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The Effect of Adverse Housing and Neighborhood Conditions on the Development of Diabetes Mellitus among Middle-aged African Americans

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Abstract

The authors examined the associations of observed neighborhood (block face) and housing conditions with the incidence of diabetes by using data from 644 subjects in the African-American Health Study (St. Louis area, Missouri). They also investigated five mediating pathways (health behavior, psychosocial, health status, access to medical care, and sociodemographic characteristics) if significant associations were identified. The external appearance of the block the subjects lived on and housing conditions were rated as excellent, good, fair, or poor. Subjects reported about neighborhood desirability. Self-reported diabetes was obtained at baseline and 3 years later. Of 644 subjects without self-reported diabetes, 10.3% reported having diabetes at the 3-year follow-up. Every housing condition rated as fair-poor was associated with an increased risk

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of diabetes, with odds ratios ranging from 2.53 (95% confidence interval: 1.47, 4.34 for physical condition inside the building) to 1.78 (95% confidence interval: 1.03, 3.07 for cleanliness inside the building) in unadjusted analyses. No association was found between any of the block face conditions or perceived neighborhood conditions and incident diabetes. The odds ratios for the five housing conditions were unaffected when adjusted for the mediating pathways. Poor housing conditions appear to be an independent contributor to the risk of incident diabetes in urban, middle-aged African Americans.

Keywords

African Americans; aging; diabetes mellitus; housing; questionnaires; residence characteristics

Diabetes mellitus is now approaching epidemic proportions (1). In the United States, the prevalence and incidence of diabetes increased dramatically during the past two decades (1) such that diabetes now affects about 20.8 million people or 7 percent of the population (2). The number of individuals with diagnosed diabetes is estimated to triple by the year 2050 (3).

African Americans are more likely than Whites to develop diabetes (4). Estimates show that 3.2 million African Americans currently have diabetes (5). The number of African Americans with diabetes is projected to triple by the year 2050, but the number is estimated to only double among Whites (3).

While the pathogenesis of diabetes is complex, a number of factors have been identified that increase the risk of the disease. In addition to African-American race, they include increased body mass index, age 45 years or older, physical inactivity, poor nutrition, hypertension, smoking, stress, and alcohol use, among others (1, 4). Genetic factors also play a role, but nongenetic risk factors appear to be the primary culprits (6). Among these, the role of the physical environment is often cited but usually in the context of social and behavioral factors, such as the promotion of and access to high-calorie foods and low physical activity levels (7–9). To our knowledge, the role of neighborhood and housing conditions and their relation to the development of diabetes has not been examined.

There are several potential mediating mechanisms through which adverse conditions of neighborhoods and housing may promote the development of diabetes. First, they may increase the risk of diabetes through adoption and maintenance of behaviors such as lack of participation in physical activity (10), greater use of tobacco (11), alcohol consumption (12), and poor nutrition (13–18). These behaviors are typically more prevalent among persons residing in areas affected by adverse neighborhood and housing conditions (19). Second, psychosocial factors such as depression, increased stress, lower social support, and poor mental health status may also mediate the association since they are associated with the risk of developing diabetes (20–24) and also with neighborhood and housing conditions (25, 26). Third, adverse neighborhood and housing conditions may affect the development of diabetes through their influence on the development of other health conditions of residents. These include obesity, hypertension, and other comorbid conditions (10, 20). Fourth, environmental conditions, such as dioxin (27, 28), lead (29), and polychlorinated biphenyl

(30) exposure, may also play a role in the association of adverse neighborhood and housing conditions with development of diabetes.

While many of the above-mentioned factors may increase the risk of diabetes, if adverse neighborhood and housing conditions are associated with diabetes incidence, it is unclear whether these factors mediate that association. In addition, access to and contact with the medical system may increase the likelihood of detecting diabetes, particularly in the most obese individuals (31). Moreover, residents affected by adverse neighborhood and housing conditions are likely to be different in terms of their sociodemographic characteristics (e.g., age, income) from those residing under better conditions (32, 33), and these differences may convey increased vulnerability to diabetes.

