Glucose intolerance and other cardiovascular risk factors in Haiti (PREDIAH)

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SUMMARY

Aims: To assess the prevalence of diabetes and other forms of glucose intolerance and to examine their relationship with some cardiovascular risk factors in a population representative of the capital of Haiti.

Methods: This cross-sectional survey was conducted in the metropolitan area of Port-au-Prince, Haiti. A population-based sample of 1620 adults was randomly selected using a two-stage cluster method, stratified in 3 age groups: 20-39, 40-64 and ≥65 years of age. Diagnosis of diabetes and pre-diabetes (IFG and IGT) was based on the 2003 Expert Committee criteria.

Results: The total response rate was 69%. The age-standardized prevalence of diabetes was 4.8% in men and 8.9% in women (P=0.0014), with, overall, 70.6% of previously diagnosed cases. Standardized for the Segi world population aged 30-64 years, its prevalence was 7.4% in men and 11.1% in women (NS). The age-standardized prevalence of pre-diabetes was 6.4% in men and 8.0% in women (NS). Hypertension was found in 48.7% in men and 46.5% in women (NS). Its rates in people ≥40 years old were 69.1% in men and 67.2% in women (NS). Abdominal obesity was strongly independently associated with diabetes and pre-diabetes in both genders. Hypertension was shown to be risk factor for pre-diabetes and total glucose intolerance in women. High education was associated with lower risk of diabetes in men.

Conclusion: Prevalence of diabetes and pre-diabetes is moderately high in Port-au-Prince, Haiti. In people aged ≥40 years, the rate of normal blood pressure is less than 25%. Intervention programs to prevent simultaneously and manage diabetes and hypertension are imperative, and prevention strategies through lifestyle modifications should be cost-effective.

Key-words: Prevalence · Diabetes · Pre-diabetes · Hypertension · Abdominal obesity · Prevention strategies.

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RÉSUMÉ

Anomalies de la tolérance au glucose et autres facteurs de risque cardiovasculaire en Haïti (PREDIAH)

Objectifs : Estimer la prévalence du diabète et des autres troubles de la tolérance au glucose et examiner leur relation avec d'autres facteurs de risque cardiovasculaires dans une population représentative de la capitale d'Haïti.

Méthodes : Cette étude transversale a été menée dans la région métropolitaine de Port-au-Prince, capitale d'Haïti. 1620 adultes ont été sélectionnés au hasard selon un échantillonnage en grappes en 2 étapes et stratifiés en 3 groupes d'âge: 20-39, 40-64 et ≥ 65 ans.

Résultats : Le taux de réponse total était de 69 %. La prévalence du diabète ajustée à l'âge était de 4,8 % chez l'homme et 8,9 % chez la femme (P = 0,0014), avec au total 70,6 % des cas déjà connus. La prévalence du diabète rapportée à la population mondiale de Segi âgée de 30-64 ans était de 7,4 % chez l'homme et 11,1 % chez la femme (NS). La prévalence du pré-diabète ajustée à l'âge était de 6,4 % chez l'homme et 8,0 % chez la femme (NS). Une hypertension artérielle était trouvée chez 48,7 % des hommes et 46,5 % des femmes (NS). Sa fréquence dans la population de ≥ 40 ans était de 69,1 % chez l'homme et 67.2 % chez la femme (NS). L'obésité abdominale s'est révélée un facteur de risque important et indépendant du diabète et du pré-diabète dans les deux sexes. L'hypertension artérielle s'est révélée être un facteur de risque pour le pré-diabète et l'ensemble des troubles de la tolérance au glucose. Un haut niveau d'éducation était associé à un moindre risque de diabète chez l'homme.

Conclusion : La prévalence du diabète et du pré-diabète est modérément élevée à Port-au-Prince. Chez les sujets de ≥ 40 ans, la fréquence de tension artérielle normale était < 25 %. Les programmes d'intervention pour prévenir simultanément et prendre en charge le diabète et l'hypertension artérielle deviennent impératifs. Les stratégies de prévention fondées sur les modifications du mode de vie devraient être rentables sur le plan épidémiologique.

