Self-Reported Diabetes and Health Behaviors in Remote Indigenous Communities in Northern Queensland, Australia

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OBJECTIVE — This study examines associations between self-reported diabetes and self-reported smoking, alcohol consumption, fruit consumption, and participation in adequate exercise in remote indigenous communities, using data from the Well Persons' Health Check (WPHC).

RESEARCH DESIGN AND METHODS — The WPHC was a cross-sectional survey of 2,862 indigenous individuals (1,602 Aborigines, 1,074 Torres Strait Islanders, and 186 persons of joint descent) aged ≥15 years. The study was conducted in 26 remote communities in northern Queensland, Australia, between March 1998 and October 2000.

RESULTS — A total of 32% of individuals with self-reported diabetes and 25% of other individuals reported eating enough fruit, according to National Health and Medical Research Council criteria: odds ratio (OR) 1.407 (95% CI 1.108–1.786), $P = 0.006$. After adjustment for age, sex, and ethnicity, no significant difference could be observed: adjusted OR 1.22 (0.944–1.574), $P = 0.128$. A total of 58% of participants who reported diabetes and 51% of others reported adequate exercise: OR 0.761 (0.609–0.952), $P = 0.018$. This difference was not significant after adjustment for age, sex, and ethnicity: adjusted OR 0.896 (0.705–1.14), $P = 0.370$. A total of 43% of individuals who reported diabetes and 72% of others reported consuming alcohol: OR 0.295 (0.235–0.369), $P < 0.001$. After adjustment for age, sex, and ethnicity, this difference was still significant: adjusted OR 0.550 (0.428–0.709), $P < 0.001$. Diabetic drinkers consumed alcohol at harmful levels similar to those of nondiabetic drinkers ($P = 0.691$). A total of 40% of individuals who reported diabetes and 63% of other persons were tobacco smokers: OR 0.403 (0.322–0.505), $P < 0.001$. Although this crude difference was attenuated by adjustment for age, sex, and ethnicity, persons with self-reported diabetes were still significantly less likely to smoke tobacco than other participants: adjusted OR 0.666 (0.521–0.852), $P = 0.001$. Smoking prevalence among the diabetic indigenous participants was more than double that in nondiabetic nonindigenous Australians.

CONCLUSIONS — This study suggests that indigenous individuals with diabetes living in rural and remote communities are not adopting lifestyle changes required for optimal self-management of the disease. This contributes to the large excess of mortality and morbidity experienced by this population.

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Diabetes has long been recognized as an important health issue in many indigenous populations, particularly the Australian indigenous population (1–3). Cohort studies have shown that tobacco smoking (4) as well as obesity and other features of the metabolic syndrome (5–9) are independent predictors of incidence of diabetes.

In addition, tobacco smoking has been found to be a significant contributor to the incidence of complications of diabetes such as neuropathy, nephropathy, retinopathy, erectile dysfunction, and ischemia (4). Avoidance of tobacco is an important component in the management of diabetes (4,10).

It is known that smoking recruitment and nicotine addiction rates are high and cessation rates are low among individuals at greater socioeconomic disadvantage (11) and that indigenous people in remote Queensland communities are among the most disadvantaged in Queensland (12–14).

Little is known about the effectiveness of smoking cessation interventions in patients with diabetes (4); assumptions have been made that existing interventions will be as effective in diabetic patients as in nondiabetic patients. Evidence from Australian general practice suggests that physicians are unlikely to apply well-characterized interventions to diabetic patients, beyond advising cessation of cease smoking (10). Whether smoking cessation interventions are being applied and/or are effective in Australian indigenous community settings is unknown.

The aim of this study is to examine differences in health behaviors between indigenous people who are aware of having diabetes and those in whom diabetes has not been diagnosed.

