

# Diabetes in Bolivia

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## ABSTRACT

**Objective.** To measure the prevalence of diabetes mellitus (DM), hypertension, obesity, and related risk factors in major cities in Bolivia

**Methods.** A population-based survey was conducted in four Bolivian cities: La Paz, El Alto, Santa Cruz, and Cochabamba. The total sample size was chosen to be 2 948 persons. The overall response rate was 86%, with the rate varying somewhat among the four cities. DM was diagnosed through an oral glucose tolerance test (OGTT) 2 hours after an overload of 75 grams of glucose, using World Health Organization criteria.

**Results.** The overall prevalence of DM in the four urban areas combined was 7.2% (95% confidence interval (CI): 6.2%–8.3%) and of impaired glucose tolerance (IGT) was 7.8%. A total of 73.1% (95% CI: 65.0%–81.0%) of those previously diagnosed with DM and 73.7% (95% CI: 61.0%–86.4%) of newly diagnosed cases were overweight, according to measurements of body mass index. Hypertension was found in 36.5% (95% CI: 27.6%–45.5%) of known diabetics and in 36.6% (95% CI: 23.0%–50.1%) of newly diagnosed cases, compared to only 15.9% (95% CI: 14.3%–17.5%) among people without DM. The disease was most common among older persons and those with little education.

**Conclusions.** Diabetes is a genuine public health problem in Bolivia. Further, the high prevalence of IGT that was found suggests that diabetes prevalence will increase in the near future in the country unless prevention strategies are implemented.

## Key words

Diabetes, prevalence, Bolivia.

Diabetes mellitus is a major public health problem worldwide. In the Americas the number of people who have diabetes was estimated at almost

35 million in the year 2000 and is expected to reach 63 million by 2025 (1). This increase in the number of people with diabetes will represent an unexpected and unaffordable cost to most Latin American countries.

Diabetes mellitus presents a high economic burden to both individuals and society, not only due to health care costs but also to indirect costs caused by loss of productivity and premature mortality. People affected by diabetes have medical expenditures that are two to four times higher than those of their nondiabetic counterparts (2). According to a study carried out in Chile in 1996, the annual economic

burden of diabetes in that country was US\$ 1 111 million (3).

The objective of this study was to measure the prevalence of diabetes and risk factors associated with diabetes and other chronic diseases, such as obesity and hypertension, in the adult population of four major cities of Bolivia. Together, those four cities account for about 15% of the Bolivian population.

## MATERIALS AND METHODS

Bolivia is an Andean South American country of some 7 900 000 inhabi-

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tants. The Bolivian population is mostly composed of aboriginal groups, such as the Aymara and Quechua Indian communities. People of Hispanic origin constitute only 20% of the Bolivian population. The Bolivian landscape consists of the Andean highlands, valleys, and broad plains. Four major Bolivian cities were included in the survey: La Paz, El Alto, Santa Cruz, and Cochabamba. These cities are the most important urban centers in the country. Survey participants were selected randomly using information from the Bolivian National Statistical Institute (*Instituto Nacional de Estadística*). A five-stage cluster sample design was followed in each city. In descending order, the sampling units were census areas, blocks, houses, families, and individuals.

Sample size was calculated by assuming a prevalence of diabetes of 4% among people aged 20 years or more, a design effect of 2, and a confidence level of 95%. The final sample size calculated was 2 948 subjects. The overall participation rate was 86% and varied somewhat among the cities. The response rate was lower in El Alto and La Paz, with 76% and 80%, respectively, while Cochabamba and Santa Cruz each had a response rate of 94%. Well-trained surveyors visited the homes of the selected individuals one time. The survey instrument was validated in a small sample in each participating site.

Households and participants were selected systematically according to a written schedule. Only one person per household was selected to participate, with that individual matching the required characteristics of age (20 years or older) and gender. The survey data collection extended from January to August of 1998.