Therefore, we examined the association of adverse neighborhood (block face) and housing conditions with incidence of diabetes. We also examined the extent to which health behavior, access to medical care, psychosocial factors, health status, and sociodemographic characteristics accounted for any observed associations.

MATERIALS AND METHODS

Baseline sample

The sampling design of the African-American Health Study has been described elsewhere (34). Briefly, the African-American Health Study is a population-based cohort study of 998 African Americans. All subjects lived in either a poor, inner-city area (St. Louis, Missouri) or less impoverished and more heterogeneous suburbs just northwest of the City of St. Louis. Sampling proportions were set to recruit approximately equal numbers of subjects from both areas (sampling strata), which resulted in higher probabilities of selection in the inner city because it had fewer eligible subjects. Sampling involved random selection of first-area street segments within block groups and then housing units within each selected street segment. Professional interviewers (two thirds of whom were African American) with extensive project-specific training contacted households in person. Within each noninstitutional housing unit, interviewers screened for eligibility criteria, which were self-reported Black or African-American race and birth date from January 1936 through December 1950. If the household contained two or more eligible persons, one of them was selected by using Kish tables (35).

As a result, we used weighted data in the analysis. The overall weight for each African-American Health Study subject was constructed by using three components representing 1) the probability of selection based on the proportion of area segments, housing units, and (when appropriate) number of eligible persons in the household; 2) sample nonresponse; and 3) a poststratification weight for population nonresponse or noncoverage based on the 2000 US Census. When these weights are applied, the African-American Health Study cohort represents the noninstitutionalized African-American population in the two areas as of the 2000 US Census.

Inclusion criteria also involved Mini-Mental State Examination scores of 16 or greater and willingness to sign informed consent. We used the inclusion score of 16 because previous studies showed that subjects were able to make vital decisions about their medical care and there was the potential for false-positive results when using the standard scores of 23/24 (36). All subjects received in-home, baseline evaluations that averaged 2.5 hours, which occurred between September 2000 and July 2001. The response rate was 76 percent (998/1,320).

Follow-up sample

In-home interviews were conducted 36 months after baseline assessments. Of the 998 persons who participated at baseline, 853 were successfully interviewed at follow-up. Since 51 persons had died between baseline and follow-up, the response rate for surviving subjects was 90.1 percent (853/947). In-home follow-up assessments took an average of 1.5 hours to complete. Attrition analysis through four waves and involving all major variables indicated that drop-out status was associated with diagnoses of cancer (adjusted odds ratio = 2.57) and heart disease (adjusted odds ratio = 0.48) only and better vision (adjusted odds ratio = 0.90 per point on a 13-point scale. Thus, no attrition bias during waves 1–4 is evident for any of the major variables involved in the current analysis.

Incident diabetes

Both the baseline and follow-up interviews asked respondents about the presence of diabetes: “Did a doctor ever tell you that you have diabetes, high blood sugar, ‘sugar,’ sugar in your urine, or ‘sweet blood’?” The possible responses were “yes,” “suspect or possible,” “no,” “don’t know,” or “refuse.” Test-retest reliability of this question in a subsample of African-American Health Study participants was very high ($\kappa = 0.94$) (37). We limited subjects in this study to those reporting “no” to this question at baseline. At follow-up, we defined incident diabetes as answering “yes” to the same question.

Adverse neighborhood and housing conditions

Neighborhood and housing conditions were based on interviewer observations at the block face of the location of study participants and on participants’ self-report of neighborhood desirability. Housing conditions also were observed by the interviewers at the home of the study participant.

The survey team “objectively” assessed the external appearance of the block face (neighborhood) where the respondent lived during the earlier process of household enumeration by using a previously published assessment tool (38). On a four-point scale (1 = excellent, 4 = poor), observers rated each of five characteristics: condition of houses, amount of noise (from traffic, industry, etc.), air quality, condition of the streets, and condition of the yards and sidewalks in front of homes where participants lived. Of all block faces, 84.8 percent were rated by two independent observers. The average of the scores of two raters was used in the analysis, when available. Kappa was very high, ranging from a low of 0.66 (condition of the streets) to a high of 0.84 (conditions of the yards and sidewalks) (39).