RESEARCH DESIGN AND METHODS

Study design

The Well Person's Health Check (WPHC) was a cross-sectional survey conducted in 26 remote indigenous communities in northern Queensland, Australia, between March 1998 and October 2000. Data were collected regarding chronic disease

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Abbreviations: AusDiab, Australian Diabetes, Obesity, and Lifestyle Study; OR, odds ratio; NHS, National Health Survey; STI, sexually transmissible infection; WPHC, Well Persons' Health Check.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

Table 1—*Age- and sex-stratified prevalence of self-reported diabetes in WPHC participants, compared with AusDiab results*

	Aboriginal		Aboriginal and Islander		Islander		AusDiab 2000	
Age (years)	Men	Women	Men	Women	Men	Women	Men	Women
15–24	1/172 (0.5)	2/206 (0.9)	1/29 (3.4)	0/33 (0)	1/134 (0.7)	0/119 (0)	NA	NA
25–34	7/193 (3.6)	11/214 (5.1)	0/25 (0)	1/25 (4)	3/132 (2.2)	5/138 (3.6)	0/585 (0)	2/799 (0.3)
35–44	14/165 (8.4)	37/184 (20.1)	1/19 (5.2)	2/21 (9.5)	17/119 (14.2)	12/98 (12.2)	12/1,091 (1.1)	13/1,462 (0.9)
45–54	20/104 (19.2)	24/118 (20.3)	0/8 (0)	4/8 (50)	17/91 (18.6)	38/76 (50)	38/1,350 (2.8)	54/1,541 (3.5)
55–64	6/67 (8.9)	38/84 (45.2)	0/2 (0)	1/8 (12.5)	13/38 (34.2)	18/43 (41.8)	80/93 (8.6)	50/1,091 (4.6)
65–74	6/34 (17.6)	11/44 (25)	2/2 (100)	2/4 (50)	10/32 (31.2)	22/36 (61.1)	94/731 (12.8)	61/832 (7.3)
75+	1/5 (20)	5/12 (41.6)	0/2 (0)	0/0	4/8 (50)	5/10 (50)	50/360 (13.8)	46/472 (9.7)
Total	55/740 (7.4)	128/862 (14.8)	4/87 (4.5)	10/99 (10.1)	65/554 (11.7)	100/520 (19.2)	217/5,050 (4.3)	205/6,197 (3.3)

Data are *n* (%).

risk factors and sexually transmissible infection (STI). A treatment service was offered for persons with positive results for STI.

Subjects

The target population for the WPHC was indigenous persons aged ≥13 years. Participation was voluntary, and the survey was open to all residents of the community. The WPHC was advertised through printed media (posters, pamphlets), local radio, and word of mouth via the local health service, community council, and community groups.

Qualitative feasibility studies were conducted in many communities to provide information to local residents about the WPHC and to assess barriers to participation. Information from these studies assisted in determining when and where the WPHC was held, the level of involvement of local and visiting staff, and issues such as transportation to the screening site. These feasibility studies also provided information about health perceptions and priorities in the community, which was useful in tailoring local promotional strategies.

Of the 3,507 participants, 474 nonindigenous participants were excluded from this analysis, along with 171 individuals aged <15 years, leaving 2,862 individuals to participate in the study. Individuals aged <15 years were excluded from the analysis because participation in this age group was dependent on the time of year and the presence of a secondary school in the community. Based on local census data, this represents a participation rate of ~44.5%. Participation rates varied from 19 to 92% among the communities; greater participation was noted in smaller communities.

The study complied with the National Health and Medical Research Council guidelines for research in Aboriginal and Torres Strait Islander Health (15), and

Table 2—*Age- and sex-stratified prevalence of self-reported inadequate fruit consumption in WPHC participants, by self-reported diabetes status compared with National Nutrition Survey results*