An appointment to visit a nearby clinic was made for each participant. Subjects were asked to come to the clinic early in the morning after at least 12 hours of fasting. Once there, they were asked to consume a drink containing 75 g of glucose. Capillary blood samples were taken 2 hours after this oral glucose load. Blood glucose was determined using a HemoCue glu-

cometer, which is not affected by hematocrit levels. Persons were classified, using 1985 criteria of the World Health Organization (4), as having normal or impaired glucose tolerance (IGT), or as having diabetes.

Known diabetic subjects did not receive the oral glucose tolerance test (OGTT); they were only asked to provide a fasting blood sample in order to validate their diagnosis. Well-trained surveyors measured height, weight, blood pressure, and waist and hip circumferences. Weight and blood pressure were also measured for all participants. All measurements were taken twice, and averages of the two measurements were used in the analysis. Height and weight were used to calculate body mass index (BMI), and waist and hip circumferences to calculate waist-to-hip ratio (WHR). BMI was classified according the following classification of overweight (4): Grade I, BMI = 25.0–29.9; Grade II, BMI = 30.0–34.9; Grade III, BMI = 35.0–39.9; and Grade IV, BMI ≥ 40.0. Abdominal fat accumulation was defined as a WHR > 1.0 in men and > 0.85 in women (5). Hypertension was defined as systolic blood pressure (SBP) ≥ 140 mm Hg and/or diastolic blood pressure (DBP) ≥ 90 mm Hg, or taking anti-hypertensive medication (6).

Blood pressure was measured by trained nurses with aneroid sphygmomanometers following recommendations of the United States' Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (6). Before the data collection process, a national seminar was conducted to assure stan-

dardization of measurements (blood pressure, height, weight, body circumferences) at the four sites. Instruments such as sphygmomanometers and balances were calibrated periodically.

Participants were asked a series of questions relating to personal and socioeconomic information. Additional questions regarding risk factors for diabetes and other noncommunicable diseases among the participants and their family members were also posed. Data were weighted in proportion to the general population of each city.

## RESULTS

### Diabetes prevalence and demographic characteristics

Table 1 shows the prevalence of diabetes, hypertension, and overweight (BMI ≥ 25) in the surveyed population. The diabetes prevalence rate determined for the four major cities of Bolivia was 7.2% and was similar in males and females. Hypertension was found in 19.6% of participants and was somewhat higher in males (21.5%) than in females (17.8%), but the difference was not statistically significant ( $P > 0.05$ ). Overall, 60.7% of the surveyed population was overweight, with overweight being more common in females than in males.

Table 2 shows the demographic characteristics of the population by category of glucose intolerance. Overall, 5.2% of the surveyed population was found to have newly diagnosed diabetes, 2.0% had a previous diagnosis of diabetes, and 7.8% were classi-

**TABLE 1. Diabetes, hypertension, and overweight (percentage and 95% confidence interval) in four major cities of Bolivia, by gender, 1998**

Variable	No.	Males		Females		Males and females	
		%	(95% CI)	%	(95% CI)	%	(95% CI)
Diabetes mellitus	2 533	6.8	(5.2–8.5)	7.6	(6.3–8.9)	7.2	(6.1–8.3)
Hypertension <sup>a</sup>	2 533	21.5	(19.1–24.0)	17.8	(15.6–20.0)	19.6	(18.0–21.3)
Overweight <sup>b</sup>	2 530	56.6	(53.2–59.9)	64.7	(62.3–67.0)	60.7	(58.4–62.9)

<sup>a</sup> Hypertension = systolic blood pressure ≥ 140 mm Hg and/or diastolic blood pressure ≥ 90 mm Hg.

<sup>b</sup> Overweight = body mass index ≥ 25.