We also obtained a subjective measure of neighborhood conditions from respondents at baseline by using a four-item scale of the neighborhood as a place to live, general feelings about the neighborhood, attachment to the neighborhood, and neighborhood safety from crime (40). Participant responses were dichotomized for each condition. Questions were modified from the Behavioral Risk Factor Surveillance System and are similar to those from other studies (41).

Assessment of housing conditions was an observed five-item scale based on the interviewer's ratings at the baseline interview regarding the cleanliness inside the building, physical condition of the interior, condition of furnishings, condition of the exterior of the building, and a global rating (all rated as excellent, good, fair, or poor). In the analysis, each condition was dichotomized as either fair or poor versus good or excellent. The housing condition of 80 subjects was reassessed 5–45 days after the first assessment by the same assessors (42). Kappa showed moderate agreement for all five housing conditions (the condition of furnishings ($\kappa = 0.79$), cleanliness inside the building ($\kappa = 0.74$), condition of the exterior of the building ($\kappa = 0.74$), the global rating of the building ($\kappa = 0.71$), and physical condition of the interior ($\kappa = 0.68$)).

Potential mediating pathways

Pathways that may account for any observed association of adverse neighborhood and housing conditions with development of diabetes examined in this study consisted of health behavior factors, psychosocial factors, health status, access to medical care, and sociodemographic characteristics. First, health behavior factors consisted of a seasonally adjusted activities dimensions summary index on the Yale Physical Activity Scale (continuous variable) (43), smoking status, and risk of alcohol abuse (score of at least 2 on the CAGE alcohol screening instrument) (44). All were obtained at baseline, except for risk of alcohol abuse, which was assessed 1 year after baseline.

Second, psychosocial factors consisted of social support and depressive symptoms. Social support was measured by using five items (someone to confide in, get together with, help with daily chores, turn to for suggestions, and love and make you feel wanted; range: 5–25) from the Medical Outcomes Study social support instrument (45). The resulting scale score was recoded to contrast being in the lowest quintile versus all others. Depressive symptoms were measured by using the 11-item version of the Center for Epidemiologic Studies Depression scale ($\alpha = 0.836$) (46). A score of 9 or greater on the 11-item version is equivalent to 16 or greater on the 20-item scale (46) and was considered to indicate a high level of depressive symptoms.

Third, health status at baseline consisted of self-reported health, body mass index, hypertension, number of severe chronic conditions, presence of one or more lower-body functional limitations, number of medications used, and whether the subject had been hospitalized overnight in the year prior to baseline. Self-reported health was measured by the SF-36 Health Survey's self-rated health status question (Medical Outcomes Trust, Inc., Waltham, Massachusetts). Whether the respondent ever experienced any of nine severe chronic conditions (47) was based on self-report of physician diagnosis. The chronic conditions included asthma, chronic airway obstruction, heart failure, heart attack, angina, stroke, chronic kidney disease, arthritis, and cancer other than a minor skin cancer. The presence of one or more lower-body functional limitations at baseline was noted by using the Nagi physical performance scale (48, 49). Subjects were asked whether they had taken any medications, prescribed by a physician or not, in the past 2 weeks (34).

Fourth, access to medical care consisted of having health care insurance at the time of or during the 12 months prior to interview and not being able to see a physician because of cost during 12 months prior to baseline interview. Fifth, demographic baseline factors included age, gender, income categories, perceived income adequacy, educational attainment, marital status, employment status, length of time at the present address, home ownership, and sampling stratum.

