13.2% in 2000 to 52.1% in 2018; this difference represents about 40 percentage points in 18 years. While in the non-indigenous group, although the trend is increasing, the difference in the same period is about ten percentage points, going from 34.7% in 2000 to 44.3% in 2018. This trend is consistent with the annualized average of 2.3 percentage points, suggesting that the distribution has shifted to the right with a total increase over the 2000-2018 period of 42.2%.[37] The percentage change obtained between surveys for diabetes prevalence for the indigenous group was 6.7% [2.6,11.0] and 0.1% [-1,1,1.4] for the non-indigenous group. Nationally, the percentage change was 0.5% [-0.7,1.8]. Only the percentage for the indigenous group was statistically significant.

On the other hand, more than half of the non-indigenous group presented abdominal obesity during the entire study period. This result was superior to that of Villalta et al. in a cross-sectional study of 195 indigenous women over 45; they found that the most frequent component of metabolic syndrome (30%) was abdominal circumference.[38] Based on the analysis of another national survey, the first wave (2002) of the Mexican Family Life Survey, a longitudinal study of Mexican households and communities, Stoddard et al. found that indigenous adults had significantly lower odds of obesity (OR = 0.58, 95% CI 0.49-0.68), and diabetes 0.59 (95% CI 0.40.0.68) than nonindigenous adults, when indigenous status was defined as the ability to speak an indigenous language, after adjusting for lifestyle indicators. In this case, diabetes was defined only for diagnosed diabetes.[39]

Some authors stated that acculturated societies are entering a dangerous era with rapidly increasing rates of obesity in populations leading to rising levels of type 2 diabetes[40,41]; In this sense, Mexico has experienced a change in eating habits in recent decades.

Groenendael stated that the most critical change had been the shift from a traditional rural diet of corn and beans to a highly commercialized and industrialized diet under the influence of changing economic models. This change is also observed in rural areas of Mexico,[42] where the indigenous population is mainly found. Consumption of ultra-processed food and sugar-sweetened beverages has been linked to an increased risk of obesity and other metabolic disorders.[43,44] In a study conducted in communities in Mexico with a predominantly indigenous population, the high consumption of tortillas (15-20 tortillas per day) and the daily, social and sumptuary consumption of soft drinks and beer have been associated with excessive kcal intake.[45]

Differences in the healthy lifestyles of indigenous people may be associated with a higher prevalence of obesity; therefore, it is possible to suggest that this change in body composition could be related to the increased prevalence of diabetes.

Soto-Estrada et al. suggested that the steady increase in the mortality rate from type 2 diabetes from 1990 to 2015 coincides with the increase in the energy density of Mexican dietary patterns from 1961 to 2013.[9] Different dietary patterns are one of several factors involved, some of which could be related to lifestyle changes.

Although this study did not examine diabetes control, Cruz-Sánchez and Cruz-Arceo's findings deserve attention. In an indigenous community in Tabasco, they conducted qualitative research about diabetes. The researchers found that women have access to the health service once a month to receive health education and to control chronic diseases to maintain social inclusion programs. They are diagnosed with diabetes when they already have symptoms or complications. In some cases, peritoneal dialysis or insulin was applied when the damage had progressed to a very advanced level. The abandonment of medical treatment can result in blindness or death in the indigenous population. There is a greater trust in herbal medicine among them. Diabetes self-care requires daily glucose monitoring, preferably in the morning, as part of self-care. There was no equipment available to any of the study participants. Every month, health center staff perform this examination during control visits. Indigenous communities' poverty conditions determine this.[46] Even though Mexican guidelines for diabetes treatment exist, few physicians are familiar with or follow them. In addition, primary care clinics (which treat most cases) lack the infrastructure to treat chronic diseases. Individual consultations are too brief, and other health professionals are rarely included and involved.[47]

Limitations

Among the strengths of the present study is the design that allows the representation of the adult population in Mexico. Using similar methodologies between 2000, 2006, 2012, and 2018 surveys will enable us to assess the trend in diabetes prevalence. Nevertheless, we recognize that using the criterion of speaking an indigenous language to identify the indigenous population may be limited. One of the problems that arise when trying to include possible confounding factors is the lack of precise information on the indigenous group. For example, information about a lifestyle: sweet beverage consumption and sedentarism behavior. Finally, our study is cross-sectional, which limits our ability to generate causal hypotheses.

