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Prevalence of Diabetes, Prediabetes, and Associated Risk Factors Among Agricultural Village Residents in the Dominican Republic

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Abstract. This study examined the prevalence and risk factors of prediabetes and type 2 diabetes among residents of agricultural settlement villages (*bateyes*) in the Dominican Republic. From March to April 2016, a cross-sectional, multi-stage cluster survey was conducted across the country's three agricultural regions (southwest, east, and north). At selected households, an adult completed a questionnaire to assess demographics, diabetes knowledge, and care, and two household residents of any age provided finger-prick blood samples that were analyzed for hemoglobin A1c (HbA1c). HbA1c was categorized as normal (< 5.7%), prediabetic (5.7–6.4%), or diabetic (≥ 6.5%). The prevalence rates of diabetes and prediabetes were 8.6% (95% confidence interval [CI], 6.2–11.8%) and 20.4% (95% CI, 17.9–23.2%), respectively, among all participants (*N* = 1293; median age, 35 years; range, 2–96 years), and 10.0% (95% CI, 7.2–13.8%) and 20.0% (95% CI, 17.4–23.0%), respectively, among adults 18 years or older (*N*

Today, *bateyes* are some of the poorest areas of the country. Many *bateyes* lack basic water and sanitation services and display high rates of illiteracy, malnutrition, and HIV, which comprise a clustering of health and social problems that could be considered a syndemic.[22,23] Although the Dominican Republic has enshrined the universal right to health in its Constitution and has integrated chronic disease management in primary healthcare,[20] *batey* residents, which include Haitian migrants, Dominican-born persons of Haitian descent, and ethnic Dominicans, frequently have difficulty accessing those services because of the ongoing problems of poverty, discrimination, and lack of documentation.[24,25] There is a potentially large burden of undiagnosed and/or poorly controlled chronic diseases, including diabetes, within this population.

The primary goals of this study were to measure the prevalence of prediabetes and type 2 diabetes in Dominican *bateyes* and to determine the proportion of undiagnosed type 2 diabetes. The study also explored diabetes knowledge and past treatment-seeking experiences to assess possible risks for diabetes. The study findings are framed by the sociopolitical context of *bateyes* and the challenges faced by transitioning countries such as the Dominican Republic, where rapid economic change, a shift in the burden of disease, and legacies of social exclusion continue to impact human health.

METHODS

S . d de . . This study was nested within a prevalence survey of malaria and lymphatic filariasis (LF) in Dominican *bateyes*.[26] The target population consisted of all persons living in Dominican *bateyes*. The study design was a household-based, cross-sectional, multi-stage cluster survey conducted across three regions in the country from March 9 to April 24, 2016. This time period corresponds to the *zafra*, or annual sugar cane harvest, when most Haitian migrant workers are thought to be present in *bateyes*.

The target sample size of 1446 blood samples was based on detecting prevalence rates of malaria and LF of 5% (±2.5% with 95% two-sided significance level) in each of the three regions with a design effect of 1.5 and a 10% nonresponse rate.

The sampling frame was based on a 2012 nationwide census that identified 426 distinct *bateyes* across four regions: southwest, north, east, and the greater Santo Domingo area.[27] *Bateyes* in greater Santo Domingo were excluded because of discontinued agricultural activity. The remaining *bateyes* were categorized into three strata (regions): southwest, north, and east. To generate representative samples within each region, approximately 17 clusters (*bateyes*) per stratum were randomly selected using the probability of selection proportional to the population size. Several larger *bateyes* were selected more than once; for those cases, the *batey* comprised two (or in one case, three) clusters. Within each *batey*, 15 households were chosen by interval (systematic) selection after a random start using community maps prepared by survey teams before sampling.