Statistical analysis

We assessed the correlation between block face and housing conditions with the phi coefficient. We used logistic regression to determine the unadjusted risk of block face, housing, perceived neighborhood conditions, and each of the covariates on self-reported diabetes at follow-up. Next, we assessed the potential mediating effect of each of the five hypothesized pathways of the association of adverse block face, housing, and perceived neighborhood conditions with diabetes incidence by adding all variables constituting a potential pathway to the logistic model containing only neighborhood and housing conditions. This procedure was conducted for each of the pathways separately. Reduction in odds ratios for the adverse neighborhood and housing conditions relative to unadjusted analysis was evidence for mediation. The fit of the models was analyzed by calculation of Hosmer-Lemeshow goodness-of-fit statistics and Nagelkerke R^2.

We used the propensity score method to obtain adjusted estimates of the effect of neighborhood and housing conditions on development of diabetes (50, 51). Propensity score methods produce estimates that are more accurate than multivariable logistic regression estimates when there were seven or fewer events per confounder, as was the case in the present study (52). We included only those variables associated with diabetes development when calculating propensity scores (53). The propensity score was defined as the conditional probability of a person living under a certain neighborhood/housing condition given the covariates included. We then grouped the subjects into five strata representing quintiles of the propensity score. This method is usually adequate to remove more than 90 percent of the bias due to each of the covariates in a fully specified model (50).

We conducted a series of analyses to challenge the robustness of the findings. First, since mediators are required to be associated with both neighborhood/housing conditions and incident diabetes (54), we examined the mediational effects of only those variables that were associated with the risk of diabetes. Doing so also reduces the potential for collinear effects between variables as part of a pathway. Second, we expected that persons who resided longer in their neighborhood/home would have more exposure or opportunity to be affected by environmental conditions than persons who resided there for a shorter period of time. We determined whether the associations of neighborhood and housing conditions with incidence of diabetes were similar when limiting the analysis to persons who reported living at the same address for at least 5 years before the baseline interview and when limiting the analysis to persons who resided at the same address during the 3-year study period.

Third, previous studies have shown that persons who owned their home were more likely to report better health status than those who rented (55). Therefore, we determined whether the associations of housing conditions with incidence of diabetes were similar when limiting the analysis to persons who owned their home.

Fourth, one of the issues in neighborhood-based observational research has been how to deal with selection bias (56). We used propensity scores in an attempt to address the fact that persons are not randomly assigned to housing or neighborhood conditions (57). The propensity score is defined as the conditional probability of a person living under a certain neighborhood/housing condition given all observed socio-demographic covariates. We then modeled the association of neighborhood/housing conditions for the entire sample, adjusting for propensity score group in an attempt to control for selection bias. Next, we determined whether the adjusted odds ratio for the neighborhood/housing condition changed when adding all variables as part of the five hypothesized pathways to a model containing only the propensity score group and the adverse neighborhood/housing condition. This procedure was again performed separately for each of the five potential mediating pathways.

RESULTS

Analysis excluded 255 participants (weighted; 221 un-weighted) who reported a diagnosis of diabetes at baseline and 98 participants (weighted; 110 unweighted) who did not complete the 3-year follow-up, leaving data on 644 persons (weighted) without diabetes available for analysis. Among the remaining 644 subjects, the correlations between observed adverse housing and block face conditions were modest, ranging from −0.01 to 0.23, suggesting substantial variability in housing conditions within block faces.

Table 1 describes the characteristics of the study population. Of subjects without diabetes at baseline, 65 (10.3 percent) reported having diabetes at the 3-year follow-up. In univariate analysis, persons who were older, had a body mass index of >25.0 kg/m^2, had ever been told they had hypertension, had more severe chronic conditions, and reported one or more lower-body functional limitations were more likely to develop incident diabetes at the 3-year follow-up.