**TABLE 2. Demographic characteristics of known and newly diagnosed diabetics and of persons with impaired glucose tolerance (IGT) (percentage and 95% confidence interval) in four major cities of Bolivia, 1998**

Demographic variables	No.	Known diabetics		New diabetics		Persons with IGT	
		%	(95% CI)	%	(95% CI)	%	(95% CI)
Gender							
Male	1 036	5.1	(3.7–6.4)	1.8	(1.0–2.5)	6.6	(5.0–8.1)
Female	1 497	5.3	(4.1–6.5)	2.3	(1.5–3.1)	9.1	(7.5–10.6)
Age (years)							
25–39	1 109	1.2	(0.4–1.9)	1.0	(0.3–1.4)	4.6	(3.4–5.8)
40–44	286	2.5	(0.7–4.3)	3.0	(1.0–5.0)	5.2	(2.6–7.7)
45–49	298	8.6	(5.3–11.9)	2.0	(0.4–3.6)	10.1	(6.7–13.5)
50–54	271	10.3	(6.4–13.2)	0.8	(–0.2–1.8)	10.2	(6.1–14.3)
55–59	204	10.3	(6.0–14.6)	3.2	(0.8–5.7)	8.5	(4.8–12.3)
60–64	126	16.0	(8.5–23.6)	3.7	(–0.3–7.7)	11.9	(5.5–18.3)
65+	239	11.8	(7.5–16.1)	6.1	(3.1–9.0)	20.5	(15.0–26.1)
Language							
Spanish	1 496	5.8	(4.6–7.1)	2.7	(1.8–3.6)	9.0	(7.5–10.5)
Aymara	776	4.0	(2.5–5.4)	0.8	(0.3–1.4)	5.6	(3.9–7.3)
Quechua	266	5.7	(2.9–8.5)	2.7	(0.7–4.7)	8.1	(4.6–11.7)
Education							
None	170	9.5	(4.5–14.5)	3.8	(0.8–6.9)	12.8	(7.2–18.3)
Primary	1 017	5.9	(4.7–7.1)	2.5	(1.5–3.5)	10.4	(8.4–12.5)
High school	672	5.2	(3.3–7.1)	1.5	(0.8–2.3)	6.5	(4.2–8.7)
Technical school/university	662	3.2	(2.0–4.5)	1.1	(0.2–2.1)	4.2	(2.8–5.6)
Total/overall	2 533	5.2	(4.3–6.0)	2.0	(1.5–2.6)	7.8	(6.7–8.9)

fied as having impaired glucose tolerance (IGT). Findings showed that 5.1% of males and 5.3% of females were previously diagnosed with diabetes, while 1.8% of males and 2.3% of females were diagnosed during the study. IGT was diagnosed in 6.6% of males and 9.1% of females.

IGT as well as previously and newly diagnosed diabetes increased with age (Table 2). The highest prevalence of previously diagnosed diabetes was found among persons 60 to 64 years old. Newly diagnosed diabetes and IGT both peaked in the group 65 years of age and over. In comparison to those who reported either Aymara or Quechua as their native language, Spanish speakers had a higher prevalence rate of newly diagnosed diabetes, of previously diagnosed diabetes, and of IGT. Those reporting having no formal education were found to have the highest level of diabetes, of previously diagnosed diabetes, and of IGT.

### Risk factors and lifestyle

According to our findings, a high proportion of Bolivian diabetics are overweight (Table 3). The proportion of overweight was similar among those with known diabetes, newly diagnosed diabetes, and IGT, and it was significantly lower among those with normal glucose tolerance. In overweight people, those with diabetes and IGT outnumbered those with normal glucose tolerance. In addition, 51.8% of known diabetics and 51.5% of newly diagnosed diabetics had abdominal fat accumulation (a measurement of obesity based on waist-to-hip ratio). Hypertension was found in 36.5% of known diabetics and in 36.6% of newly diagnosed cases, compared to only 15.9% of persons without diabetes. In both diabetic groups, most cases fell into the category of stage 1 hypertension.