Conclusions

In contrast to non-indigenous populations, our main result reveals an increased probability of being diabetic in the indigenous population from 2006 to 2018. It is necessary to clarify the origin of the accelerated change in diabetes prevalence among the indigenous population in Mexico.

Acknowledgments

None

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

References

1. Saeedi P, Petersohn I, Salpea P, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Res Clin Pract* 2019; 157: 107843.
2. INEGI-INSP. *Presentación de resultados. Encuesta Nacional de Salud y Nutrición 2018*. México, https://ensanut.insp.mx/encuestas/ensanut2018/doctos/informes/ensanut_2018_presentacion_resultados.pdf (2018).
3. Villalpando S, de la Cruz V, Rojas R, et al. Prevalencia y distribución de la

diabetes mellitus tipo 2 en población adulta mexicana. Una encuesta probabilística. *Salud Publica Mex* 2010; 52: 19–26.

4. Van Melle JP, Bot M, De Jonge P, et al. Diabetes, glycemic control, and new-onset heart failure in patients with stable coronary artery disease: Data from the heart and soul study. *Diabetes Care* 2010; 33: 2084–2089.
5. Patricia E, Fiallos C, Janeth L, et al. Relación entre enfermedades reumáticas y diabetes mellitus Relationship between rheumatic diseases and diabetes mellitus. *Rev Cuba Reumatol* 2019; 1–10.
6. Wyatt LH, Ferrance RJ. The musculoskeletal effects of diabetes mellitus. *J Can Chiropr Assoc* 2006; 50: 43–50.
7. Sellmeyer DE, Civitelli R, Hofbauer LC, et al. Skeletal metabolism, fracture risk, and fracture outcomes in type 1 and type 2 diabetes. *Diabetes* 2016; 65: 1757–1766.
8. Cheng HC, Chang TK, Su WC, et al. Narrative review of the influence of diabetes mellitus and hyperglycemia on colorectal cancer risk and oncological outcomes. *Transl Oncol* 2021; 14: 101089.
9. Soto-Estrada G, Moreno Altamirano L, García-García JJ, et al. Trends in frequency of type 2 diabetes in Mexico and its relationship to dietary patterns and contextual factors. *Gac Sanit* 2018; 32: 283–290.
10. Amanat S, Ghahri S, Dianatinasab A, et al. Exercise and Type 2 Diabetes BT - Physical Exercise for Human Health. In: Xiao J (ed). Singapore: Springer Singapore, pp. 91–105.
11. Milne G. Containing obesity "from a human evolutionary perspective". *J Aust Tradit Soc* 2018; 24: 208–213.
12. Robles-Berlanga R (SEDATU). Delimitación de las zonas metropolitanas México 2015. *Secr Desarro Agrar Territ y Urbano* 2015; 288.
13. INEGI. Población rural y urbana. *Cuéntame de México*, https://cuentame.inegi.org.mx/poblacion/rur_urb.aspx?tema=P#:~:text=Población.,Rural y urbana&text=El número de habitantes de,viven más de 2%2C500 personas.%7D (2022, accessed 18 October 2022).
14. Serrano-Carreto E. *Regiones indígenas de México*. 1st ed. Mexico: Comisión Nacional para el Desarrollo de los Pueblos Indigenas, Programa de las Naciones Unidas para el Desarrollo, https://www.gob.mx/cms/uploads/attachment/file/35735/cdi-regiones-indigenas-

mexico.pdf (2006).