Mots-clés : Prévalence · Diabète · Pré-diabète · Hypertension · Obésité abdominale · Stratégies de prévention.

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Diabetes, as other non communicable diseases associated with modifications in lifestyle, is seriously increasing worldwide. It has become a public health problem in developing countries, because of its growing prevalence, economic and social costs and important cardiovascular complications [1]. In Haiti, a survey conducted in 1969 in a selected population suggested a prevalence of diabetes of 1.2%, in the adult population of Port-au-Prince, the capital city of Haiti [2]. However, the lack of recent epidemiological data hampers the establishment of national strategies for prevention and control of this disease. The aims of the present study were to assess, among the population of Port-au-Prince, the prevalence of diabetes and all forms of glucose intolerance and to examine their relationship with hypertension, lifestyle, social and anthropometric features.

Subjects and methods

The target population was comprised of people ≥20 years of age living in the metropolitan area of Port-au-Prince, which includes Port-au-Prince city and its 6 surrounding cities (Carrefour, Cité Soleil, Tabarre, Delmas, Pétion-Ville and Kenscoff) for a population of 2 millions inhabitants (25% of the total Haitian population). A sample size of 1500 participants was needed to allow a precision of ±1.3% for the 95% CI estimation, assuming diabetes prevalence equal to 7%. A non-response rate of 7.5% was expected; therefore we planned to include 1620 subjects. A two-stage cluster method was used to obtain a representative sample of the general population. First, we randomly selected 54 census blocks, which are geographical areas defined for the 2003 national census by the "Institut Haïtien de Statistiques et d'Informatique" (IHSI) having 150-200 houses [3]. In each block, we randomly selected the first house on the map given by IHSI, and the next houses were taken consecutively. All the members aged ≥20 years present at the time of a house visit were invited to participate. Thirty people were selected in each block. The sample was stratified in 3 age groups (20-39, 40-64 and ≥65 years) with 10 subjects in each stratum.

Four to 5 weeks before the field survey, a media campaign by radio, newspapers and television was organized in each studied city. The team members attended a training course during 3 days, covering different aspects of the study, including completion of the questionnaire, anthropometric, blood pressure and glucose measurements. The ethics board of the Ministry of Public Health and Population approved the study, which was carried out from September 2002 to May 2003. Verbal and written consent was obtained from all participants.

In each eligible household, the examiners explained the purpose and the procedure of the survey. They selected individuals meeting the inclusion criteria and invited them to participate. They administered to each selected subject a questionnaire that collected information on medical history, lifestyle characteristics (such as physical activity, smoking, alcohol consumption, and dietary habits), socio-economic status, education, time and composition of the last meal, snack or drink (except water). Anthropometric measurements were taken. Height and weight were measured with the subject in light clothing and without shoes, using a standard clinical scale and a portable height rod. BMI was calculated as weight in kg divided by height in m^2. On the standing participant, waist circumference was measured midway between the iliac crest and the lowest rib, and hip circumference was measured at its maximum. Waist-to-hip ratio (WHR) was calculated. Blood pressure (BP) was measured twice, 2 min apart, to the nearest 2 mmHg, in the right arm, after 10 min rest in the sitting position. A mercury sphygmomanometer was used with appropriate cuffs and calibrated each morning. Systolic blood pressure (sBP) was recorded at the level of appearance of sound and diastolic blood pressure (dBP) at the level of sound disappearance (phase V). The mean of both findings was calculated and taken for all subjects.

Diabetes diagnosis was performed through a two-step procedure. First, diabetes screening was performed using a casual capillary blood glucose (CBG) test in all eligible subjects, with a portable glucometer (One Touch® Ultra Blood Glucose Meter; Lifescan). This device uses a glucose oxidase method and provides plasma-calibrated results. It was checked and calibrated every morning. The efficacy and reliability of this measurement technique have been reported previously [4-7]. All subjects with:

– casual glycaemia <80 mg/dl (4.4 mmol/l), without any history of diabetes, were considered as non diabetic [8-10];

– fasting glycaemia ≥160 mg/dl (8.9 mmol/l) or non-fasting glycaemia ≥200 mg/dl (11.1 mmol/l) were considered as diabetic.

