

Characterization of adults without risk and with risk for type 2 diabetes, and adults with type 2 diabetes in Northern Mexico

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ABSTRACT

Objective: To characterize a group of adults without risk and with risk for type 2 diabetes and with type 2 diabetes in Northern Mexico. **Method:** Descriptive, correlational and cross-sectional design; 250 apparently healthy persons, male and female, between 18 and 65 years of age, were included, who were recruited in a shopping mall of Monterrey, Mexico. The instruments used were paper and pencil, anthropometric measurements, and a sample of 3 ml of blood to process glyca-
ted hemoglobin. **Results:** Females predominated (72.8%), average age was 43.9 years ($DE = 12.7$), average of 11.5 years of schooling ($DE = 4.3$), 80% has family history of diabetes; 13.1% of participants had indicative diabetes figures, and 26.9% had the risk of developing it. The results regarding fat percentage and waist circumference were above the recommended cutting points. A high risk of diabetes, high social support, sufficient monthly income, and community characteristics favoring health were noticed; on the contrary, anxiety, a healthy lifestyle, depression symptoms, and work-related stress had low percentages. 86.8% of people see the doctor only when they are sick, and more than 50% of the people were recommended to exercise and keep a balanced diet; more than half of the people were informed to be at risk of diabetes. **Conclusion:** It is important to use the ecological perspective which opens the understanding of processes and factors of different levels of social organization involved in the risk of developing T2D.

Keywords: Diabetes mellitus; public health; social ecology; risk factors (DeCS; BIREME).

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INTRODUCTION

Type 2 diabetes mellitus (T2D) is a worldwide public health problem⁽¹⁾; in Mexico, it is the second cause of death, with an increase of 4% in the prevalence during the last four years, which has led the country to have the fifth place worldwide with more adults diagnosed with T2D⁽²⁻⁴⁾.

In spite of existing multiple standards and interventions in the country regarding prevention and early detection of T2D risk^(5,6), their implementation and fulfillment of prevention indicators are still far from being reached; some authors affirm that the T2D has had a positive growth pattern of 2.7% per year⁽⁷⁾.

Evidence suggests that this growth pattern is due to a complex metabolic nature, since diabetes mellitus is associated to non-modifiable factors such as age, race, genetic heritage, etc., and modifiable factors related to unhealthy life styles such as physical inactivity, overweight, and obesity [OW/OB], unhealthy diet, and alcohol consumption^(2,8). The literature reports several successful interventions that have manipulated individual factors, such as changes in the eating patterns and promotion of physical activity. However, even if significant results have been reported, these have had no impact in the reduction of incidence and prevalence at national level⁽⁷⁾.

Different theoretical ideas^(11,12) among them the Ecological Model for the Promotion of Health (MEPS by its acronym in Spanish)⁽¹³⁾ sustains that the development of risk and progression toward the disease is produced by the presence of factors at different levels of the social structure, such as interpersonal level (interpersonal relations), institutional level (working conditions), community level (specific circumstances of life), and public policy level (access and use of actions at public level). For this reason, it is essential to understand the different factors involved in the progression of the risk of having T2D up to the onset of the disease using the ecological perspective, including factors that have not been studied in depth, since they may influence in the person and make him vulnerable to the disease.

The literature review highlights individual factors such as lack of physical activity, OW/OB, HTA, family history of type 2 diabetes⁽²⁾, low educational and economic level¹⁴, anxiety, depression⁽¹⁵⁾, consumption of psychoactive substances⁽¹⁶⁾, low perception of risk⁽¹⁷⁾; as well as factors in different levels of the social structure such as the limited social support¹⁸, long working days, work-related stress^(19,20), food insecurity, perception of community issues^(21,22), urban development and urbanization⁽²³⁻²⁵⁾, the low educational level in the community⁽²⁶⁾, low access to the healthcare system^(27,28), and the local and national economy^(29,30).