15. INEGI. Hablantes de lengua indígena en México, https://www.inegi.org.mx/temas/lengua/ (2020, accessed 18 October 2022).
16. Hall GH, Patrinos H (eds). *Indigenous Peoples, Poverty, and Development*. Cambridge University Press, https://econpapers.repec.org/RePEc:cup:cbooks:9781107415140 (2014).
17. Servan-Mori E, Torres-Pereda P, Orozco E, et al. An explanatory analysis of economic and health inequality changes among Mexican indigenous people, 2000-2010. *Int J Equity Health* 2014; 13: 1–8.
18. Rojas-Martínez R, Basto-Abreu A, Aguilar-Salinas CA, et al. Prevalence of previously diagnosed diabetes mellitus in Mexico. *Salud Publica Mex* 2018; 60: 224–232.
19. Castro-Porras L V., Rojas-Russell ME, Aedo-Santos Á, et al. Stature in adults as an indicator of socioeconomic inequalities in Mexico. *Rev Panam Salud Publica/Pan Am J Public Heal* 2018; 42: 1–9.
20. WHO. Obesity and overweight, https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight (2021, accessed 11 July 2021).
21. Ahmad OB, Boschi-pinto C, Lopez AD. Age standardization of rates: a new WHO standard. *GPE Discuss Pap Ser* 2001; 1–14.
22. Sepúlveda J, Tapia-Conyer R, Velásquez O, et al. Diseño y metodología de la Encuesta Nacional de Salud 2000. *Salud Publica Mex*; 49. Epub ahead of print 2007. DOI: 10.1590/s0036-36342007000900015.
23. Olaiz-Fernández G, Rivera-Dommarco J, Shamah-Levy T, Rojas R, Villalpando-Hernández S H-AM et al. *Encuesta Nacional de Salud y Nutrición 2006. Instituto Nacional de Salud Pública: Cuernavaca*. 2006.
24. Romero-Martínez M, Shamah-Levy T, Franco-Núñez A, et al. National health and nutrition survey 2012: Design and coverage. *Salud Publica Mex* 2013; 55: 332–340.
25. Romero-Martínez M, Shamah-Levy T, Vielma-Orozco E, et al. Encuesta Nacional de Salud y Nutrición 2018-19: metodología y perspectivas. *Salud Publica Mex* 2019; 61: 917–923.
26. WHO. *Classification of diabetes mellitus*. Geneve. Epub ahead of print 2019. DOI: https://apps.who.int/iris/handle/10665/325182.
27. PAHO (Pan American Health Organization). Diabetes,

https://www.paho.org/en/topics/diabetes (2022, accessed 18 October 2022).