Each of the individual fair or poor block face or housing conditions was present among 22–28 percent of respondents (table 2). Every housing condition was associated with an increased risk of diabetes in unadjusted analysis, with odds ratios ranging from 1.78 (cleanliness inside the building) to 2.53 (physical condition inside the building). Relative to unadjusted results, the odds ratios for the five housing conditions were not materially affected when examining the adjusted odds ratios of the five potential pathways by which adverse housing conditions were hypothesized to be associated with development of diabetes (table 3). The Hosmer-Lemeshow values ranged from 0.01 to 0.58, with 16 of 25 models having values greater than 0.05. The Nagelkerke R^2 ranged from 0.02 to 0.11. There was no association of any of the block face conditions or perceived neighborhood conditions with incident diabetes. Several sensitivity analyses were performed (table 4). However, none of these changes in model specification altered the results appreciably.

DISCUSSION

Our analyses show that adverse block face conditions and perceived neighborhood were not associated with development of self-reported diabetes. In contrast, adverse housing conditions were independently associated with the development of self-reported diabetes. Sensitivity analyses showed that the observed associations were robust with respect to residential mobility and home ownership. None of the hypothesized pathways attenuated our findings, suggesting that housing conditions may produce the observed effect by another untested pathway.

Housing conditions have shown strong, independent associations with health (58), including self-rated health (55). To our knowledge, our study is the first to examine the association of neighborhood and housing conditions with development of diabetes, particularly among African Americans who are at increased risk of developing the disease.

We were unable to demonstrate the mechanisms by which housing conditions were associated with an increased risk of diabetes. Alternative explanations need to be explored. Potential mediators of this association need to be associated with both adverse housing conditions and risk of diabetes.

Although we captured a surrogate for the energy balance between physical activity and diet in body mass index, we did not have information about consumption of specific nutrients that increase the risk of diabetes, including consumption of a Western diet (higher intakes of red and processed meats, high-calorie and high-fat foods, and refined grains) (15, 16), eating few whole-grain foods and legumes (18), and low consumption of magnesium (13, 59). Even though food stores in poor neighborhoods are less likely to sell healthier items such as low-fat and high-fiber products (60), it is unclear whether consumption of specific nutrients can mediate the association between housing conditions and development of diabetes.

Another potential pathway that we were unable to examine in the current study relates to the presence of contaminants in the physical environment. Dioxin may increase the risk of diabetes (27, 28). Since nearly all human dioxin exposure comes from food sources and adverse neighborhood conditions are associated with poorer nutrition (7), it is more likely that dioxin levels are associated with neighborhood conditions than with housing conditions. Therefore, dioxin levels are unlikely to account for our findings.

Additional risk factors for diabetes not examined in our study are family history of diabetes (4), high density lipoprotein cholesterol (4), and stress (24). It is unclear how these risk factors could be associated with adverse housing conditions but not with adverse block face conditions and therefore explain our findings.

Study limitations include analysis of a single race living in a single city and of a restricted age range, all of which may limit generalizability. However, focusing on a single race allows the disentanglement of race and income. It also could be argued that persons who initially have health problems subsequently live in neighborhoods and housing situations associated with adverse conditions because they lack the money and the physical ability to improve their living conditions. However, associations in our study remained when limiting the population to those who did not move during the study period and when adjusting for income and for activity levels, thereby providing little evidence for reverse causation.

We used self-reported diabetes to classify cases of diabetes. Screening for blood glucose was not done; thus, some cases of incident diabetes probably were missed. Despite the very high test-retest reliability of self-reported diabetes in the African-American Health Study data (37), misclassification of diabetes status may still be present, which could lead to biased results. As many as 30 percent of people who meet criteria for diabetes do not know that they have the disease (61, 62). However, unless misclassification of self-reported diabetes depended on housing condition, our results would likely be a conservative estimate of the association between housing conditions and diabetes.

The proper geographic scale and how best to measure the neighborhood characteristics that are important are both unclear, but our study suggests that a reasonable block face measure that has been shown to be associated with other health outcomes (38, 49) was not associated with incident diabetes. In summary, urban, middle-aged African Americans who lived under adverse housing conditions were more likely to develop diabetes 3 years later. The findings appear robust with respect to several sensitivity analyses. None of the available risk factors for diabetes was able to explain the observed association.

