Symptoms of Diabetes and Their Association With the Risk and Presence of Diabetes

Findings from the Study to Help Improve Early evaluation and management of risk factors Leading to Diabetes (SHIELD)

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OBJECTIVE — The American Diabetes Association (ADA) lists seven symptoms of diabetes; however, it is not known how specific these symptoms are for initial diagnosis of type 2 diabetes. The Study to Help Improve Early evaluation and management of risk factors Leading to Diabetes (SHIELD) examined prevalence of ADA symptoms and their association with diabetes diagnosis.

RESEARCH DESIGN AND METHODS — SHIELD is a 5-year observational study of individuals with or at risk for diabetes diagnosis. Following an initial screening phase, follow-up questionnaires were mailed to a stratified random sample of individuals ($n = 22{,}001$) with type 1 or type 2 diabetes or at high (three to five risk factors) or low (zero to two risk factors) risk for diabetes. Individuals reported whether they experienced each ADA symptom, as well as symptoms unrelated to diabetes.

RESULTS — A total of 15,794 questionnaires were returned (response rate 71.8%). All ADA symptoms were reported more frequently in type 2 diabetes than in low- and high-risk groups ($P < 0.0001$ for each). Multivariable logistic regression analyses found that each ADA symptom other than irritability was significantly associated with type 2 diabetes, as was erectile/sexual dysfunction. However, 48% of type 1 diabetic and 44% of type 2 diabetic respondents reported no ADA symptom in the previous year.

CONCLUSIONS — Occurrence of ADA symptoms alone may not adequately identify those who should be evaluated for type 2 diabetes. Longitudinal data from SHIELD will evaluate whether combinations of symptoms or addition of other symptoms can better identify individuals for evaluation.

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By 2005 estimates, 7.0% of the U.S. population (20.8 million people) have diabetes; nearly one-third of these are undiagnosed (1,2). Accurate widely available tests make for easy diagnosis of diabetes. The challenge lies in testing the right people in a timely fashion. It is not uncommon for patients with type 2 diabetes to remain undiagnosed for many years, often until early complications of the disease appear (3). In those at high risk for diabetes, several studies have demonstrated the benefits of interventions to prevent or delay onset of the disease (4–8).

Several groups, including the American Diabetes Association (ADA), have led efforts to increase awareness of the need for early diagnosis and treatment to improve long-term outcomes associated with diabetes. One way to accomplish this has been by highlighting symptoms associated with diabetes in the hope that this will lead people experiencing those symptoms to seek medical attention. The ADA provides a list of seven symptoms of diabetes on their website (www.diabetes.org), as follows: frequent urination, excessive thirst, extreme hunger, unusual weight loss, increased fatigue, irritability, and blurry vision. The International Diabetes Federation lists these same symptoms (except for irritability), plus slow-healing wounds and recurrent infections, as "warning signs" of diabetes; however, they caution that their onset may be more gradual and less noticeable for type 2 compared with type 1 diabetes (9). The ADA recommends that an individual "see your doctor right away" if one or more of these seven symptoms are present. While these symptoms are often obvious in patients with type 1 diabetes, it is not known how specific they are, singly or in groups, for initial diagnosis of type 2 diabetes. Increased fatigue is a general, less informative symptom than frequent urination or blurry vision. Evidence to support these symptoms, or other patient characteristics, as highly associated with a diagnosis of type 2 diabetes would be valuable in pursuing the ultimate goal of early diagnosis and treatment.

The Study to Help Improve Early evaluation and management of risk factors Leading to Diabetes (SHIELD) is a 5-year longitudinal observational study of individuals with or at risk for a diagnosis of diabetes. Through self-reported questionnaires, this nationwide survey has identified individuals with type 1 or type 2 diabetes or selected risk factors for a

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*A complete listing of the SHIELD Study Group members can be found in the APPENDIX.
Abbreviations: ADA, American Diabetes Association; SHIELD, Study to Help Improve Early evaluation and management of risk factors Leading to Diabetes.
A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

diagnosis of diabetes. SHIELD provides a unique opportunity to report the prevalence of the ADA symptoms in various patient groups and the association of those symptoms with a diagnosis of diabetes. One goal of this study was to examine the usefulness of the ADA symptom checklist and its individual components in identifying individuals who require formal testing for diabetes.