28. INEGI. Principales causas de mortalidad por residencia habitual, grupos de edad y sexo del fallecido. *Consulta de resultados. Tabulados básicos*, https://www.inegi.org.mx/sistemas/olap/registros/vitales/mortalidad/tabulados/pc.asp?t=14&c=11817 (2020, accessed 18 October 2022).
29. Sánchez-Pozos K, Menjívar M. Genetic Component of Type 2 Diabetes in a Mexican Population. *Arch Med Res* 2016; 47: 496–505.
30. Granados-Silvestre MA, Ortiz-López MG, Granados J, et al. Susceptibility background for type 2 diabetes in eleven Mexican Indigenous populations: HNF4A gene analysis. *Mol Genet Genomics* 2017; 292: 1209–1219.
31. Esparza-Romero J. Prevalencia y factores asociados a diabetes mellitus tipo 2 en población indígena de México: revisión sistemática. *Rev Med Inst Mex Seguro Soc* 2021; 58: 317–327.
32. Pacheco LS, Hernández-Ontiveros DA, Iniguez-Stevens E, et al. Prevalence and correlates of diabetes and metabolic syndrome in a rural indigenous community in Baja California, Mexico. *BMC Public Health* 2018; 18: 1–11.
33. Mendoza-Caamal EC, Barajas-Olmos F, Garciá-Ortiz H, et al. Metabolic syndrome in indigenous communities in Mexico: A descriptive and cross-sectional study. *BMC Public Health* 2020; 20: 1–8.
34. Eide ER, Showalter MH. Estimating the relation between health and education: What do we know and what do we need to know? *Econ Educ Rev* 2011; 30: 778–791.
35. Juárez-Ramírez C, Théodore FL, Villalobos A, et al. Social support of patients with type 2 diabetes in marginalized contexts in Mexico and its relation to compliance with treatment: A sociocultural approach. *PLoS One* 2015; 10: 1–22.
36. Connolly V, Unwin N, Sherriff P, et al. Diabetes prevalence and socioeconomic status: A population based study showing increased prevalence of type 2 diabetes mellitus in deprived areas. *J Epidemiol Community Health* 2000; 54: 173–177.
37. Barquera S, Hernández-Barrera L, Trejo-Valdivia B, et al. Obesidad en México, prevalencia y tendencias en adultos. Ensanut 2018-19. *Salud Publica Mex* 2020; 62: 682–692.
38. Villalta M. Prevalencia de síndrome metabólico en mujeres indígenas mayores de 45 años. *Rev médica (Colegio Médicos y Cir Guatemala)* 2016; 155: 33–36.
39. Stoddard P, Handley MA, Vargas Bustamante A, et al. The influence of

indigenous status and community indigenous composition on obesity and diabetes among Mexican adults. *Soc Sci Med* 2011; 73: 1635–1643.

40. Saxton SN, Clark BJ, Withers SB, et al. Mechanistic links between obesity, diabetes, and blood pressure: Role of perivascular adipose tissue. *Physiol Rev* 2019; 99: 1701–1763.
41. Monterroza M, Isabel D, Jiménez C, et al. Investigaciones Andina ISSN: 0124-8146 ISSN: 2538-9580 Fundación Universitaria del Área Andina - FUNANDI. *Pap la Intercult en el Control del cáncer en pueblos indígenas* 2018; 6–7.
42. Van Groenendael L. Habits of nutrition in México. *Collab Pap*; 8, https://dsp.facmed.unam.mx/wp-content/uploads/2015/11/gu8.pdf (2007).
43. Bhurosy T, Kaschalk E, Smiley A, et al. Comment on 'ultraprocessed food consumption and risk of overweight and obesity: The University of Navarra Follow-Up (SUN) cohort study'. *Am J Clin Nutr* 2017; 105: 1012.
44. Malik VS, Popkin BM, Bray GA, et al. Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: A meta-analysis. *Diabetes Care* 2010; 33: 2477–2483.
45. Pague-Pliego J, Eroza-Solana E, Acero-Vidal C. *Vivir sufriendo de azucar*. San Cristóbal de Las Casas, Chiapas: Universidad Nacional Autónoma de México, 2018.
46. Cruz-Sánchez M, Cruz Arceo MD los Á. El significado de la diabetes mellitus entre indígenas chontales de Tabasco, México. *Población y Salud en Mesoamérica*; 18. Epub ahead of print 2020. DOI: 10.15517/psm.v18i1.40092.
47. Barquera, S., Campos-Nonato, I., Aguilar-Salinas, C., Lopez-Ridaura, R., Arredondo, A., & Rivera-Dommarco J. Diabetes in Mexico: cost and management of diabetes and its complications and challenges for health policy. *Global Health* 2013; 9: 1–9.

Figure 1. Predicted probabilities and risk of having diabetes by indigenous group.

Models for risk of diabetes by year of survey, stratified by indigenous group; adjusted for sex, age, waist circumference, urbanity area

Table 1. Population according to sociodemographic characteristics in Mexican adults from 2000 to 2018, by indigenous group.