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TABLE 1

Selected characteristics at baseline and unadjusted risk of developing self-reported diabetes for subjects in the African-American Health Study (weighted *n* = 644), St. Louis area, Missouri, 2000–2004

	Prevalence at baseline*	Odds ratio	95% confidence interval
Demographics			
Age (per year)	56.2 (4.3)	1.07	1.01, 1.14
Gender (women vs. men)	55.9	1.18	0.70, 2.01
Household income ($)			
<20,000 vs. ≥50,000	24.9	0.96	0.53, 1.84
20,000–<50,000 vs. ≥50,000	46.4	0.98	0.53, 1.83
Perceived income adequacy			
Not enough to get by vs. comfortable income	14.8	0.58	0.33, 1.03
Just enough to get by vs. comfortable income	37.0	0.65	0.30, 1.40
Highest level of education (<12 years vs. ≥12 years)	21.9	0.99	0.53, 1.87
Marital status (married vs. not married)	51.6	0.94	0.56, 1.58
Employment (employed vs. unemployed)	62.5	0.90	0.53, 1.55
Length of time at present address (≥5 years vs. <5 years)	73.3	1.53	0.82, 2.85
Own vs. rent home	68.6	1.22	0.66, 2.27
Area (suburban vs. inner city)	78.2	0.76	0.41, 1.38
Access to medical care			
Health insurance at time of or during the 12 months before interview (no vs. yes)	17.7	1.25	0.64, 2.42
Did not receive medical care because of cost (yes vs. no)	8.0	0.85	0.30, 2.38
Psychosocial			
Social support (lowest quintile)	21.0	1.01	0.53, 1.92
CES-D† score ≥9 of 11 (yes vs. no)	18.9	1.29	0.69, 2.41
Health behavior			
Physical activity: YPAS†	37.1 (21.3)	1.00	0.99, 1.01
Smoking status			
Current vs. never	31.1	1.34	0.72, 2.48
Former vs. never	35.6	1.42	0.74, 2.73
Risk of alcohol abuse (CAGE† score ≥2) (yes vs. no)	8.0	0.71	0.35, 1.45
Health status			
Body mass index (kg/m^2)			
25.0–29.9 vs. <25.0	35.6	4.53	1.39, 14.77
≥30.0 vs. <25.0	41.4	8.19	2.56, 26.17
Hypertension (yes vs. no)	56.3	1.73	0.99, 3.03
Self-perceived health status (fair/poor vs. good/very good/excellent)	28.6	1.37	0.79, 2.39
No. of severe chronic conditions (per condition)	0.8 (0.9)	1.30	1.02, 1.66
One lower-body functional limitation (yes vs. no)	46.0	1.72	1.02, 2.93
Having been hospitalized (yes vs. no)	13.6	0.84	0.38, 1.86
No. of medications (per medication)	3.7 (3.3)	1.01	0.94, 1.10

[*] Values are expressed as mean (standard deviation) or percent.

[†] CES-D, Center for Epidemiologic Studies Depression (Scale); YPAS, Yale Physical Activity Scale (seasonally adjusted summary score); CAGE, CAGE alcoholism screening instrument (44).

TABLE 2

Neighborhood and housing conditions at baseline and unadjusted risk of diabetes for subjects without diabetes at baseline in the African-American Health Study (weighted *n* = 644), St. Louis area, Missouri, 2000–2004