Those two categories and also the subjects with a previous diagnosis of diabetes under insulin and/or oral antidiabetic agents were excluded from further testing.

All the other individuals, including those with a previous history of diabetes but not under insulin and/or oral antidiabetic agents, proceeded to the second step and were reexamined early in the morning after an overnight fast (10-16 hours), in a survey center near their home, where all of them underwent a fasting CBG test. The participants

Abbreviations

CBG:	Capillary Blood Glucose
DBP:	Diastolic Blood Pressure
IFG:	Impaired Fasting Glucose
IGT:	Impaired Glucose Tolerance
NGT:	Normal Glucose Tolerance
OGTT:	Oral Glucose Tolerance Test
SBP:	Systolic Blood Pressure
TGI:	Total Glucose Intolerance
WHR:	Waist-to-Hip Ratio

with a fasting CBG ≥126 mg/dl (7 mmol/l) were classified as diabetic. Those whose fasting CBG were <80 mg/dl (4.4 mmol/l) were considered not to have diabetes. All the others received a 75 g oral glucose load over ≤5 minutes and underwent another CBG measurement after 2 hours. Between fasting and 2-h blood tests, individuals were requested to stay seated in a non-smoking education room where they could watch videos on different aspects of prevention and control of diabetes.

The participants newly diagnosed as having diabetes, IGT, IFG or hypertension were given an appointment within 4 days with a registered nurse of FHADIMAC for an educative meeting.

Classification of glucose tolerance

Glucose tolerance was classified according to the 2003 criteria of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus: fasting plasma glucose <100 mg/dl (5.6 mmol/l) and 2-h plasma glucose <140 mg/dl (7.8 mmol/l) for normal glucose tolerance (NGT), fasting plasma glucose ≥126 mg/dl (7 mmol/l) or 2-h plasma glucose ≥200 mg/dl (11.1 mmol/l) for diabetes, fasting plasma glucose <126 mg/dl (7 mmol/l) and 2-h plasma glucose ≥140 mg/dl (7.8 mmol/l) and <200 mg/dl (11.1 mmol/l) for impaired glucose tolerance (IGT). The impaired fasting glucose (IFG) was defined as fasting plasma glucose ≥ 100 mg/dl (5,6 mmol/l) and <126 mg/dl (7.0 mmol/l) and 2-h plasma glucose <140 mg/dl (7.8 mmol/l). Pre-diabetes included all patients having IFG and IGT [8,11-13].

Classification of other risk factors and lifestyles

Blood pressure was classified according to Joint National Committee 7 (JNC 7) criteria: normal blood pressure for systolic blood pressure (sBP) <120 mmHg and diastolic blood pressure (dBP) <80 mmHg, pre-hypertension for sBP between 120 and 139 mmHg or dBP between 80 and 89 mmHg, and hypertension for sBP ≥ 140 mmHg or dBP ≥ 90 mmHg or the use of antihypertensive medication [14].

Normal weight was defined as body mass index (BMI) ≥ 18.5 and <25.0 kg/m^2. Obesity was defined as BMI ≥30.0 kg/m^2 and overweight as BMI ≥25.0 and <30.0 kg/m^2. Central body fat distribution was evaluated by waist-to-hip ratio (WHR) and waist girth. A WHR ≥0.90 in men or a WHR ≥0.85 in women defined the android profile [15]. A waist girth ≥102 cm in men or ≥88 cm in women defined abdominal or central obesity [16].

Physical activity was considered as a combination of leisure and occupation-related activities. The leisure-related activity was scored 1 for non-physically active hobbies, 2 for physically active hobbies or active sport 1-2 times per week, 3 for active sport ≥3 times per week. The occupation-related activity was scored 1 for unemployment and non-physically active work, 2 for physically active work, 3 for heavy work. Physical activity was classified as "sedentary" if the sum of both types of activity was equal to 2, "moderate" if the sum was 3-4, and "heavy" if the sum was 5-6. Current smokers represented subjects smoking at least one cigarette a day. Alcohol consumption was classified according to the number of drinks (1 drink = 12 g of ethanol) taken per week. Consumption of ≥5 drinks per week defined current drinker. Education was recorded as the highest grade completed. High level of education applied to secondary and technical school and university. High income represented ≥3000 gourdes (national currency) per month for one person, the equivalent to US$ 100.