RESEARCH DESIGN AND METHODS

— SHIELD has three phases totaling 5 years in duration: *1*) an initial screening phase to identify cases of interest in the general population; *2*) a baseline survey to follow up identified cases with questions about health status, health knowledge and attitudes, and current behaviors and treatments; and *3*) four additional annual surveys to follow disease progression in those with diagnosed diabetes and follow the rate of transition from at risk to a diagnosis of diabetes. The SHIELD survey methodology has been described in detail (10).

The screening survey was mailed on 1 April 2004 to a stratified random sample of 200,000 U.S. households, representative of the U.S. population for geographic residence, household size and income, and age of head of household, identified by the Taylor Nelson Sofres National Family Opinion panel. The screening survey consisted of 12 questions (anthropometry, history of cardiovascular events, and diagnosis of diabetes, pre-diabetes, metabolic syndrome, dyslipidemia, and hypertension) designed to identify individuals with diabetes and those with risk factors for future diagnosis of diabetes. The head of household completed the screening questionnaire for up to four adult (aged ≥18 years) household members. Screening data were postweighted to conform to U.S. census data for age, sex, and household size. A cell-weighting procedure was used to weight the screening data, resulting in 70 unique demographic cells defined by sex, age-group, and household size. Each cell was assigned a weight (ranging from 0.44 to 2.05); therefore, the total sample was very similar to the U.S. population, both weighted and unweighted. The proportion of respondents for SHIELD unweighted and weighted and the U.S. census was as follows: age 18–44 years, 39.8, 52.0, and 52.0%; women, 53.0, 51.8, and 51.9%; white, 87.2, 86.7, and 82.5%; income <$40,000, 39.8, 39.1, and 38.9%; household size of four or more members, 26.3, 32.8, and 32.8%, respectively. A response rate of 63.7% was obtained from 127,420 households (totaling 211,097 adults).

Based on the screening survey, respondents at risk for diabetes were identified through risk factors. Five risk factors were identified through epidemiological studies and expert opinion: *1*) abdominal obesity (waist circumference: men, ≥97 cm; women, ≥89 cm), *2*) BMI ≥28 kg/m^2, *3*) reported diagnosis of cholesterol problems of any type, *4*) reported diagnosis of high blood pressure/hypertension, and *5*) history of cardiovascular disease (i.e., heart disease/myocardial infarction, reported narrow or blocked arteries, stroke, coronary artery bypass graft surgery, angioplasty/stents to clear arteries). Stepwise logistic regression analyses, adjusted for age and race/ethnicity, verified that these five risk factors were independently and approximately equally predictive of diabetes diagnosis. Respondents with none, one, or two of the five risk factors were classified as low risk for diabetes diagnosis and respondents with three to five risk factors were classified as high risk.

The baseline survey was mailed in September and October 2004 to a representative sample of individuals, independently sampled (n = 22,001), who were identified in the screening survey as having type 1 diabetes, type 2 diabetes, or one of the six risk factor levels (range 0–5). Each respondent group was balanced to be representative of that U.S. population for age, sex, geographic region, household size, and income based on weighted screening data; then, a random sample from each group was selected and sent the baseline survey. The baseline survey consisted of 64 questions on health-related topics, including symptoms, comorbidities, family history, medical testing, health-related quality of life, diet, exercise, health insurance, physician visits, medications, and medication adherence. A response rate of 71.8% was obtained (n = 15,794). The current analysis focuses on data obtained from the baseline survey.

Individuals with type 1 or type 2 diabetes or high or low risk self-reported their experiences in the past month and past 12 months for each of the seven ADA symptoms, as well as for seven additional symptoms or conditions (erectile/sexual dysfunction; shortness of breath; chest pressure, discomfort, or pain; temporary disability; recovering from surgery; severe illness; and other health problems). Some of these additional symptoms were considered potentially diabetes related (e.g., erectile/sexual dysfunction), while others were hypothesized as unrelated (e.g., recovering from surgery).