So far, no evidence has been found concerning individual factors or about the social structure, within the context of a theoretical perspective such as MEPS, which are present and influence the risk to suffer from T2D and the progression to active disease in the northeast part of Mexico; additionally, given the magnitude that this

problem represents, it is essential to contribute to the best understanding of the ecological factors that influence the development of the T2D, to allow the redesign and the implementation of interventions in order to prevent the disease, most likely to reduce its incidence, prevalence, and additional costs associated to the treatment at local level.

On the basis of the above, the objective of this study was to characterize a group of adults without risk and with risk for Type 2 diabetes and with Type 2 diabetes in the northeast part of Mexico.

METHODOLOGY

Cross-sectional descriptive design where the population was comprised by persons between 18 and 65 years of age, male and female, from the metropolitan area of Monterrey, Mexico. The size of the sample was estimated through nQueryAdvisor with statistical significance of (α) < .05, medium effect size (γ), and power ($1 - \beta$) of .90, for a sample of 250 participants; sampling was non-probabilistic. People of both sexes, between 18 and 65 years of age, were included; excluded were persons with Type 1 diabetes mellitus, maturity onset diabetes of the young (MODY), and pregnant women. Participants were recruited in a shopping mall of the metropolitan area of Monterrey through a personal invitation and ads. People who agreed to participate received a detailed explanation about the study. After the approval by the participant, the compliance of inclusion criteria was checked, and the process of informed consent took place. Data collection was carried out in three phases: 1. Filling out of instruments used, 2. Anthropometric measurements, and 3. The extraction of a blood sample to process glycated hemoglobin (HbA1c). This process was performed by a doctoral student of Nursing Sciences, and one research assistant, previously trained to fill out the instruments used, carrying out anthropometric measurements, and collection of 3 ml of venous blood. This last one was processed by the clinical analysis laboratory called "Q.F.B. Iris Guajardo Guajardo" of the School of Chemical Sciences of the Universidad Autónoma de Nuevo León (ISO-9001:2008 certification), through High-performance liquid chromatography (HPLC), pursuant to international standard guidelines². HbA1c was classified pursuant to the American Diabetes Association², figures $\leq 5.6\%$ were considered normal, from 5.7% to 6.4% HbA1c as risk to T2D, and $\geq 6.5\%$ HbA1c as a sign of T2D. The study was performed in accordance to ethical guidelines settled by the Regulation of the General Health Act in the Area of Health Research⁽³¹⁾, as well as the approval by a Committee of Bioethics, Research, and Biosafety, with registry number D-1325. In every case, the informed consent of the participants was obtained prior to filling out the instruments. Data were collected in the second half of 2018.

In Table 1, the variables to measure the theoretical levels that correspond to the person and the social structure according to the MEPS are described; all of the instruments were validated in the Mexican population. For the statistical

analysis, the continuous variables are presented with mean and standard deviation(s) and the categorical variables with frequencies and percentages.

RESULTS

The HbA1c was determined in 245 participants, since in five of them was not possible to extract the blood sample. 60% of them have figures of HbA1c within normal limits, 26.9% present risk figures for T2D, and 13.1% present figures that indicate T2D.

Females predominated by 72.8%; average was 43.9 years ($s = 12.7$); average years of schooling was 11.5 years ($s = 4.3$). 80.8% referred having family history of T2D. 32.8% and 17.2% of participants drink alcoholic beverages and smoke cigarettes, respectively, and consumption is most prevalent in men than in women.

Table 2 shows that those who are at risk of having T2D, or already have T2D, have the largest proportion of relatives with diabetes; obesity and the high perception of risk factors for T2D predominate; the largest part of the sample does not have healthy lifestyles; anxiety and depressive symptoms were shown in low percentages.

In accordance with table 3, most of the participants perceive a high social support, a monthly income sufficient to cover their basic needs, under work-related stress, and community characteristics that favor health. Almost all of the group participants being studied seek medical service only when they feel sick; it was recommended to exercise and keep a healthy diet to more than half of the sample.

DISCUSSION

T2D requires a wider understanding of all factors that play a role in the development of risk and the progression towards disease from theoretical perspectives that overcome the approach circumscribed to the individual. For this reason, it is essential to include the MEPS, which establishes the importance of variables aside of the individual, and in different levels of social organization, which may determine behaviors that promote health. This theoretical approach is of significance to the nursing discipline since it broadens the scope of interacting variables that influence on the risk for T2D and its full development, a disease that significantly impacts Mexican population⁽²³⁾.