Among newly diagnosed diabetics, a smoking habit was reported by

34.4% of them, and 60.6% of them reported drinking alcohol (Table 4). These figures resemble those for people with normal glucose tolerance. Overall, 22.6% of known diabetics reported chewing coca leaves regularly. The proportion of newly diagnosed diabetic subjects reporting this practice was 4.7%, but the number of subjects in this group was not large enough for comparison to subjects classified as nondiabetic or having IGT.

In addition to a high prevalence of obesity, diabetics displayed a lack of physical activity (Table 4). According to self-reports, 58% of previously known diabetics and 77.1% of newly diagnosed diabetics never exercise. Overall, 36.8% of known and 40.4% of newly diagnosed diabetics reported having sedentary lifestyles, compared to 20.4% of persons without diabetes. A family history of diabetes was reported more frequently for known diabetic subjects and newly diagnosed diabetic subjects than for persons without diabetes.

## DISCUSSION

This study shows that performing diabetes prevalence surveys based on the 2-hour OGTT is feasible in Latin America.

The prevalence of diabetes in Bolivia was similar to that in other South American countries, such as Colombia (7), Venezuela (8), Uruguay (8), Brazil (9), and Argentina (10), but higher than in Paraguay (11) and Chile (12). However, the rate of previously diagnosed diabetes was lower than that reported in the Hispanic population within the United States (13), which is understandable in light of the fact that the latter may have better access to health care and therefore greater chances of being diagnosed. The reportedly high prevalence rate of IGT suggests that Bolivia is still undergoing an epidemiological transition and that a higher prevalence of diabetes mellitus can be expected in that country in the near future (1).

Those reporting Spanish or Quechua as their native language were found to

**TABLE 3. Overweight, abdominal fat accumulation, and hypertension among known and newly diagnosed diabetics and among persons with impaired glucose tolerance (IGT) (percentage and 95% confidence interval) in four major cities of Bolivia, 1998**

Variable	No.	Known diabetics		New diabetics		IGT		Normal	
		%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Overweight									
Grade 1 (BMI 25.0–29.9) <sup>a</sup>	958	39.9	(31.2–48.7)	33.1	(20.3–45.9)	40.5	(33.2–47.7)	37.0	(34.8–39.3)
Grade 2 (BMI 30.0–34.9)	408	23.1	(15.7–30.5)	24.3	(12.2–36.5)	20.7	(14.7–26.7)	13.8	(12.3–15.3)
Grade 2 (BMI 35.0–39.9)	117	8.1	(2.3–13.8)	13.4	(4.3–22.6)	7.8	(4.3–11.2)	3.6	(2.8–4.5)
Grade 3 (BMI ≥ 40)	94	2.0	(0–3.9)	2.9	(–2.7–8.38)	3.1	(0.5–5.8)	4.0	(3.1–5.0)
Overall	1 577	73.1	(65.0–81.1)	73.7	(61.0–86.4)	72.1	(65.4–78.6)	58.5	(56.3–60.8)
Abdominal fat accumulation <sup>b</sup>	1 181	51.8	(42.7–60.9)	51.5	(37.3–65.7)	50.4	(43.1–57.8)	38.8	(36.6–41.0)
Hypertension (BP in mm Hg)									
Stage 1 (SBP <sup>c</sup> 140–159 or DBP <sup>d</sup> 90–99)	318	21.4	(13.8–29.0)	21.4	(9.6–33.3)	15.4	(10.1–20.8)	11.3	(9.9–12.7)
Stage 2 (SBP 160–179 or DBP 100–109)	106	7.5	(3.0–12.0)	9.1	(1.1–17.1)	8.5	(4.4–12.5)	3.0	(2.3–3.8)
Stage 3 (SBP ≥ 180 or DBP ≥ 110)	57	7.6	(2.1–13.2)	6.1	(0.2–12.0)	6.7	(2.9–10.6)	1.6	(1.1–2.1)
Overall	481	36.5	(27.6–45.5)	36.6	(23.0–50.1)	30.7	(23.9–37.4)	15.9	(14.3–17.5)

<sup>a</sup> BMI = body mass index.