Statistical analysis

Prevalence of each symptom was determined as the percent of respondents within each group reporting the symptom in the past 12 months. Comparisons across groups were made using χ^2 for pairwise comparisons. Comparisons were first made between type 1 and type 2 diabetes and between high risk and low risk, followed by between type 2 diabetes and high and low risk. Bonferroni adjustment was applied to adjust for multiple comparisons; thus, statistical significance for categorical variables was set a priori as $P < 0.002$. For continuous variables, ANOVA with post hoc Student-Newman-Keuls Tukey multiple comparisons test was used to test differences across groups. To determine whether ADA symptoms were independently associated with type 2 diabetes diagnosis, multivariate stepwise logistic regression model was constructed while adjusting for other key risk factors for diabetes. A diagnosis of type 2 diabetes was the dependent variable, and age-group, race/ethnicity, sex, BMI category, income, household size, geographic region, market size, comorbid conditions, ADA symptoms, and other symptoms were independent variables. Type 1 diabetic respondents were not included in this regression model.

Less than 12% of the baseline survey respondents were from the same household. The correlation between responses for individuals from the same household for the ADA symptoms was tested, and the correlation was minimal ($r = -0.028$ to 0.021) and not statistically significant except for frequent urination ($r = -0.028$).

RESULTS

— Totals of 3,937 type 2 diabetic, 371 type 1 diabetic, 5,485 high-risk, and 5,753 low-risk respondents completed the baseline survey and ADA symptoms questions.

Demographics

Across all groups, most respondents were female and white (Table 1). Respondents in the low-risk and type 1 diabetic groups were younger than those in the high-risk and type 2 diabetic groups, respectively ($P < 0.0001$). Those in the high-risk and

Table 1—*Sociodemographic characteristics of respondents to the SHIELD baseline survey*

	Low risk (0–2 risk factors)	High risk (3–5 risk factors)	Type 1 diabetes	Type 2 diabetes
n	5,753	5,485	371	3,937
Sex				
Male	34.5*	43.3†	38.4	42.1
Female	65.5	56.7	61.6	57.9
Age (years)				
18–24	7.6*	0.6*†	9.4	0.1‡
25–34	17.3	5.3	25.3	2.6
35–44	23.0	11.5	28.3	9.9
45–54	21.7	20.7	22.9	20.9
55–64	13.7	24.4	11.9	28.3
65–74	9.2	20.3	1.6	21.8
≥75	7.5	17.2	0.5	16.5
Race/ethnicity				
White	90.8*	90.9*†	92.8	87.6‡
Black	5.7	7.2	2.8	9.9
Other/NA	3.5	1.8	4.4	2.5
Spanish/Hispanic				
Hispanic	3.1	2.0	3.5	2.9
Non-Hispanic	92.5	92.2	93.8	91.4
NA	4.3	5.8	2.7	5.7
BMI category (kg/m^2)				
Underweight (<18.5)	2.7*	0.2*†	1.6	0.45‡
Normal weight (18.5–24.99)	39.7	4.6	43.0	10.6
Overweight (25–29.99)	33.6	27.3	32.1	26.7
Obese (≥30)	24.1	67.9	23.3	62.3
Annual household income ($)				
<22,500	17.9*	25.5*†	21.8	30.1‡
22,500–39,999	18.7	21.3	19.9	22.6
40,000–59,999	19.0	17.9	20.2	16.6
60,000–89,999	21.1	17.5	17.0	15.7
≥90,000	23.3	17.9	21.0	15.0
Household size				
1 member	13.9*	23.0†	18.6	22.8‡
2 members	35.5	44.7	34.5	45.0
3 members	19.3	14.6	20.5	15.5
4 members	17.8	10.3	15.9	9.4
≥5 members	13.5	7.3	10.5	7.2

Data are percent unless otherwise indicated. *$P < 0.0001$, type 2 diabetes vs. high or low risk; †$P < 0.0001$, high vs. low risk; ‡$P < 0.0001$, type 1 vs. type 2 diabetes. NA, not available.

type 2 diabetic groups were more likely to be African American, to be obese, to have lower income, and to live in smaller households than those in the low-risk and type 1 diabetic groups, respectively ($P < 0.0001$) (Table 1).