I . e . e a d b . . d e . . . The survey consisted of two main components: a household-level questionnaire and blood sample testing. Inclusion criteria for the household questionnaire were as follows: age at least 18 years; resident of a selected house; and able to verbalize consent to participate. Nonresidents of the selected household, individuals younger than 18 years, and persons who did not provide oral informed consent were excluded. The questionnaire was administered to consenting participants in their preferred language (Haitian Kreyòl or Spanish). The questionnaire asked questions about demographics, migration history, diabetes knowledge, attitudes, and practices (KAP), and previous experiences within the healthcare system related to diabetes. Questionnaires were administered by bilingual interviewers fluent in Spanish and native speakers of Haitian Kreyòl. The original English version of the questionnaire was translated to both Haitian Kreyòl and Spanish and then back-translated to English for comparisons with the original survey. The questionnaire was then piloted among a convenience sample. Adjustments were made to ensure the comprehension and comfort of participants. Household questionnaire responses were collected using Eagle Survey (mobile v.1.3.3) software on Samsung GalaxyT0TD[(detectin230.7(cr1e)-452(ran-)]TTD1.2203TD[(using)m2.8074i8TD

ever heard of diabetes (Kreyòl, *maladi djabèt* or *sik*; Spanish, *diabetes* or *azúcar*); if they could name a symptom of diabetes; if they could name a symptom, then they were asked whether they could also name a body part affected by diabetes; if they had ever been tested for diabetes; if they had ever been told by a healthcare worker that they had diabetes; if they were ever told that they had diabetes, then they were asked whether they have ever used medicine for diabetes; and what they would do if they were ever told by a healthcare worker that they had diabetes. These questions were adapted from the National Health and Nutrition Examination Survey.[30] Item 5 was subsequently used to differentiate diagnosed and undiagnosed participants among those whose HbA1c laboratory samples fulfilled the diagnostic criteria for diabetes.

Da a a a . . Electronic questionnaire data were uploaded into Excel (Microsoft Corp., Redmond, WA) and matched with laboratory data based on de-identified, individual-level code identifiers. Laboratory data were double-entered into Excel (Microsoft) by a CENCET staff member. Discrepancies between household and laboratory identification codes were reconciled by reviewing the original paper data forms used by laboratory technicians. Ten observations could not be reconciled and were excluded.

Data analyses were conducted with Stata v14.2. Weighted population estimates and 95% confidence intervals (CI) were calculated using the *svy* command to account for the complex survey design, including clustering, stratification, and sampling weights. Analyses of subgroups (HbA1c categories, ethnic groups) were performed using the *subpop* command.

Univariate logistic regression based on potential risk factors was performed to assess the odds of being prediabetic and diabetic among household questionnaire respondents.

tested for diabetes. Among those tested, a greater proportion had diabetes (23.9%) compared with the proportion with diabetes who were not previously tested (7.8%). Most respondents (61.8% overall) could not name a symptom of diabetes. When asked, “What would you do if I told you had diabetes?”,

TABLE 2

Demographic data and diabetes knowledge and treatment characteristics among adult questionnaire respondents overall and by diabetic status in the Dominican Republic in 2016