The sample for this study that was recruited was largely formed by women, which corresponds well with other authors^(14,16,22), confirming that it is the female gender which shows the largest interest in its health. It also draws attention that the percentage is way above the reports at national level of participants with family history of T2D⁽¹⁴⁾. The evidence shows that these persons have up to 30% of chance of getting T2D at younger ages, compared with those who do not have this family history; this is likely to be associated to genes linked to susceptibility for T2D⁽⁴⁰⁾. In this sample, this risk condition for T2D is also explained by

the OW/OB status (more than five percentage points than national prevalence) of the participating group, considered a high risk factor for T2D⁽¹⁴⁾.

A positive factor in this group was the average years of schooling above the national average⁽³⁾. It is known that the education level is associated with the risk for T2D; several studies have shown that the lower the educational level, the higher the risk and incidence of T2D. The opposite has also been confirmed, that is, a higher level of schooling favors the adoption of healthy behaviors which reduces the probability of developing the disease⁽¹⁶⁾.

The majority of the participants stated that they do not drink alcohol or smoke cigarettes; situation that is not consistent with the information found in the literature, which sustains a strong association regarding the use of this type of drugs with the risk for and the incidence of T2D^(16,18). This behavior shown in the sample may be due to the high education level considered as health protective factor, since it allows making assertive decisions preventing circumstances and risk situations for health.

The figures of HbA1c in healthy adult people suggest that the population of northeast Mexico is prone to developing T2D⁽¹⁴⁾. This situation is explained by inherited susceptibility and unhealthy behaviors and lifestyles, standing out a poor diet and physical inactivity; presence of OW/OB, which affects the production and secretion of insulin; the oxidation of circulating fatty acids; the consequent accumulation of blood glucose; and the inadequate quality of insulin transduction and resistance processes.

The analysis of groups with and without risk for T2D, and with figures that indicate T2D according to HbA1 figures, allowed making the profile of the persons who constitute the sample. Those with diagnosed type 2 diabetes were the older ones, with low income and less information about the risk to have T2D. It is well known that the increase in age is associated with the risk for T2D^(2,8), due to the aging processes that negatively affect the physiological mechanisms of compensation to keep the quality and quantity in insulin excretion, having as aggravating factor the presence of other risk factors such as OW/OB, unbalanced diet, and physical inactivity, which exacerbate the inadequate function of the metabolic processes related to the glucemic balance.

It was found that sufficient income for basic needs was present in larger percentage in the sub-group without risk for T2D. The risk for T2D is associated to lower income⁴¹. It is consistent with the findings in the study group, which indicate that the capability to meet individual and home needs is vital in the promotion and consecution of healthy lifestyles to prevent the risk of type 2 diabetes.

The reception of information about healthy diet was larger in the sub-group with risk for and with T2D. The association of lack of information about the risk for T2D and an inadequate healthy diet with the risk for T2D^(14,41) has been demonstrated. However, it is possible that the reception of information about a healthy diet and about the risk for T2D does not produce and effect on the perception of the risk