	Presence at baseline (%)	Odds ratio	95% confidence interval
"Objective" block face (neighborhood) conditions of fair-poor quality			
Housing conditions	28.4	1.11	0.63, 1.95
Noise level from traffic, industry, etc.	23.3	0.90	0.48, 1.67
Air quality	22.1	1.20	0.66, 2.18
Street and road quality	22.1	1.03	0.56, 1.91
Yard and sidewalk quality	26.9	1.05	0.59, 1.88
"Objective" housing conditions of fair-poor quality			
Cleanliness inside the building	24.9	1.78	1.03, 3.07
Physical condition inside the building	21.6	2.53	1.47, 4.34
Condition of furnishings inside the building	25.6	2.20	1.29, 3.75
Condition of the outside of the building	23.9	2.39	1.40, 4.08
Overall condition of the dwelling	23.3	1.78	1.02, 3.09
Perceived neighborhood conditions			
Fair-poor rating of the neighborhood	26.6	1.04	0.58, 1.84
Mixed or terrible feeling about the neighborhood	22.1	1.10	0.60, 2.02
Undecided or not at all attached to the neighborhood	41.1	0.68	0.40, 1.18
Slightly unsafe—not at all safe in the neighborhood	40.6	0.61	0.35, 1.06

TABLE 3

Odds ratios (95% confidence intervals) for the association of fair-poor housing conditions with risk of diabetes at the 3-year follow-up compared with good-excellent housing conditions obtained by examining five potential pathways for subjects without diabetes at baseline in the African-American Health Study, St. Louis area, Missouri, 2000–2004

Housing condition (fair-poor)	Variables adjusted for in the model											
	Health behavior*		Psychosocial†		Health status‡		Access to medical care§		Sociodemographic¶		Propensity score#	
	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval
Cleanliness inside the building	1.96	1.10, 3.50	1.75	0.99, 3.09	2.03	1.11, 3.69	1.71	0.98, 3.00	2.08	1.13, 3.85	1.89	1.06, 3.37
Physical condition inside the building	2.65	1.51, 4.66	2.55	1.45, 4.48	2.56	1.42, 4.60	2.46	1.40, 4.31	3.00	1.63, 5.52	2.35	1.33, 4.14
Condition of the furnishings inside the building	2.37	1.36, 4.12	2.19	1.26, 3.80	2.41	1.35, 4.28	2.15	1.24, 3.71	2.49	1.38, 4.47	2.27	1.27, 3.88
Condition on the outside of the building	2.47	1.41, 4.33	2.33	1.33, 4.07	2.34	1.31, 4.18	2.25	1.30, 3.92	2.74	1.48, 5.07	2.22	1.26, 3.91
Overall condition of the dwelling	1.85	1.04, 3.30	1.76	0.99, 3.14	1.78	0.97, 3.24	1.69	0.95, 3.01	2.12	1.12, 4.02	1.63	0.91, 2.92

* Physical activity, smoking, risk of alcohol abuse.

† Social support, depression.

‡ Self-rated health, number of severe chronic conditions, at least one lower-body functional limitation, body mass index, hypertension.

§ Health insurance, hospitalization, did not receive medical care because of cost.

¶ Age, sex, income, perceived income adequacy, education, marital status, employment, length of time at present address, own the home, area.

Age, body mass index, hypertension, self-rated health, number of severe chronic conditions, lower-body functional limitations.

TABLE 4

Sensitivity analysis of the unadjusted odds ratios (95% confidence intervals) for the association of housing conditions with incident diabetes for subjects without diabetes at baseline in the African-American Health Study, St. Louis area, Missouri, 2000–2004

Housing condition	Among persons who did not move during the 3-year study period		Among persons who had lived at the same address for more than 5 years before their baseline interview		Among persons who owned their home at baseline	
	Odds ratio	**95% confidence interval**	**Odds ratio**	**95% confidence interval**	**Odds ratio**	**95% confidence interval**
Cleanliness inside the building	2.49	1.26, 4.93	2.73	1.41, 5.23	3.12	1.56, 6.25
Physical condition inside the building	3.19	1.61, 6.32	4.03	2.12, 7.68	4.81	2.45, 9.44
Condition of the furnishings inside the building	2.80	1.48, 5.32	3.20	1.70, 6.04	3.32	1.68, 6.58
Condition on the outside of the building	2.79	1.45, 5.36	3.26	1.72, 6.20	3.39	1.73, 6.65
Overall condition of the dwelling	2.18	1.11, 4.27	3.11	1.63, 5.94	3.20	1.63, 6.30