	Non-indigenous				Indigenous			
	2000	2006	2012	2018	2000	2006	2012	2018
	%[95% CI]	%[95% CI]	%[95% CI]	%[95% CI]	%[95 % CI]	%[95% CI]	%[95% CI]	%[95% CI]
Frequency in thousands N	47,806	45,762	59,973	77,652	3,496	3,122	4,325	5,062
Sample size observations n	41,245	5,328	8,610	11,985	3,776	501	1,122	1,177
Women	53.1 [52.3,53.9]	53.5 [51.3,55.7]	53.6 [51.4,55.8]	54.6 [53.0,56.1]	51.4 [49.1, 53.7]	61.8 [55.9,67.4]	49.0 [42.5,55.6]	55.8 [51.6,59.9]
Age								
20-39	61.1 [60.3,61.9]	53.1 [51.0,55.2]	51.8 [49.5,54.1]	43.3 [41.7,45.0]	54.8 [53.0, 56.7]	47.6 [41.8,53.4]	44.9 [38.4,51.6]	38.8 [34.8,43.0]
40-59	26.8 [26.1,27.5]	32.2 [30.3,34.1]	33.2 [31.0,35.4]	36.9 [35.5,38.4]	31.0 [29.1, 33.0]	33.3 [28.1,38.8]	35.9 [30.7,41.6]	37.6 [33.5,41.9]
60 and more	12.1 [11.6,12.6]	14.7 [13.3,16.1]	15.0 [13.6,16.5]	19.8 [18.5,21.1]	14.2 [12.7, 15.8]	19.2 [15.2,23.8]	19.1 [15.6,23.2]	23.6 [20.3,27.3]
Educational level								
Elementary or less	44.9 [41.5,48.3]	47.8 [45.6,50.1]	39.9 [37.7,42.1]	29.3 [28.0,30.7]	77.3 [74.1, 80.3]	82.1 [77.4,85.9]	75.5 [70.6,79.9]	65.0 [60.5,69.3]
Secondary	23.8 [23.0,24.7]	23.9 [22.2,25.8]	28.5 [26.4,30.6]	27.0 [25.6,28.4]	13.1 [11.3, 15.1]	11.6 [8.3,16.0]	14.1 [11.3,17.4]	21.7 [18.5,25.2]
High school	20.7 [18.9,22.5]	17.1 [15.4,18.8]	18.6 [17.0,20.4]	24.9 [23.5,26.4]	7.1 [5.7,8.7]	4.4 [2.6,7.5]	6.6 [4.4,9.9]	8.2 [6.1,10.9]
Bachelor or more	10.6 [9.4,12.0]	11.1 [9.5,13.0]	13.0 [11.3,14.9]	18.8 [17.5,20.2]	2.5 [1.7,3.8]	1.9 [0.6,5.2]	3.8 [2.4,5.9]	5.1 [3.3,7.8]
Currently working	50.5 [49.5,51.4]	53.1 [51.1,55.1]	54.9 [52.7,57.1]	61.6 [60.1,63.2]	51.2 [48.7, 53.7]	45.5 [40.0,51.1]	52.8 [46.5,59.0]	62.5 [58.8,66.0]
Social security	97.6 [97.4,97.7]	51.6 [49.2,54.0]	75.9 [74.0,77.8]	82.8 [81.5,84.0]	96.7 [95.9, 97.4]	33.0 [26.5,40.2]	73.6 [65.1,80.7]	87.8 [84.9,90.2]
Socioeconomic level in terciles								
Tertile 1	27.9 [23.7,32.7]	25.8 [23.8,27.9]	22.3 [20.6,24.1]	26.6 [25.2,28.1]	79.0 [74.4, 82.9]	74.9 [68.1,80.6]	66.5 [58.2,73.9]	74.3 [69.7,78.4]
Tertile 2	33.2 [32.4,34.1]	32.6 [30.4,34.9]	33.3 [31.3,35.4]	33.3 [31.8,34.8]	15.9 [13.3, 18.9]	16.8 [12.5,22.1]	20.1 [15.7,25.3]	19.9 [16.4,23.9]
Tertile 3	38.9 [34.2,43.7]	41.6 [38.9,44.3]	44.4 [42.0,46.8]	40.1 [38.3,41.9]	5.2 [3.6,7.3]	8.4 [4.6,14.6]	13.4 [6.9,24.3]	5.8 [4.1,8.2]
Region								
North	21.2 [20.0,22.4]	21.7 [19.5,24.0]	21.3 [19.5,23.1]	21.4 [20.1,22.8]	3.0 [2.3,4.0]	3.0 [1.5,5.9]	4.4 [2.7,7.3]	4.6 [3.1,7.0]
Central	53.0 [51.5,54.4]	51.4 [48.2,54.6]	51.8 [49.0,54.6]	51.0 [48.9,53.1]	10.2 [8.5,12.3]	14.5 [8.9,22.8]	20.6 [13.0,31.0]	20.1 [13.2,29.2]