	Aborigines		Torres Strait Islanders		Joint descent		
Age (years)	Self-reported diabetes	Other	Self-reported diabetes	Other	Self-reported diabetes	Other	National Nutrition Survey (%)
Men							
15–24	1/1 (100)	46/171 (27)	0/1 (0)	38/133 (29)	0/1 (0)	7/28 (25)	90.05
25–34	2/7 (29)	27/185 (15)	0/3 (0)	38/128 (30)	—	9/25 (36)	85.62
35–44	6/14 (43)	28/151 (19)	6/17 (35)	27/102 (26)	1/1 (100)	6/18 (33)	85.01
45–54	4/20 (20)	16/82 (20)	3/17 (18)	19/74 (26)	—	2/8 (25)	79.85
55–64	2/6 (33)	13/61 (21)	5/13 (38)	9/25 (36)	—	0/2 (0)	
65–74	2/6 (33)	8/28 (29)	4/10 (40)	3/22 (14)	1/2 (50)	0/2 (0)	78.46
75+	0/1 (0)	0/4 (0)	0/4 (0)	1/4 (25)	—	—	
Total	17/55 (31)	138/682 (20)	18/65 (28)	135/488 (28)	2/4 (50)	24/83 (29)	83.7
Women							
15–24	0/2 (0)	48/203 (24)	—	29/119 (24)	—	6/33 (18)	90.34
25–34	2/11 (18)	43/203 (21)	0/5 (0)	34/132 (26)	0/1 (0)	7/24 (29)	86.95
35–44	5/36 (14)	36/147 (24)	7/12 (58)	25/86 (29)	2/2 (100)	10/19 (53)	83.41
45–54	7/24 (29)	26/94 (28)	17/38 (45)	18/38 (47)	4/4 (100)	3/4 (75)	81.33
55–64	10/38 (26)	13/46 (28)	5/18 (28)	10/25 (40)	1/1 (100)	4/7 (57)	
65–74	5/11 (45)	10/33 (30)	10/22 (45)	5/14 (36)	1/2 (50)	1/2 (50)	78.41
75+	2/5 (40)	2/7 (29)	1/5 (20)	1/5 (20)	—	—	
Total	31/127 (24)	178/733 (24)	40/100 (40)	122/419 (29)	8/10 (80)	31/89 (35)	83.7

Data are *n* (%) unless otherwise indicated.

Table 3—*Age- and sex-stratified prevalence of self-reported inadequate exercise in WPHC participants, by self-reported diabetes status compared with National Health Survey results*

	Aborigines		Torres Strait Islanders		Joint descent		National Health Survey 1995*
Age (years)	Self-reported diabetes	Other	Self-reported diabetes	Other	Self-reported diabetes	Other	(%)
Men							
15–24	0/1 (0)	73/171 (43)	0/1 (0)	35/133 (26)	0/1 (0)	9/28 (32)	56.2*
25–34	4/7 (57)	88/184 (48)	2/3 (67)	47/128 (37)	—	10/25 (40)	65.4*
35–44	10/14 (71)	76/151 (50)	11/17 (65)	51/101 (50)	1/1 (100)	11/17 (65)	70.4*
45–54	13/20 (65)	37/84 (44)	6/17 (35)	35/74 (47)	—	4/8 (50)	70.1*
55–64	2/6 (33)	26/61 (43)	5/13 (38)	7/25 (28)	—	1/2 (50)	
65–74	3/6 (50)	16/27 (59)	5/10 (50)	12/22 (55)	2/2 (100)	2/2 (100)	57*
75+	1/1 (100)	2/4 (50)	3/4 (75)	3/4 (75)	—	—	78.5*
Total	33/55 (60)	318/682 (47)	32/65 (49)	190/487 (39)	3/4 (75)	37/82 (45)	62.1
Women							
15–24	1/2 (50)	117/204 (57)	—	80/119 (67)	—	19/33 (58)	56.2*
25–34	8/11 (73)	120/202 (59)	2/5 (40)	67/132 (51)	1/1 (100)	11/24 (46)	65.4*
35–44	20/37 (54)	93/146 (64)	6/12 (50)	48/86 (56)	1/2 (50)	16/19 (84)	70.4*
45–54	13/24 (54)	57/94 (61)	19/38 (50)	19/37 (51)	4/4 (100)	3/4 (75)	70.1*
55–64	27/38 (71)	30/45 (67)	12/18 (67)	12/25 (48)	0/1 (0)	3/7 (43)	
65–74	9/11 (82)	20/33 (61)	11/22 (50)	6/14 (43)	2/2 (100)	2/2 (100)	57*
75+	3/5 (60)	6/7 (86)	3/5 (60)	2/5 (40)	—	—	78.5*
Total	81/128 (63)	443/731 (61)	53/100 (53)	234/418 (56)	8/10 (80)	54/89 (61)	71.7

Data are *n* (%) unless otherwise indicated. *The National Health Survey data were unavailable in age- and sex-specific strata; results shown for age groups include men and women.

ethics approval was granted by the Cairns Base Hospital Ethics Committee in March 1998. All participants and community councils gave written informed consent.