Occurrence of symptoms

Of the seven ADA symptoms, those reported most frequently for the previous 12 months by respondents with type 1 and type 2 diabetes were frequent urination (27.0 and 33.8%, respectively) and increased fatigue (26.4 and 27.3%, respectively) (Table 2). Excessive thirst, irritability, and blurry vision ranged from 17.8 to 23.2% across both types of diabetes. Prevalence of symptoms was similar in the type 1 and type 2 diabetic groups ($P > 0.002$). The proportions with the non-ADA symptoms were not significantly different between type 1 and type 2 diabetic respondents; however, erectile/sexual dysfunction was reported more frequently by those with type 2 diabetes (18.3 vs. 11.1%, $P = 0.001$).

The ADA symptoms reported most in the high-risk and low-risk groups during the past 12 months were the same as for the diabetic groups: frequent urination (24.2 and 13.2%, respectively) and increased fatigue (23.1 and 14.2%, respectively) (Table 2). All symptoms were reported significantly more frequently in the high-risk group than in the low-risk group ($P < 0.001$), except irritability (13.9% in high-risk vs. 12.3% in low-risk, $P = 0.02$), unusual weight loss (1.9 vs. 2.4%, $P = 0.09$), and severe illness (1.4 vs. 1.0%, $P = 0.06$).

All of the ADA symptoms were reported more frequently in the type 2 diabetic group than in the low-risk ($P < 0.0001$) and high-risk ($P < 0.0001$) groups. Other non-ADA symptoms, such as erectile dysfunction, shortness of breath, and chest pain, had higher prevalence in the diabetes and high-risk groups than in the low-risk group, which may be attributed to their relationship to diabetes or cardiovascular disease and obesity (Table 2).

Respondents with the highest BMI (obese) were more likely to report excessive thirst, excessive hunger, irritability, and fatigue but least likely to report sudden weight loss than respondents with lower BMI (normal or overweight) ($P < 0.05$). There was no difference in the reporting of frequent urination by BMI level ($P > 0.44$).

Number of symptoms

More than half (56%) of type 2 diabetic respondents reported experiencing one or more of the ADA symptoms in the previous 12 months (Table 2), and therefore, 44% of those with type 2 diabetes had none of the seven ADA symptoms. The frequency at which symptoms were reported was similar for type 1 (52%) and type 2 (56%) diabetic respondents. The low-risk group had 31% reporting one or more symptoms and 69% reporting no symptoms. In the high-risk group, 45% reported one or more symptoms and 55% reported none.

Logistic regression

Sex, geographic region, and market size were not significantly associated with type 2 diabetes in the stepwise logistic regression model (Table 3). Increasing age, black or Hispanic race/ethnicity, higher BMI, lower household income levels, and household size were associated with a higher likelihood of having type 2 diabetes. Other conditions associated with type 2 diabetes included sleep apnea or other sleep problems, asthma, circulation problems, and kidney problems. Each of the ADA symptoms other than irritability was significantly associated with type 2 diabetes. Also, erectile/sexual dysfunction,

Table 2—*Specific symptoms and number of ADA symptoms experienced in previous 12 months, by risk group*