Statistical analysis

Epi Info 2002 and SPSS 10.0 software were used for data management and statistical analyses. Age standardization was made based on the age structure of the population ≥20 years of the 1982 census [17] confirmed by preliminary data from the 2003 census (unpublished). The χ^2 test and the Student's t-test were used for between group comparisons, and the χ^2 trend test for trends. For comparisons with world populations, age-standardized prevalence rates for diabetes using the Segi population aged 30-64 years were also calculated [18]. Age groups and BMI ≥30 kg/m^2, abdominal obesity, android profile, hypertension, high income, current drinking, history of diabetes in first-degree relatives, sedentary lifestyle, high level of education (compared to their absence) were used in univariate analysis for diabetes, pre-diabetes and total glucose intolerance (TGI), which includes all forms of glucose intolerance. Variables found to be associated with diabetes or pre-diabetes were included in multiple logistic regression model with backward elimination method. Diabetes, pre-diabetes and TGI were compared to NGT. Because of significant differences in the sample for both sexes regarding education, BMI, smoking and drinking habits, analyses were performed separately for each gender. A P value <0.05 was considered significant.

Results

A total of 1620 subjects were selected for the study. Seventy-five refused to participate. Of the 1545 who agreed to participate (women 70%), 11 refused to take the test after completing the questionnaire, 329 were classified at the first step procedure from their medical history or the results of the casual CBG test. We referred 1205 for further testing to our facilities where 597 came. To improve the subject response rate for this second step, we made another visit to the positive screenees, and we took an appointment with them to have the OGTT made at their home. We were able to test 187 subjects during that second phase. This gave us a total of 1 113 subjects (69% of the randomized representative sample of the population) for whom we could determine the glycaemic status. We found no statistical differences between the participants attending the survey centers and the non-attendees for the studied variables.

Socio-demographic characteristics of the survey population are shown in table I. Women were older, shorter, and weighted less than men but had higher BMI (P<0.0001), with 20.4% of women and 6.6% of men being obese.

Abdominal obesity was considerably more frequent in women (42.4% vs. 5.8%, P<0.0001). Men were more physically active than women (P<0.0001). Prevalence of known diabetes was 5.7% in women and 3.2% in men (P<0.001).

Table I
General characteristics of the survey population by gender.

	Male n=331	Female n=782	P value
Age groups in years (%)			0.0045
20-39	40.2	30.2	
40-64	34.1	38.2	
65+	25.7	31.6	
Height (cm)	169.7±8.5	157.4±8.9	<0.0001
Weight (kg)	65.3±12.0	62.6±14.2	0.0019
Abdominal obesity (%):			
Waist ≥102/88, men/women	5.8	42.4	<0.0001
BMI (kg/m^2)			<0.0001
<18.5	7.9	4.5	
18.5-24.9	69.4	42.3	
25.0-29.9	16.1	32.8	
30.0+	6.6	20.4	
Android profile (%):			
WHR ≥0.90/0.85, men/women	25.8	49.0	<0.0001
Known diabetes (%)	3.2	5.7	<0.0001
SBP (mmHg)	135.6±23.6	139.9±29.5	0.0198
DBP (mmHg)	87.9±14.5	89.5±16.2	NS
Pre-Hypertension (%):			
120-139/80-89 mmHg	10.5	9.1	NS
Hypertension (%): ≥140/90 mmHg	48.7	46.5	NS
Family history of diabetes (%)	12.7	11.6	NS
Alcohol (current drinker) (%)	16.1	2.0	<0.0001
Smoking (current smoker) (%)	15.2	5.9	<0.0001
Physical activity (%)			<0.0001
Sedentary	31.3	36.9	
Moderate	60.4	61.5	
Heavy	8.3	1.6	
Education (%)			<0.0001
Illiterate	8.6	20.3	
Literate only	3.0	6.3	
Elementary school	17.4	29.4	
Secondary school	46.0	36.4	
Technical school	5.5	3.6	
University	19.5	4.0	
Hign income (>US$100/month)	21.3	12.0	<0.0001

Data are means ± SD or unless otherwise indicated; NS, not significant.