Tabla 1. Variable definition and operationalization

Levels of Influence	
Intrapersonal Level	
Sex	Female, male.
Age	Age
Education level	Years of formal education.
Family history of T2D	T2D diagnosis in one or more family members
Drinking	Voluntary use of alcohol. Yes/No.
Smoking	Smoking. Yes/No.
Waist circumference (CC)	Increase of waist circumference in women >80 cm and in men >94 cm. It was measured with flexible tape, SECA 203.
Body fat	Increased > 25% in men and > 35% in women. It was measured with the InBody 230 scale.
Lifestyle	Individual actions addressed to promote a healthy lifestyle. This was evaluated with the "Cuestionario de Perfil de Estilo de Vida II"(PEPS-II) ⁽³²⁾ (Questionnaire of the Profile of Life Style II).
T2D risk perception	Individual identification of characteristics and behavior that can increase the risk to develop T2D. It was evaluated with the instrument "Percepción de los Factores de Riesgo de Diabetes Tipo 2" ⁽³³⁾ (Perception of risk factors for type 2 diabetes).
Anxiety	Temporary or permanent emotional response with somatic symptoms of stress in the face of stimuli perceived as threatening. It was evaluated using the "Cuestionario de Ansiedad Estado-Rasgo" (STAI) ⁽³⁴⁾ (State-trait Anxiety Inventory).
Depressive symptoms	Feelings of sadness, despair and decreased ability to enjoy preferred activities. It was evaluated with the "Beck II Depression Inventory" (BDI-II) ⁽³⁵⁾ (Beck II Depression Inventory).
Interpersonal Level	
Social support	Perception of availability of a person to provide emotional, physical, and economical help or support, It was evaluated using the "Escala Multidimensional de Apoyo Social Percibido" (MSPSS) ⁽³⁶⁾ (Multidimensional Scale of Perception of Social Support).
Institutional Level	
Monthly income	Monthly salary to cover basic needs. Sufficient/Insufficient.
Work-related stress	Mental state of pressure and worry related to some work-related activity. It was evaluated with the "Cuestionario Desbalance Esfuerzo / Recompensa" ⁽³⁷⁾ (Effort-Reward Imbalance Questionnaire).
Community Level	
Characteristics of the community	Availability of healthy food, green areas, sport facilities, and safety, which can benefit health. It was evaluated with the instrument called "Características de la Comunidad" ⁽³⁸⁾ (Community Characteristics).
Public Policy Level	
Public policy	Access and use of health action related to weight control, physical activity, healthy diet plan, education about risk factors, multidisciplinary consultations, and lab test to prevent the risk for T2D ⁽³⁹⁾ .

Fuente: Elaboración propia.

of getting sick and so does not influence in the increase of health awareness, which prevents positive and lasting changes to favor healthy lifestyles.

In relation to theoretical support, the perspectives of ecological nature have been gaining acceptance as alternatives and approaches, which include non-linear, changing, unpredictable, moderating, and mediating factors; they consider the influences of context in order to explain the complexity regarding health behaviors, and the production and progression toward disease. For this reason, it is important and necessary that health research sustains in theories that allow improving the understanding of the phenomena in the actual context, to increase the validity of the results, and to contribute to visualize the future behavior and potential impact over the health of the people⁽¹³⁾.

These results may be taken with grain of salt, since it was a non-probabilistic sample due to the impossibility of having a sample frame for the random selection of participants; other biological indicators related to the risk for type 2 diabetes were not included, such as insulin, blood sugar, oral glucose tolerance curve, and lipid profile. Moreover, the cross-sectional design prevented us from carrying out a follow-up over time in order to determine the incidence of T2D, the conversion rate of the participants in risk for T2D to type 2 diabetes, and to determine causal relationships; besides, it limits the possibilities of generalizing the findings to other populations.

Table 2. Frequencies and percentages of intrapersonal variables according to HbA1c figures