	Low risk (0–2 risk factors)	High risk (3–5 risk factors)	Type 1 diabetes	Type 2 diabetes
n	5,753	5,485	371	3,937
ADA symptoms				
Frequent urination	13.2*	24.2*†	27.0	33.8
Increased fatigue	14.2*	23.1*†	26.4	27.3
Irritability	12.3*	13.9*	22.6	17.8
Excessive thirst	5.8*	8.8*†	23.2	20.0
Blurry vision	6.3*	10.4*†	21.6	18.2
Extreme hunger	3.3*	4.5*†	11.1	9.5
Unusual weight loss	2.4*	1.9*	4.9	4.4
Other symptoms				
Erectile/sexual dysfunction	5.1*	13.8*†	11.1	18.3‡
Shortness of breath	8.4*	20.3†	16.4	20.3
Chest pressure, discomfort, or pain	6.6*	14.1†	11.9	12.4
Temporary disability	4.5*	6.0†	10.0	6.3
Recovering from surgery	4.7*	8.6†	11.3	8.4
Severe illness	1.0	1.4	2.2	1.5
Other health problems	11.6*	17.2*†	14.0	13.9
ADA symptoms reported (*n*)				
0	69.4	54.7	47.7	44.3
1	15.8	22.2	19.1	21.4
2	8.0	12.2	10.8	14.2
3	3.6	6.2	7.5	8.6
4	1.6	2.8	6.5	5.2
5	1.0	1.3	3.5	3.7
6	0.4	0.5	4.0	2.2
7	0.2	0.1	0.8	0.4
Means ± SD	0.58 ± 1.09	0.87 ± 1.24†	1.37 ± 1.79	1.31 ± 1.61

Data are percent unless otherwise indicated. *$P < 0.0001$, type 2 diabetes vs. high or low risk; †$P < 0.001$, high vs. low risk; ‡$P < 0.001$, type 1 vs. type 2 diabetes.

shortness of breath, chest discomfort, and other health problems were significantly associated with type 2 diabetes. People reporting excessive thirst in the previous 12 months were 2.5 times more likely to have type 2 diabetes. Odds ratios for the other symptoms ranged from 1.19 to 1.68. Several conditions and symptoms were associated with lower likelihood of type 2 diabetes. Those who reported allergies, anxiety, chronic fatigue syndrome, shortness of breath, chest pressure or discomfort, or other health problems were less likely to have type 2 diabetes.

CONCLUSIONS — The SHIELD findings indicate that the most commonly reported symptoms in any of the patient groups were frequent urination and increased fatigue. It is noteworthy that ~70% of patients did not report having each of these symptoms thought to be highly characteristic of diabetes. The symptoms are those of significant hyperglycemia, which should mainly occur in a person with undiagnosed or poorly controlled diabetes. If one has diabetes that is well controlled, these symptoms should not be reported. This finding suggests either that most diagnosed diabetic patients have little symptomatology (due to good glycemic control) or that this list of symptoms lacks specificity for the disease. As early diagnosis of diabetes is a central goal, it will be important to determine whether this large pool of diagnosed but largely asymptomatic respondents in SHIELD reflects earlier diagnosis and adequate symptom control through appropriate treatment or simply attention to the wrong symptoms.

The diagnostic usefulness of the ADA symptoms may be limited by their occurrence in a restricted window of time between asymptomatic disease onset and treatment-induced symptom control. A recently published Danish study of newly diagnosed type 2 diabetic patients found that five of the seven ADA symptoms (frequent urination, abnormal thirst, weight loss, fatigue, and visual disturbances), plus symptoms of genital itching, stomatitis, confusion, and (in men) balanitis, were associated with glycemic level, irrespective of age, sex, BMI, blood pressure, antihypertensive treatment, or complications (11).

Unlike that study, which was confined to newly diagnosed (and likely symptomatic) type 2 diabetic patients, SHIELD sampled all individuals with a previous diagnosis of diabetes. Of respondents with diabetes, more than half (56%) reported one or more ADA symptoms compared with 45% of those at high risk (with three to five risk factors) and 31% of those at low risk (with zero to two risk factors). Of perhaps greater significance, 44% of those with type 2 diabetes and 55% of those at high risk reported no symptoms. From these data, one might conclude that 30% of those at low risk would be encouraged to visit their doctor immediately and be tested for diabetes, likely with low yield, and 55% of those at high risk would be neither encouraged nor tested. This indicates that using one or more of the ADA symptoms alone as the impetus to see one's doctor is not likely to discriminate between those with undiagnosed diabetes and those at risk (high or low). Many of those with symptoms but no diagnosis may continue to be undiagnosed. In addition, patients with type 2 diabetes commonly remain undiagnosed until complications appear, suggesting that the disease may be asymptomatic during the initial years (9).