Hypertension was found in 48.7% in men and 46.5% in women (NS). Pre-hypertension was found in 10.5% in men and 9.1% in women (NS). Men significantly had a higher level of education than women, drank alcohol and smoked more than women.

The prevalences by age and sex of the different forms of glucose intolerance for people ≥20 years of age are presented in table II. The age-standardized prevalence of diabetes was 4.8% in men (95% CI: 2.7-6.9%) and 8.9% in women (95% CI: 7.0-10.9%) (P=0.0014). In the subsample of subjects aged 30-64 years, the crude prevalence of diabetes was 7.1% in men (95% CI: 3.2-11.0%) and 10.5% in women (95% CI: 7.4-13.6%) (NS). The age-adjusted prevalences using the standardized-age distribution of Segi [17] were 7.4% in men (95% CI: 2.8-12.0%), 11.1% in women (95% CI: 7.5-14.7%) (NS) and 10.0% in both sexes (95% CI: 7.1-12.9%). IFG affected 2.7% of men and 2.4% of women (NS). IGT affected 3.7% of men and 5.6% of women (NS). The age-standardized prevalence of pre-diabetes was 6.4% in men and 8.0% in women (NS). That of TGI was 11.2% in men and 16.9% in women (P=0.0024). Prevalence of diabetes increased with age in men (P=0.0112) and in women (P<0.0001). Women were more affected than men in all age groups. Prevalence of pre-diabetes increased also with age (P<0.0001) in both genders without significant difference between them.

In the sub-group of diabetic people, proportion of known diabetes was 77.3% in men, 69.2% in women (NS) and 70.6% in both sexes; 76,7% of women and 77.3% of men have also hypertension (NS); 20.8% of women and 12.8% of men had also pre-hypertension (NS). Thus, less than 10% of diabetic people had normal blood pressure according to JNC 7 criteria. Insulin treatment was reported in 10% of the known diabetic people.

In people aged ≥40 years, the rates of hypertension were 69.1% in men and 67.2% in women (NS); those of pre-hypertension were 10.5% in men and 9.2% in women (NS). In the same group, the risk of having hypertension or any form of glucose intolerance was 72.7% in men and 73.3% in women, and the investigated cardiovascular risk factors having the highest prevalence rates were: hypertension (69.1%), sedentary lifestyle (44.3%), android profile (37.4%) and BMI ≥25 kg/m^2 (32.1%) in men, and android profile (68.0%), hypertension (67.2%), BMI ≥25 kg/m^2 (55.6%) and abdominal obesity (52.8%) in women.

It is worthy to note that according to the IDF (International Diabetes Federation) 2005 definition of central obesity (waist circumference ≥94 cm for europid men and ≥80 cm for europid women) [19], the rates for abdominal obesity would be 14.7% in men and 67.8% in women among adults ≥20 years of age.

Table III presents the results of univariate analysis after adjustment for age. In women, alcohol, smoking, sedentary lifestyle and high income showed no statistical significance with any form of glucose intolerance and were not included in multivariate regression model. In men, it was the same for BMI ≥30 kg/m^2, family history of diabetes, alcohol, smoking and high income.

Table IV shows the association between risk factors and glucose intolerance by reference to normal glucose tolerance status, using multiple logistic regression model. It would be useful to note that in women, BMI ≥30 kg/m^2 was rejected by backward selection and its initial exclusion from the model did not change the significance of the other risk factors studied. Increased age, abdominal obesity, android profile and family history of diabetes had significant independent association with diabetes in women, whereas in men, the risk factors of diabetes were abdominal obesity and android profile while higher educational level was associated with lower risk of diabetes. For pre-diabetes, advanced age, abdominal obesity, hypertension and family history of diabetes in women,

Table II
Prevalence (%) of glucose intolerance by age group.