Variables	Total		Without risk of developing T2D		With risk of developing T2D		With T2D	
	f	%	f	%	f	%	f	%
			147	60	66	26.9	32	13.1
Family background								
Yes	197	80.4	110	74.80	59	89.4	28	87.5
No	35	14.3	26	17.70	5	7.6	4	12.5
Unknown	13	5.3	11	7.50	2	3.0	0	0
Total	245	100	147	100.00	66	100	32	100
Waist Circumference (or CC)								
Men								
Normal	21	31.3	15	33.3	3	20	3	42.9
Increased	46	68.7	30	66.7	12	80	4	57.1
Total	67	100	45	100	15	100	7	100
Women								
Normal	23	13	12	11.8	6	11.8	5	20
Increased	155	87	90	88.2	45	88.2	20	80
Total	178	100	102	100	51	100	25	100
Percentage of body fat								
Men								
Normal	19	28.4	15	33.3	2	13.3	2	28.6
Increased	48	71.6	30	66.7	13	86.7	5	71.4
Total	67	100	45	100	15	100	7	100
Women								
Normal	33	18.5	21	20.6	8	15.7	4	16
Increased	145	81.5	81	79.4	43	84.3	21	84
Total	178	100	102	100	51	100	25	100
Life style								
Developed	88	35.9	51	34.7	24	36.4	13	40.6
Not developed	157	64.1	96	65.3	42	63.6	19	59.4
Total	245	100	147	100	66	100	32	100
T2D risk perception								
High	163	66.5	88	59.8	53	80.3	22	68.7
Low	82	33.5	59	40.2	13	19.7	10	31.3
Total	245	100	147	100	66	100	32	100
Anxiety								
High	25	10.2	19	12.9	4	6.1	2	6.3
Low	220	89.8	128	87.1	62	93.9	30	93.7
Total	245	100	147	100	66	100	32	100
Depressive symptoms								
Minimal	157	64.1	93	63.3	45	68.2	19	59.4
Slight	34	13.9	18	12.2	11	16.7	5	15.6
Moderate	33	13.5	21	14.3	7	10.6	5	15.6
Severe	21	8.5	15	10.2	3	4.5	3	9.4
Total	245	100	147	100	66	100	32	100

Source: Self-source

n= 245

Table 3. Frequencies and percentages of interpersonal, institutional, community, and public policy variables according to HbA1c figures

Influence level	Variables	Total		Without risk of developing		With risk of developing		With T2D	
		f	%	f	%	f	%	f	%
				147	60	66	26.9	32	13.1
Interpersonal	Social support								
	High	176	71.8	104	70.7	51	77.3	21	65.6
	Low	69	28.2	43	29.3	15	22.7	11	34.4
	Total	245	100	147	100	66	100	32	100
Institutional	Monthly income								
	Sufficient	161	65.7	106	72.1	38	57.6	17	53.1
	Insufficient	84	34.3	41	27.9	28	42.4	15	46.9
	Total	245	100	147	100	66	100	32	100
	Work-related stress								
Without work-related stress	235	95.9	140	95.2	66	100	29	90.6	
With work-related stress	10	4.1	7	4.8	0	0	3	9.4	
	Total	245	100	147	100	66	100	32	100
Community	Características comunitarias								
	Favorecedoras	167	68.2	100	68.1	45	68.2	22	68.8
	No favorecedoras	78	31.8	47	31.9	21	31.8	10	31.2
	Total	245	100	147	100	66	100	32	100
Public policy	Attending health service								
	When he feels sick	212	86.5	128	87.1	57	86.4	27	84.4
	When he is healthy	33	13.5	19	12.9	9	13.6	5	15.6
	Total	245	100	147	100	66	100	32	100
	Recommendation to exercise								
	Yes	164	6.9	92	62.6	9	74.2	23	71.9
	No	81	33.1	55	37.4	17	25.8	9	28.1
	Total	245	100	147	100	66	100	32	100
	Recommendation to have a balanced diet								
	Yes	158	64.5	86	58.5	50	75.8	22	68.8
	No	87	35.5	61	41.5	16	24.2	10	31.2
	Total	245	100	147	100	66	100	32	100
	Information about risk to develop T2D								
Yes	127	51.8	59	40.1	42	63.6	26	81.3	
No	118	48.2	88	59.9	24	36.4	6	18.7	
Total	245	100	147	100	66	100	32	100	

Source: Self-source

n= 245

CONCLUSION

It is concluded that 13.1% of adults had HbA1c figures that indicate T2D and 26.9% had figures that indicate risk for type 2 diabetes.

Predominant risk factors for T2D were found in the sample such as the presence of family history of diabetes, obesity, and low development of healthy lifestyles.

There were significant differences in age, perception of risk for T2D, the low income, the information related to a healthy diet and that related to the prevention of the risk for T2D, among the subgroups without risk and with risk for T2D and with type 2 diabetes.

The use of the ecological perspective that opens the understanding of the processes and factors of different levels of social organization involved in the risk of developing type 2 diabetes is important.

CONFLICT OF INTEREST

The authors declare they do not have any conflict of interest.

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