Anthropometric measurements

Participants were asked to remove any heavy clothing (jackets, etc.) and footwear and were then weighed to the nearest 0.1 kg and measured for height to the nearest centimeter. Waist and hip circumferences were measured to the nearest centimeter. Waist-to-hip ratio was calculated as waist circumference divided by hip circumference. BMI was calculated as weight (kg) divided by height squared (m^2).

Interview questions

Interviews took the form of a standardized questionnaire administered in a face-to-face interview. Five specifically trained interviewers performed interviews and measurements. Regular meetings were held regarding standardization of interview techniques.

Participants were asked to recall all food eaten the day before the screening, and the number of servings of fruits and vegetables was recorded. A serving was defined as "about a handful of fruit or vegetables, or half a cup," which is equivalent to ~150 g of fruit or 75 g of vegetables. This 24-h recall method of assessing food intake has been validated elsewhere (16–18).

Exercise was measured using a 7-day recall method in which each participant was asked to recall all exercise performed the week before the interview. The interviewer assessed the intensity and duration of that exercise. The interviewer recorded the number of days in the past week on which the participant was deemed to have exercised moderately for ≥30 min.

Participants were asked if they had diabetes diagnosed by a doctor (self-reported diabetes) and/or chronic heart, lung, or kidney conditions, as well as the year in which these conditions were diagnosed. Participants were asked if they were taking any vitamin supplements or medications.

Participants were asked if they currently smoked tobacco. Smokers were asked how many cigarettes they smoked daily. Nonsmokers were asked if they had ever smoked and, if so, when they had ceased smoking. The same questions were asked with respect to alcohol consumption; drinkers were asked to recall the types and quantities of alcohol consumed in the previous 7 days.

These methods of collecting information regarding drinking, smoking, fruit consumption, and exercise have been widely used elsewhere (18–22).

Blood sample collection and analysis

Fasting venous blood samples were collected by a medical officer, registered nurse, or trained phlebotomist from 2,779 of the 2,862 participants, and the following biochemical measurements were made: triglycerides, total cholesterol, HDL cholesterol, LDL cholesterol, γ-glutamyl transferase (GGT), red cell folate (RCF), and glucose. Participants with a fasting glucose concentration of 5.5 mmol/l were followed-up within 1 month of the screening and were tested with a 75-g oral glucose tolerance test.

Statistical analysis

Statistical analyses were performed using SPSS statistical software (version 10; SPSS, Chicago, IL) (23). Odds ratios were

Table 4—*Age- and sex-stratified prevalence of self-reported smoking in WPHC participants, by self-reported diabetes status compared with the AusDiab results*