South	25.9 [23.4,28.5]	26.9 [24.5,29.5]	26.9 [24.7,29.3]	27.6 [25.8,29.4]	86.7 [84.1, 88.9]	82.4 [74.3,88.4]	75.0 [65.2,82.8]	75.3 [66.5,82.4]
Area of residence								
Rural	18.7 [13.2,25.8]	15.0 [13.0,17.1]	19.1 [17.1,21.3]	19.7 [17.8,21.7]	57.8 [51.9, 63.5]	53.2 [43.7,62.4]	57.9 [48.9,66.4]	49.8 [41.5,58.0]
Urban	81.3 [74.2,86.8]	85.0 [82.9,87.0]	80.9 [78.7,82.9]	80.3 [78.3,82.2]	42.2 [36.5, 48.1]	46.8 [37.6,56.3]	42.1 [33.6,51.1]	50.2 [42.0,58.5]

Table 2. Change in the diabetes prevalence in Mexican adults by indigenous group and year of survey

	Diagnosed diabetes				Undiagnosed diabetes		Total diabetes	
	Frequency in thousands	Sample observations	Unadjusted prevalence	Adjusted prevalence[a]	Unadjusted prevalence	Adjusted prevalence[a]	Unadjusted prevalence	Adjusted prevalence[a]
	N	n	%[95% CI]	%[95% CI]	%[95% CI]	%[95% CI]	%[95% CI]	%[95% CI]
Non-indigenous								
2000	46,030	40,194	5.9 [5.5,6.2]	7.7 [7.3,8.2]	NA	NA	5.9 [5.5,6.2]	7.7 [7.3,8.2]
2006	47,559	5,496	7.5 [6.4,8.7]	8.7 [7.5,10.0]	8.8 [7.6,10.1]	9.5 [8.3,10.8]	16.9 [15.4,18.5]	18.3 [16.8,20.0]
2012	59,973	8,610	8.8 [7.7,10.1]	9.7 [8.5,11.0]	4.5 [3.7,5.5]	4.5 [3.9,5.3]	13.3 [11.9,14.9]	14.4 [13.0,16.0]
2018	77,652	11,985	10.3 [9.4,11.1]	9.8 [9.1,10.6]	6.3 [5.3,7.3]	6.0 [5.2,6.9]	16.5 [15.3,17.8]	17.2 [16.1,18.3]
Change (%)			*3.3 [2.5,4.1]**		*-2.8 [-4.9,-0.6]**		*0.1 [-1.1,1.4]*	
Indigenous								
2000	3,357	3,645	3.5 [2.7,4.5]	4.1 [3.1,5.2]	NA	NA	3.5 [2.7,4.5]	4.1 [3.1,5.2]
2006	3,230	513	5.3 [3.5,7.8]	5.4 [3.6,7.9]	4.0 [2.4,6.6]	3.9 [2.3,6.5]	9.6 [6.9,13.1]	9.4 [6.8,12.9]
2012	4,325	1,122	8.9 [5.6,13.9]	8.2 [5.6,11.9]	4.8 [3.3,6.8]	4.6 [3.3,6.5]	13.7 [9.9,18.5]	12.7 [9.8,16.3]
2018	5,062	1,177	10.3 [8.1,13.1]	9.2 [7.3,11.5]	8.5 [5.7,12.6]	8.2 [5.5,12.1]	18.8 [14.7,23.7]	18.7 [15.0,23.2]
Change (%)			*6.4 [4.1,8.8]**		*7.7 [1.3,14.6]**		*6.7 [2.6,11.0]**	
National								
2000	49,707	44,107	5.7 [5.3,6.1]	7.4 [7.0,7.9]	NA	NA	5.7 [5.3,6.1]	7.4 [7.0,7.9]
2006	50,794	6,011	7.6 [6.6,8.8]	8.4 [7.4,9.7]	8.5 [7.4,9.7]	9.1 [8.0,10.3]	16.4 [15.0,18.0]	17.7 [16.3,19.3]