<sup>b</sup> Abdominal fat accumulation = waist-to-hip ratio > 1.0 in men, > 0.85 in women.

<sup>c</sup> SBP = systolic blood pressure.

<sup>d</sup> DBP = diastolic blood pressure.

**TABLE 4. Risk factors for chronic noncommunicable diseases among known and newly diagnosed diabetics and persons with impaired glucose tolerance (IGT) (percentage and 95% confidence interval) in four major cities of Bolivia, 1998**

Risk factor	Total number	Known diabetics		New diabetics		IGT		Normal	
		%	(95% CI)	%	(95% CI)	%	(95% CI)	%	(95% CI)
Smokes (at time of study)	679	16.5	(9.6–23.4)	34.4	(20.6–48.2)	30.3	(23.4–37.2)	30.4	(28.2–32.6)
Chews coca leaves regularly	415	22.6	(15.3–29.9)	4.7	(–0.1–9.6)	15.0	(9.6–20.1)	16.3	(14.5–17.9)
Drinks alcohol	1 520	38.9	(30.2–47.6)	60.6	(46.8–74.4)	58.8	(51.7–65.9)	63.8	(61.5–65.9)
Has sedentary lifestyle	538	36.8	(27.9–45.6)	40.4	(26.7–54.2)	25.6	(19.3–31.8)	20.4	(18.6–22.3)
Never exercises	1 414	58.0	(48.8–67.2)	77.1	(65.7–88.5)	66.5	(59.5–73.5)	51.1	(48.8–53.4)
Has family history of DM <sup>a</sup>	651	43.6	(34.7–52.6)	37.0	(23.6–50.4)	27.7	(21.3–34.2)	24.2	(22.2–26.1)

<sup>a</sup> DM = diabetes mellitus.

have significantly higher rates of newly diagnosed DM and IGT than those reporting Aymara as their native language. Lower prevalence rates have been reported among Aymara Indians from Chile (14). On the other hand, recent urban surveys carried out in Spain showed prevalence rates comparable to ours: 6.1% in the province of Aragon (15) and 10.3% in the province of Catalonia (16). Other social, cultural, and economic factors may also play a role in these differences in prevalence. The

relationship between glucose tolerance and ethnicity in Latin America needs more research.

In our study, the prevalence of both diabetes and IGT decreased as education increased. This may reflect the higher risk that has been described among the poor and less educated because of greater exposure to environmental risks, such as poor diet, lack of exercise, and resulting obesity.

The hypertension rate reported in Bolivia is comparable to that reported

in Canada (17), but higher than that reported in Paraguay (11). We found a similar prevalence of hypertension among men and women. Differences in the prevalence of hypertension between men and women have not been documented in the medical literature (18).

We found hypertension to be more common among people with diabetes; the association between diabetes and hypertension is well known. Escobedo de la Peña et al. described an association between obesity, hypertension,

and diabetes in a population in Mexico City (19). Sievers et al. recently reported a hypertension prevalence rate of 53% among Pima Indians with diabetes (20), but this population, in the state of Arizona in the United States, is well known for its high prevalence of obesity and diabetes.

As has been described previously in the United States (21) and Latin America (22), a family history of diabetes was more frequent among diabetic individuals than among those having normal glucose tolerance. The percentages of current smokers were smaller among known diabetics, most likely due to the medical advice given to these patients to avoid this health hazard.

Weil studied the effects of chewing coca leaves on human bodily func-

tions. He concluded that coca regulates carbohydrate metabolism in a unique way (23). It is a common belief in Bolivia that the practice of chewing coca decreases blood glucose. Accordingly, the high proportion of known diabetics reporting this practice is probably a reflection of this popular belief. Conversely, the smaller proportion of people among new diabetics who reported chewing coca leaves suggests a true hypoglycemic effect of this practice, but the number of people in this group was not enough to achieve statistical significance.