	Aborigines		Torres Strait Islanders		Joint descent		
Age (years)	Self-reported diabetes	Other	Self-reported diabetes	Other	Self-reported diabetes	Other	AusDiab 2000
Men							
15–24	0/1 (0)	119/171 (70)	1/1 (100)	96/133 (72)	1/1 (100)	21/28 (75)	NA
25–34	5/7 (71)	147/184 (80)	2/3 (67)	86/129 (67)	—	11/25 (44)	131/584 (22.5)
35–44	11/14 (79)	110/151 (73)	9/17 (53)	59/102 (58)	1/1 (100)	9/17 (53)	257/1,090 (23.6)
45–54	14/20 (70)	61/84 (73)	6/17 (35)	45/74 (61)	—	4/8 (50)	245/1,349 (18.2)
55–64	3/6 (50)	40/61 (66)	0/13 (0)	11/25 (44)	—	0/2 (0)	125/933 (13.4)
65–74	4/6 (67)	16/27 (59)	1/10 (10)	9/22 (41)	1/2 (50)	0/2 (0)	67/731 (9.2)
75+	0/1 (0)	3/4 (75)	1/4 (25)	0/4 (0)	—	—	16/359 (4.6)
Total	37/55 (67)	496/682 (73)	20/65 (31)	306/489 (63)	3/4 (75)	45/82 (55)	843/5,049 (18.2)
Women							
15–24	2/2 (100)	140/204 (69)	—	79/119 (66)	—	20/33 (61)	NA
25–34	4/11 (36)	127/202 (63)	3/5 (60)	78/132 (59)	1/1 (100)	18/24 (75)	148/798 (18.6)
35–44	24/37 (65)	92/147 (63)	6/12 (50)	43/86 (50)	1/2 (50)	6/19 (32)	238/1,462 (16.3)
45–54	11/24 (46)	56/94 (60)	8/38 (21)	13/37 (35)	2/4 (50)	0/4 (0)	209/1,540 (13.6)
55–64	12/38 (32)	19/46 (41)	2/18 (11)	8/25 (32)	0/1 (0)	1/7 (14)	96/1,090 (8.8)
65–74	2/11 (18)	10/33 (30)	5/22 (23)	2/14 (14)	1/2 (50)	0/2 (0)	48/832 (5.8)
75+	1/5 (20)	3/7 (43)	1/5 (20)	0/5 (0)	—	—	20/449 (4.5)
Total	56/128 (44)	447/733 (61)	25/100 (25)	223/418 (53)	5/10 (50)	45/89 (51)	760/6,174 (13.1)

Data are *n* (%).

calculated from 2 × 2 tables, and logistic regression models were used to adjust for age, sex, and ethnicity. Two-sided *P* values are given.

Among drinkers, the proportion of individuals with known diabetes who drank at hazardous levels was compared with that in other persons, using both an age-, sex-, and smoking-stratified cross-tabulation and χ^2 test. A logistic regression model was used to adjust for age, sex, and ethnicity.

Classifications of data

Two servings of fruit per day were considered the minimum for sufficient intake, as were five servings of vegetables, in accordance with national guidelines (24).

Participants who exercised moderately on three or more days were classified as having exercised adequately. Exercise in the National Health Survey (NHS) (25) was classified into "No Exercise," "Low Exercise Level," "Medium Exercise Level," and "High Exercise Level." For the purpose of comparison with the results of this study, the NHS "No Exercise" and "Low Exercise Level" results have been aggregated as "insufficient exercise."

Smoking and alcohol consumption status was categorized as either "Current," "Recent," "Past," or "Never." Recent smoking or drinking was defined, in the WPHC, as self-reported cessation in the previous 12 months.

RESULTS

— Self-reported age-stratified prevalence of diabetes is shown in Table 1, along with national comparisons from the Australian Diabetes, Obesity, and Lifestyle Study (AusDiab) 2000 (21). In the sample, diabetes was less prevalent in men than in women: age-adjusted OR 0.501 (95% CI 0.391–0.642), $P < 0.001$. The highest rates were found among Torres Strait Islanders.

Fruit consumption

Self-reported rates of low fruit consumption (fewer than two servings per day) are shown in Table 2, along with national comparisons from the National Nutrition Survey (26).

In a bivariate analysis, individuals with self-reported diabetes were significantly more likely to have eaten enough fruit than other persons: 32 vs. 25%, OR 1.407 (95% CI 1.108–1.786), $P = 0.006$. After adjusting for sex, age, and ethnicity, this difference was found to be no longer significant: adjusted OR 1.22 (0.944–1.574), $P = 0.128$.

Exercise

The proportions of individuals reporting insufficient exercise (fewer than 3 days in the week before the screening in which ≥30 min of moderate exercise was undertaken) are shown in Table 3.