Age groups (years)	DM	IGT	IFG	Pre-diabetes	Total
20-39					
Men	1.5	0.8	3.0	3.8	5.3
Women	2.1	3.8	1.3	5.1	7.2
40-64					
Men	10.6	7.1	2.7	9.8	20.4
Women	14.4	6.0	3.7	9.7	24.1
65+					
Men	9.4	15.3	0.0	15.3	24.7
Women	22.7	12.6	3.2	15.8	38.5
All					
Men	4.8	3.7	2.7	6.4	11.2
Women	8.9	5.6	2.4	8.0	16.9

Prevalences are crude for each age group and age-standardized for All.

Table III
Univariate analysis of selected factors for diabetes, prediabetes and Total Glucose Intolerance.

Women

	Diabetes		Prediabetes		Total Glucose intolerance	
Variable	OR	95% CI	OR	95% CI	OR	95% CI
Age (40–64/20-39)	8.3	3.1-24.3‡	2.3	1.1-5.0	4.1	2.3-7.5‡
Age (65+/20-39)	16.1	6.0-46.9‡	4.7	2.3-9.8‡	8.1	4.5-14.6‡
Abdominal obesity	4.7	3.0-7.3‡	2.7	1.5-4.8†	3.5	2.4-5.3‡
BMI ≥30 kg/m^2	3.0	1.9-4.7‡	2.3	1.2-4.4*	2.6	1.7-4.1‡
Android profile	7.5	3.8-14.7‡	3.0	1.7-5.4‡	4.6	2.9-7.1‡
Hypertension	4.7	2.8-7.9‡	2.8	1.6-4.9‡	3.6	2.5-5.2‡
Family history of Diabetes	2.1	1.1-4.0‡	2.1	1.1-3.9*	2.1	1.3-3.2‡
Alcohol (current drinker)	0.2	0.0-1.7	1.2	0.3-6.2	0.7	0.2-2.9
Smoking (current smoker)	1.0	0.4-2.6	0.9	0.3-2.7	0.9	0.4-2.0
Sedentary lifestyle	1.2	0.8-2.0	1.1	0.7-2.0	1.2	0.8-1.8
High education	0.4	0.2-0.7‡	0.4	0.2-0.8†	0.4	0.3-0.7‡
High Income	1.3	0.6-2.8	0.6	0.2-1.8	1.0	0.5-1.9

Men

	Diabetes		Prediabetes		Total Glucose Intolerance	
Variable	OR	95% CI	OR	95% CI	OR	95% CI
Age (40–64/20-39)	8.4	1.7-55.8†	3.1	0.9-10.1	4.6	1.8-12.4‡
Age (65+/20-39)	7.9	1.5-55.4†	5.1	1.6-17.3†	5.9	2.2-16.2‡
Abdominal obesity	7.0	1.9-25.8‡	6.7	2.1-21.8‡	6.8	2.4-19.6‡
BMI ≥30 kg/m^2	1.6	0.4-6.9	2.2	0.7-7.4	0.5	0.2-1.3
Android profile	10.0	3.3-30.1‡	2.7	1.0-7.6	4.6	2.2-9.6‡
Hypertension	4.1	1.1-15.7*	3.5	1.2-9.9†	3.7	1.6-8.6‡
Family history of Diabetes	2.5	0.7-8.5	0.3	0.0-2.5	1.1	0.4-3.1
Alcohol (current drinker)	0.3	0.0-2.4	0.7	0.2-3.0	0.5	0.2-1.6
Smoking (current smoker)	0.3	0.0-2.7	1.0	0.4-3.1	0.5	0.2-1.5
Sedentary lifestyle	0.9	0.3-2.5	0.4	0.2-0.9*	1.8	1.0-3.4
High education	0.3	0.1-0.7*	0.7	0.3-1.7	0.5	0.2-0.9*
High Income	1.1	0.3-4.4	1.5	0.6-3.8	1.3	0.6-3.2

*P<0.05; †P<0.01; ‡P<0.001.

advanced age and abdominal obesity in men, were shown to be risk factors. In women, TGI were positively associated with the same variables as diabetes and also with hypertension. In men, TGI was positively associated with increased age, abdominal obesity and android profile. Android profile, which was positively related to diabetes and TGI in both genders, maintained its relation with diabetes and TGI in women with BMI <25 kg/m^2 (OR: 3.50, 95% CI: 1.31-9.36% for diabetes, OR: 2.18, 95% CI: 1.11-4.2% for TGI).