	Total	Diabetic category		
		Normal	Prediabetic	Diabetic
	No. (column %)	HbA1c	HbA1c	HbA1c
	N = 730	No. (row %)	No. (row %)	No. (row %)
		N = 483	*N* = 153	*N* = 94
Age group, years				
18–35	255 (35.0)	204 (80.0)	34 (13.3)	17 (6.7)
36–55	287 (39.4)	179 (62.3)	63 (22.0)	45 (15.7)
56–75	158 (21.7)	81 (51.3)	49 (31.0)	28 (17.7)
≥ 76	29 (4.0)	18 (62.1)	7 (24.1)	4 (13.8)
Sex				
Female	444 (60.8)	287 (64.6)	94 (21.2)	63 (14.2)
Male	286 (39.2)	196 (68.5)	59 (20.6)	31 (10.8)
Residency status				
Nonpermanent/migrant	79 (10.9)	66 (83.5)	9 (11.4)	4 (5.1)
Permanent	647 (89.1)	413 (63.8)	144 (22.3)	90 (13.9)
Documentation status				
Undocumented	84 (11.6)	62 (73.8)	17 (20.2)	5 (6.0)
Documented	643 (88.5)	418 (65.0)	136 (21.2)	89 (13.8)
Ethnicity				
Haitian-born	231 (31.8)	149 (64.5)	58 (25.1)	24 (10.4)
Dominican-born and of Haitian descent	215 (29.6)	147 (68.4)	38 (17.7)	30 (14.0)
Dominican-born and not of Haitian descent	280 (38.6)	185 (66.1)	56 (20.0)	39 (13.9)
Primary occupation				
Farmer	144 (19.8)	92 (63.9)	36 (25.0)	16 (11.1)
Unemployed	296 (40.6)	196 (66.2)	58 (19.6)	42 (14.2)
Homemaker/domestic worker	97 (13.3)	61 (62.9)	17 (17.5)	19 (19.6)
Market vendor/retail/shop	86 (11.8)	52 (60.5)	26 (30.2)	8 (9.3)
Construction	28 (3.8)	24 (85.7)	3 (10.7)	1 (3.6)
Other	78 (10.7)	57 (73.1)	13 (16.7)	8 (10.3)
Ever heard of diabetes?				
No	223 (30.6)	151 (67.7)	47 (21.1)	25 (11.2)
Yes	369 (50.7)	241 (65.3)	74 (20.1)	54 (14.6)
Do not know	136 (18.7)	89 (65.4)	32 (23.5)	15 (11.0)
Ever been tested for diabetes?				
No	472 (64.8)	334 (70.8)	101 (21.4)	37 (7.8)
Yes	226 (31.0)	131 (58.0)	41 (18.1)	54 (23.9)
Do not know	30 (4.1)	16 (53.3)	11 (36.7)	3 (10.0)
Symptom of diabetes (first cited)				
Thirst/hunger	102 (14.0)	67 (66.0)	18 (17.7)	17 (16.7)
Urinary symptoms	60	37	13	10

(continued)

TABLE 3

Univariate logistic regression analysis of risk factors for prediabetes and diabetes among adult questionnaire respondents (N = 730) in the N

Haitian-born individuals, having come from a more impoverished country where infectious disease is still a major killer, appear to be at higher risk for prediabetes. In separate analyses,[26] unemployment was lowest among the Haitian-born population, suggesting that activity from manual labor at nearby sugar plantations may exert a protective effect against diabetes. Dominican-born individuals living in a more established (although, at times, just as precarious) setting appeared to be more at risk for diabetes, perhaps because of sedentarism from unemployment.

There are notable gaps in diabetes detection, knowledge, and treatment in these communities, with additional disparities between the Haitian-born population and those born in the Dominican Republic. One of the most concerning findings is that the majority of patients with diabetes were undiagnosed. A similar proportion overall had not been tested for

diabetes, and half of the participants had not heard of diabetes. Not surprisingly, one-quarter of respondents reported they would not know what to do if they were diagnosed with diabetes. Yet, among the small number of those who were

Haitian-born or Haitian-descended population; only 21% of the country as a whole has some form of insurance.[35] Clearly, there are deep structural problems involved with making healthcare more affordable for most of the population. This disparity poses a formidable challenge to reaching the groups that diabetes seems to disproportionately affect: the Dominican-born population, which includes individuals of and not of Haitian descent.

Despite apparent shortcomings in healthcare access, diagnosis, and treatment, it is still impressive that among previously diagnosed patients with diabetes (N = 37), almost all (94.1%) reported ever using medicine for diabetes. Furthermore, 65.2% of the overall population said that they would seek care at a hospital or clinic or use medicine—the two most popular responses, aside from "do not know," when asked to name where they would go or what they would do if diagnosed. These findings suggest that despite poor diabetes knowledge, the *batey* population would still seek care at healthcare centers and/or would be willing to use medication to control diabetes. Because many people would still rely on the health system for care, strengthening the clinical capacity will be a crucial component of addressing diabetes disparities. It is necessary to ensure the availability of diagnostic tests and medications and improve clinical knowledge among those who are responsible for providing care to this population on a regular basis.

LIMITATIONS

Despite conducting the survey in the evenings and on

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