2012	64,298	9,732	8.8 [7.7,10.0]	9.5 [8.4,10.8]	4.5 [3.7,5.5]	4.5 [3.9,5.2]	13.3 [12.0,14.8]	14.3 [12.9,15.7]
2018	82,714	13,162	10.3 [9.5,11.1]	9.7 [9.0,10.5]	6.4 [5.5,7.4]	6.2 [5.4,7.1]	16.7 [15.5,17.9]	17.3 [16.2,18.4]
Change (%)			*3.5 [2.7,4.2]**		*-2.2 [-4.2,-0.1]**		*0.5 [-0.7,1.8]*	

ENSA, Encuesta Nacional de Salud; ENSANUT, Encuesta Nacional de Salud y Nutrición; 95% CI:95% confidence interval; *p < 0.05

[a] Age-adjusted using the world population in 2010

Table 3. Health characteristics in Mexican adults with diabetes by indigenous group and year of survey

	2000	2006	2012	2018	p trend	2000	2006	2012	2018	p trend
	%[95% CI]	%[95% CI]	%[95% CI]	%[95% CI]		%[95% CI]	%[95% CI]	%[95% CI]	%[95% CI]	
	Non-indigenous					Indigenous				
Frequency in thousands N	2,695	3,011	7,980	12,821		117	202	591	953	
Sample observations n	2,778	2,067	1,258	2,155		162	185	157	230	
Characteristics related to diabetes										
Age of diabetes onset, mean	46.5 [45.5, 47.4]	47.4 [46.2,48.5]	48.4 [45.8,51.0]	47.1 [46.0,48.2]		48.6 [46.1, 51.1]	48.0 [44.9,51.2]	46.9 [45.0,48.9]	47.5 [44.9,50.0]	
Years with diabetes, mean	8.8 [8.3,9.4]	8.4 [7.2,9.6]	9.9 [8.9,10.9]	11.7 [10.8,12.6]	*	8.7 [6.8,10.6]	6.7 [4.4,9.1]	8.0 [5.8,10.2]	8.7 [6.7,10.7]	
Characteristics related to health condition										
BMI										
Normal	24.9 [22.0, 28.1]	18.8 [14.7,23.7]	19.1 [14.2,25.1]	17.5 [14.3,21.3]		30.7 [22.3, 40.6]	22.7 [12.2,38.2]	20.3 [12.0,32.1]	18.3 [13.3,24.7]	
Overweight	40.3 [37.4, 43.3]	43.3 [38.0,48.7]	37.6 [32.4,43.1]	38.2 [34.4,42.1]	*	56.1 [46.1, 65.6]	37.1 [25.3,50.8]	41.9 [24.3,61.8]	29.6 [20.3,40.8]	*
Obesity	34.7 [31.8, 37.8]	37.9 [32.8,43.3]	43.3 [37.5,49.2]	44.3 [40.7,48.0]	*	13.2 [7.9,21.2]	40.2 [27.4,54.4]	37.8 [24.2,53.7]	52.1 [40.7,63.4]	*
Abdominal obesity	65.7 [62.8, 68.6]	60.3 [54.6,65.6]	62.9 [57.2,68.3]	71.5 [67.3,75.3]	*	53.5 [40.2, 66.2]	54.8 [40.4,68.4]	66.9 [52.1,79.0]	65.7 [58.3,72.4]	*
Hypertriglyceridemia	23.6 [21.2, 26.2]	8.2 [5.9,11.3]	NA	29.7 [26.7,32.9]	*	27.9 [17.7, 41.0]	2.9 [0.7,11.4]	NA	23.3 [14.7,34.8]	*
Diagnosed hypertension	37.5 [34.9, 40.2]	29.5 [25.2,34.2]	40.0 [34.2,46.1]	36.7 [33.2,40.4]	*	34.3 [25.0, 44.9]	26.2 [17.0,38.2]	29.3 [18.2,43.5]	29.3 [19.9,40.8]	