Discussion

The present study provided the first population-based estimates of the prevalence of diabetes and other forms of glucose intolerance in Haiti. It was conducted in the capital city and the surrounding cities among a total urban population of 2 million inhabitants. The age-standardized prevalence of diabetes according to the Expert Committee diagnostic criteria of 2003 was 4.8% in men and 8.9% in women, among adults ≥20 years of age. The age-adjusted prevalence of diabetes in subjects aged 30-64 years, after age-standardization using the Segi distribution, was 7.4% in men, 11.1% in women and 10.0% in both sexes. In comparison, the prevalences of diabetes among adults in most urban populations of Latin America and the Caribbean, using, when possible, the world Segi population as the standard, were between 6% and 8% [20]. The age-standardized prevalence of pre-diabetes was 6.4% in men and 8.0% in women. Surprisingly enough, a high proportion (70.6%)

Table IV
Results of multiple logistic regression model of the association between Diabetes, Pre-diabetes, Total Glucose Intolerance and selected factors.

Women

	Diabetes		Pre-diabetes		Total Glucose Intolerance	
Variable	OR	95% CI	OR	95% CI	OR	95% CI
Age (40-64/20-39)	5.87	2.02-17.09†			2.55	1.39-4.71†
Age (65+/20-39)	12.16	4.17-35.41‡	2.23	1.33-3.75†	4.93	2.62-9.28‡
Family history of diabetes	2.38	1.26-4.49†	2.17	1.09-4.31*	2.28	1.36-3.82†
Android profile	2.85	1.39-5.83†			1.87	1.16-3.02*
Abdominal obesity	2.61	1.52-4.49†	1.87	1.14-3.05*	2.09	1.39-3.14‡
Hypertension			2.19	1.20-4.00*	1.60	1.02-2.49*

Men

	Diabetes		Pre-diabetes		Total Glucose Intolerance	
Variable	OR	95% CI	OR	95% CI		
Age (40-64/20-39)					3.96	1.57-10.00†
Age (65+/20-39)			2.75	1.22-6.20*	4.33	1.66-11.25†
Android profile	5.16	1.84-14.47†			2.64	1.33-5.22†
Abdominal obesity	5.87	1.65-20.88†	7.48	2.57-21.81‡	4.86	1.89-12.50†
High Education	0.33	0.12-0.91*				

*P<0.05; †P<0.01; ‡P<0.001. The variables not showed in the table were excluded by backward selection.

of the people with diabetes were previously aware of their disease. This finding does not reflect the lack of routine medical services and the trend of seeking medical advice only for advanced problems in poor countries. It could be explained by frequent and regular media campaigns on diabetes organized by FHADIMAC (Fondation Haïtienne de Diabète et de Maladies Cardio-vasculaires) for more than one decade in the metropolitan area of Port-au-Prince. We expect to address this issue in a future study in rural areas where population has less access to health care and education on means of detection of the disease.

The two-step approach of testing reduced the burden of diabetes diagnosis procedures, compared to systematic OGTT, and allowed us to perform the screening for diabetes with a good balance of sensitivity and specificity. The threshold of 80 mg/dl (4.4 mmol/l) for casual and fasting testing to exclude diabetes certainly resulted in slight underestimation of IGT and to a lesser degree IFG and maybe also diabetes [10,21]. A preliminary study (not published) conducted at the FHADIMAC 3 months before the current one, involved 200 OGTT in an adult population without known diabetes. It indicated 6.0% of IGT and no diabetes among subjects having fasting plasma glucose less than 80 mg/dl (4.4 mmol/l). The cut-off of 160 mg/dl (8.9 mmol/l) of fasting glycaemia for diagnosis of diabetes in the first step was choosen because of a cultural particularity in Haitian people: a lot of them tend to consider themselves as in a fasting state if they have drunk only some coffe with sucrose, but when requested they systematically drink or eat nothing. So, this cut-off prevented overestimation and missclassification of glucose tolerance. Anyway, the final classification was still based on the 2003 criteria of the Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. On the other hand, the threshold of 200 mg/dl (11.1 mmol/l) for non-fasting glycaemia to diagnose diabetes on site revealed a very high specificity. Indeed, the fasting CBG performed systematically at the reference center, during the educative meeting, in the subjects who had a casual CBG ≥200 mg/dl (11.1 mmol/l), were all >140 mg/dl (7.8 mmol/l).