Without accounting for other factors, individuals with self-reported diabetes were less likely than other subjects to exercise adequately: 58 vs. 51%, OR 0.761 (95% CI 0.609–0.952), $P = 0.018$. After adjusting for sex, age, and ethnicity, no significant difference was found between individuals with self-reported diabetes and other participants: adjusted OR 0.896 (0.705–1.14), $P = 0.370$.

Tobacco smoking

Tobacco smoking rates are shown in Table 4, along with national comparison data from the AusDiab 2000 survey (21). Smoking rates in indigenous study participants were almost three times those of the mostly nonindigenous sample used in the AusDiab 2000 survey (21).

Smoking prevalence in individuals with self-reported diabetes was lower than in other participants: crude analysis 40 vs. 63%, OR 0.403 (95% CI 0.322–0.505), $P < 0.001$. Although this observed effect was attenuated by adjustment for age, sex, and ethnicity, in-

Table 5—*Age- and sex-stratified prevalence of self-reported alcohol consumption in WPHC participants, by self-reported diabetes status compared with National Health Survey results*

	Aborigines		Torres Strait Islanders		Joint descent		
Age (years)	Self-reported diabetes	Other	Self-reported diabetes	Other	Self-reported diabetes	Other	National Health Survey 1995
Men							
15–24	0/1 (0)	124/171 (73)	1/1 (100)	119/133 (89)	1/1 (100)	23/28 (82)	68% (aged 18–24 year)*
25–34	7/7 (100)	172/184 (93)	3/3 (100)	110/129 (85)	—	19/25 (76)	59*
35–44	12/13 (92)	131/151 (87)	13/17 (76)	76/102 (75)	1/1 (100)	14/17 (82)	60*
45–54	13/20 (65)	76/84 (90)	9/17 (53)	56/74 (76)	—	5/8 (63)	56*
55–64	2/6 (33)	47/61 (77)	5/13 (38)	13/25 (52)	—	2/2 (100)	
65–74	0/6 (0)	18/27 (67)	2/10 (20)	13/22 (59)	1/2 (50)	0/2 (0)	58*
75+	1/1 (100)	1/4 (25)	2/4 (50)	1/4 (25)	—	—	39*
Total	35/54 (65)	569/682 (83)	35/65 (54)	388/489 (79)	3/4 (75)	63/82 (77)	68*
Women							
15–24	2/2 (100)	139/204 (68)	—	87/119 (73)	—	22/33 (67)	68% (aged 18–24 years)*
25–34	9/11 (82)	144/202 (71)	4/5 (80)	90/132 (68)	1/1 (100)	17/24 (71)	59*
35–44	25/37 (68)	104/147 (71)	2/12 (17)	44/86 (51)	2/2 (100)	8/19 (42)	60*
45–54	15/24 (63)	58/94 (62)	5/38 (13)	14/37 (38)	3/4 (75)	0/4 (0)	56*
55–64	9/38 (24)	23/45 (51)	2/18 (11)	9/25 (36)	0/1 (0)	1/7 (14)	
65–74	3/11 (27)	6/33 (18)	0/22 (0)	3/14 (21)	0/2 (0)	0/2 (0)	58
75+	0/5 (0)	2/7 (29)	0/5 (0)	0/5 (0)	—	—	39
Total	63/128 (49)	476/732 (65)	13/100 (13)	247/418 (59)	6/10 (60)	48/89 (54)	48

Data are *n* (%) unless otherwise indicated. *The National Health Survey data were unavailable in age- and sex-specific strata; results shown for age groups include men and women.

dividuals with self-reported diabetes still were significantly less likely to smoke tobacco than other participants: adjusted OR 0.666 (0.521–0.852), $P = 0.001$.

Additional analysis was performed in which individuals with self-reported diabetes were excluded. Smoking rates were compared in individuals in whom diabetes was diagnosed at the WPHC ($n = 126$) and individuals whose glucose pathology did not indicate diabetes ($n = 2,295$). No significant difference in smoking patterns between these two groups could be found after adjustment for age, sex, and ethnicity: adjusted OR 0.889 (95% CI 0.614–1.289), $P = 0.535$.

Alcohol consumption

Self-reported consumption of alcohol is shown in Table 5, with national comparison data from the NHS 1995 (22).