Chronic kidney disease	2.9 [2.1,3.8]	2.4 [1.4,3.9]	NA	3.1 [1.9,5.1]	*	0.0 [0.0,0.3]	0.0 [.,.]	NA	0.8 [0.2,3.8]	
Previous stroke	NA	2.2 [1.0,4.8]	5.3 [3.3,8.2]	3.3 [2.2,4.8]	*	NA	1.8 [0.3,12.1]	0.7 [0.1,3.3]	0.4 [0.1,1.7]	
Chronic heart failure	NA	1.3 [0.7,2.2]	4.8 [2.0,10.9]	2.4 [1.7,3.5]	*	NA	1.6 [0.2,10.9]	0.1 [0.0,0.8]	0.3 [0.1,1.6]	*
Cerebral Vascular Disease	NA	0.4 [0.1,1.0]	5.1 [2.6,9.9]	7.5 [2.6,20.3]	*	NA	1.2 [0.2,8.2]	15.4 [2.9,52.2]	0.0 [.,.]	
Depression	NA	23.7 [20.0,27.9]	32.4 [27.5,37.9]	25.3 [22.5,28.4]		NA	29.1 [18.0,43.6]	20.9 [12.4,33.1]	18.4 [11.9,27.4]	
Lifestyle habits										
Current smoker	18.0 [15.8, 20.4]	16.1 [12.5,20.5]	18.4 [13.8,24.1]	14.8 [12.4,17.4]	*	13.1 [7.0,23.3]	9.7 [4.4,20.1]	7.1 [2.8,17.0]	2.8 [1.3,6.0]	
Current drinker	28.6 [26.3, 31.1]	26.1 [23.1,29.4]	21.2 [18.0,24.7]	24.1 [21.5,26.9]		34.9 [25.3, 45.9]	24.6 [16.6,34.7]	22.0 [13.1,34.6]	14.1 [9.0,21.3]	
Current soft drink consumer (ml), mean	NA	193.5 [173.7,213.3]	263.9 [184.2,343.6]	269.5 [229.6,309.4]	*	NA	162.7 [123.3,202.2]	91.7 [58.3,125.1]	195.3 [144.5,246.1]	*

NA: Not available; *linear p trend p<0.05

Table 4. The adjusted risk of diabetes by year of the survey

	Indigenous group		**No indigenous group**	
Year of survey	**OR [95% CI]**	***p*-value**	**OR [95% CI]**	***p*-value**
2006	1		1	
2012	**1.77** [1.03 , 3.03]	0.038	**0.73** [0.61 , 0.88]	0.001
2018	**2.22** [1.35 , 3.66]	0.002	**0.82** [0.70 , 0.97]	0.017

Models for risk of diabetes by year of survey, stratified by indigenous group; adjusted for sex, age, waist circumference, urbanity area