Participation rate was not as high as expected because of a very significant increase of political and social violence in the studied areas just after the first step. This situation decreased the number of referred subjects coming to the centers for further testing and did not allow us to make the second visit to the positive screenees of the most difficult neighborhoods. In fact, we were able to determine glucose tolerance status for nearly 70% of the randomized representative subjects of the general population aged ≥20 years. In addition, from the crude data obtained from an age-stratified sample, prevalences were weighted to take into account the age- and sex-distribution obtained from the 2003 national census.

The high female proportion of the sample has probably two explanations. First, more women than men were at home at the time of the visit, because of a well-known lack of employment outside the home among women, and the inverse situation among men. Second, sex-ratio M:F in the metropolitan area according to the national census of 1982 was 0.72 [17] and preliminary data from the last national census of 2003 (unpublished) seems to confirm this demographic particularity. The strongest explanation provided is an important female migration from rural areas to the capital city and its suburbs and a nationwide male migration to USA and other Caribbean islands.

Our survey indicated an age-related increase of the frequency of diabetes and pre-diabetes. This relationship leads us to believe that public health effort to increase longevity of the Haitian population must concomitantly include intervention programs to decrease the risk factors for glucose intolerance [22-24]. In women, diabetes prevalence continuously rised until advanced age, while in men the prevalence, very low before 40 years, sharply increased in the 40-64 years group, then seemed to reach a plateau from 65 years. This last observation could be explained by a reduction of life expectancy in elderly diabetic males. The female predominance for the prevalence of diabetes has been reported in many studies. Some possible explanations are: lack of employment outside the home, sedentary lifestyle or physical activity restricted to housework, more pronounced general or abdominal obesity in women, well demonstrated here, hormonal modifications and changes in body fat distribution and increasing resistance to insulin in post-menopausal period among women. In our study, an overestimation of diabetes prevalence is possible due to the fact of selecting only the members of the households present at the time of the visit, thus excluding a substantial proportion of the non-sedentary people (mostly men).

The very high rate of hypertension put the studied population among those most affected in America [25,26]. Its prevalence, already high in the 20-39 years age group, more than doubled in the older age groups. Less than 25% of the people aged ≥40 years and less than 10% of diabetic people had normal blood pressure. Additional studies are needed to confirm these data and to identify the factors responsible for this high prevalence of abnormal blood pressure.

Abdominal or central obesity appeared strongly associated with all forms of glucose intolerance in both genders. It is interesting to point out that android profile, which was positively associated with diabetes and TGI in both genders, was a risk factor for diabetes and TGI even in women with BMI <25.0 kg/m^2. Therefore, WHR should still be used, like weight, BMI and waist girth, in assessing cardiovascular and metabolic risk in our population, especially in women. Family history of diabetes in first-degree relatives was related to all forms of glucose intolerance in women, but with none in men. High level of education was inversely associated with diabetes in men only. Sedentary lifestyle, which was associated with pre-diabetes in men by using univariate analysis, was rejected by backward selection in the multiple logistic regression model.

In summary, the present study shows that in the metropolitan area of Port-au-Prince the prevalence of diabetes among the adult population is slightly higher than in most urban populations of Latin America and the Caribbean. But the most striking finding remains the alarming increase of this prevalence over the past three decades, due probably to westernization of lifestyles. Abdominal obesity appears to be a major independent risk factor for both diabetes and pre-diabetes in both genders. The prevalence of hypertension is very high, particularly in people aged ≥40 years. These data underline the urgent need for programs targeting prevention and management of diabetes and hypertension. Prevention strategies based on lifestyle modifications that simultaneously address both these important cardiovascular risk factors should be cost-effective in this population with a very low standard of living.

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