Individuals with self-reported diabetes were significantly less likely to drink alcohol than other participants, both in a crude analysis (43 vs. 72%, OR 0.295 [95% CI 0.235–0.369], $P < 0.001$) and after adjustment for age, sex, and ethnicity (adjusted OR 0.550 [0.428–0.709], $P < 0.001$).

Hazardous and harmful alcohol consumption

For men and women, diabetic drinkers were as likely to drink at hazardous or harmful levels as other drinkers, after adjustment for age, sex, and smoking: adjusted OR 1.075 (95% CI 0.753–1.535), $P = 0.691$.

Potential participation bias

When diabetes management audits have been conducted for a contemporaneous study (27), comprehensive registers of diabetic patients have been compiled. Data from these registers were matched to WPHC data to identify possible participation bias. In the 11 communities in which both the diabetes management audits and the WPHC were conducted, 172 of 362 (47.3%) patients with diabetes attended the WPHC, which is similar to the overall community participation (49%).

In the 362 individuals studied, WPHC participants and nonparticipants were similar in age [mean (SD) 52.7 (13.4) in participants vs. 51.6 (14.6) in nonparticipants, $P = 0.466$], sex (63% women in participants vs. 59% women in nonparticipants, $P = 0.392$), and BMI [mean (SD) 33.8 (6.0) in participants vs. 32.2 (5.4) in nonparticipants, $P = 0.054$]. A total of 53% of participants with diabetes and 57% of nonparticipants with diabetes had a comorbidity ($P = 0.529$). The participant and nonparticipant diabetic patient groups both had a median duration of diagnosed diabetes of 5 years ($P = 0.594$).

A total of 28% of nonparticipants with diabetes had been admitted to the hospital at least once in the 12 months before the audit, compared with 15% of participants with diabetes ($P = 0.005$).

CONCLUSIONS — In summary, we found that Australian indigenous people in remote north Queensland communities who know they have diabetes have fruit consumption and exercise habits similar to other indigenous persons in those communities. Those who know they have diabetes are more likely to abstain from tobacco smoking and alcohol consumption, but diabetic drinkers consumed alcohol at harmful and hazardous levels similar to indigenous nondiabetic drinkers.

Our results for exercise and alcohol

consumption are similar to studies in other populations (4,28), indicating that the problem of risk behaviors in individuals with diabetes is widespread. The result for tobacco consumption contradicts other studies, in which persons with and without diabetes were reported to have similar prevalence of smoking (28). There are few reported studies of association between fruit consumption and diabetes.

Smoking rates among diabetic indigenous people remain two to three times those recorded in a national study (21) in which the participants were predominantly nonindigenous.

Because of the relatively low participation, we explored possible selection bias among known diabetic patients. It is possible that those with more or less healthy behavior did not participate because the survey was labeled a "well persons" health check. The data from the comparison of participating and nonparticipating diabetic patients suggest a participation bias in the WPHC in favor of healthier individuals with diabetes. This suggests that diabetic participants may be healthier and, therefore, may have more favorable health behaviors than diabetic nonparticipants. If these persons had participated in the study, the health behavior differences between participants with and without self-reported diabetes found in this study may have been even less significant.

Given that diabetes-associated mortality in areas of Queensland with high indigenous populations has been reported to be 10 times that in Queensland overall (14), there is a compelling need for effective interventions to achieve further smoking reduction in indigenous individuals with diabetes.

Moderate consumption of alcohol has been reported as protective against coronary heart disease mortality in patients with diabetes (29,30). However, most studies examining this association are performed in populations in which the cultural aspects of alcohol consumption are very different from those experienced by the Australian indigenous population. Very few persons who consume alcohol in these populations do so at moderate levels (12,13).

This study suggests that the behavioral changes needed for optimal self-management of diabetes are not being undertaken by remote indigenous Australians. This contributes to the large excess of mortality and morbidity experienced by this population. Further research into the effectiveness of behavior modification interventions is required to determine what interventions are efficacious and the extent to which these interventions are being applied.

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