We found a high prevalence rate of diabetes in Bolivia, with the illness being more common among older persons and those with less education. Thus, the poorest people in one of the

world's poorest countries are the most affected by the disease. Diabetes is a genuine public health problem in Bolivia. In Bolivia, as in most other countries of Latin America, the burden of diabetes will increase steadily in the near future unless prevention strategies are implemented.

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## La diabetes en Bolivia

### RESUMEN

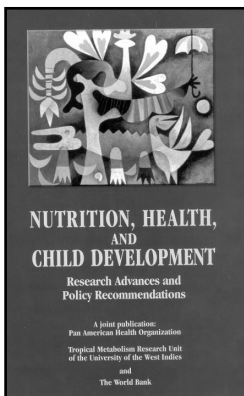
**Objetivos.** Determinar la prevalencia de la diabetes sacarina, la hipertensión, la obesidad y los factores de riesgo relacionados en grandes ciudades de Bolivia.

**Métodos.** Se realizó una encuesta poblacional en cuatro ciudades bolivianas: La Paz, El Alto, Santa Cruz y Cochabamba. El tamaño de la muestra fue de 2 948 personas. La tasa general de respuesta fue del 86%, con algunas variaciones entre las cuatro ciudades. La diabetes se diagnosticó mediante una prueba de tolerancia a la glucosa oral, con obtención de las muestras 2 h después de la administración de 75 g de glucosa; se siguieron los criterios de la Organización Mundial de la Salud.

**Resultados.** La prevalencia global de la diabetes en el conjunto de las cuatro áreas urbanas fue del 7,2%, con un intervalo de confianza del 95% (IC95%) de 6,2 a 8,3%; la del deterioro de la tolerancia a la glucosa fue del 7,8%. El 73,1% (IC95%: 65,0 a 81,0%) de los casos diagnosticados anteriormente de diabetes y el 73,7% (IC95%: 61,0 a 86,4%) de los recién diagnosticados tenían sobrepeso, de acuerdo con las mediciones del índice de masa corporal. Se diagnosticó hipertensión en el 36,5% (IC95%: 27,6 a 45,5%) de los diabéticos diagnosticados previamente y en el 36,6% (IC95%: 23,0 a 50,1%) de los recién diagnosticados, en comparación con tan solo un 15,9% (IC95%: 14,3 a 17,5%) en los individuos sin diabetes. La enfermedad fue más frecuente en las personas de más edad y en aquellas con menor nivel educacional.

**Conclusiones.** La diabetes es un verdadero problema de salud pública en Bolivia. Además, la alta prevalencia del deterioro de la tolerancia a la glucosa detectada en este estudio indica que la prevalencia de la diabetes seguirá aumentando en este país en el futuro cercano, a no ser que se pongan en práctica estrategias preventivas.

### *Nutrition, Health, and Child Development: Research Advances and Policy Recommendations*



This book, written by 18 leading professionals working at the cutting-edge of nutrition research, explore the state of knowledge on the effects of health, nutrition, and stimulation on children's development. The publication's comprehensive review of the subject deals with topics that range from generalized undernutrition, iron and iodine deficiencies, neonatal feeding, short-term food deprivation, parasitic infection, and psychological deprivation. In addition, it evaluates the results from early childhood interventions, including nutritional supplementation and psychosocial stimulation, as well as interventions in later childhood, such as school feeding and deworming programs.

All the authors conclude their chapters with a list of recommendations for those who are considering crafting nutritional policies, and two of the authors address their policy recommendations specifically to those responsible for health and education services. This alone will make this publication invaluable to policy makers and international agencies. Professionals working in health, nutrition, and education also will find here much to enhance their day-to-day work.

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