The strategy of achieving earlier diagnosis of diabetes by educating patients about the typical symptoms has other limitations. Many people with risk factors for diabetes will never research diabetes online and thereby learn the warning symptoms or refer themselves to a doctor to seek and receive testing even if they are symptomatic. A recent statewide telephone survey found that a family history of diabetes was the only identified risk factor that generated concern and prompted consultation and testing for diabetes (12). This survey (Oregon Diabetes Prevention and Control Program) was performed to study beliefs and behaviors of adults at risk for diabetes and found that even among respondents at highest risk, only one-third expressed concern about developing diabetes, one-fifth discussed their risk with a health professional during the previous year, and less

Table 3—*Multivariable logistic regression analysis of symptoms associated with type 2 diabetes*

Variable*	Odds ratio	95% CI		*P* value
		Lower	Upper	
Age-group (years)				0.000
18–24	0.03	0.01	0.11	0.000
24–34	0.35	0.27	0.45	0.000
35–44 (reference)	1.00			
45–54	1.77	1.52	2.05	0.000
55–64	2.78	2.39	3.23	0.000
65–74	2.86	2.43	3.36	0.000
≥75	2.66	2.23	3.17	0.000
Race/ethnicity				0.000
White (reference)	1.00			
Black	1.46	1.26	1.69	0.000
Other/NA	1.08	0.82	1.42	0.599
Spanish/Hispanic				0.036
Non-Hispanic (reference)	1.00			
Spanish/Hispanic	1.45	1.09	1.93	0.012
NA	0.95	0.78	1.16	0.623
BMI category				0.000
Underweight	0.75	0.43	1.30	0.308
Normal	1.00			
Overweight	1.59	1.39	1.82	0.000
Obese	2.38	2.10	2.71	0.000
Income level ($)				0.000
<22,500	1.55	1.36	1.77	0.000
22,500–39,999	1.39	1.22	1.59	0.000
40,000–59,999	1.24	1.08	1.43	0.002
60,000–89,999	1.12	0.97	1.28	0.114
≥90,000	1.00			
Household size				0.045
1 member (reference)	1.00			
2 members	1.12	1.00	1.25	0.049
3 members	1.20	1.04	1.38	0.011
4 members	1.15	0.98	1.36	0.089
≥5 members	0.99	0.82	1.18	0.883
Other health conditions				
Allergies	0.86	0.78	0.94	0.001
Anxiety	0.85	0.75	0.96	0.011
Sleep apnea/problems	1.18	1.05	1.32	0.006
Asthma	1.15	1.02	1.30	0.023
Chronic fatigue syndrome	0.74	0.60	0.92	0.006
Circulation problems	1.39	1.24	1.56	0.000
Kidney problems	1.28	1.11	1.49	0.001
ADA symptoms				
Frequent urination	1.28	1.16	1.42	0.000
Excessive thirst	2.48	2.15	2.87	0.000
Extreme hunger	1.55	1.29	1.87	0.000
Unusual weight loss	1.68	1.33	2.13	0.000
Increased fatigue	1.19	1.07	1.33	0.002
Blurry vision	1.58	1.39	1.80	0.000
Other symptoms				
Erectile/sexual dysfunction	1.46	1.30	1.64	0.000
Shortness of breath	0.78	0.69	0.88	0.000
Chest pressure/discomfort	0.68	0.58	0.78	0.000
Other health problems	0.66	0.58	0.74	0.000

*Sex, geographic region, and market size were not significantly associated with type 2 diabetes. NA, not available.

than half reported having been tested for diabetes during this same year.

It is critical, therefore, for physicians to identify people at risk for diabetes during routine visits and test appropriately using the fasting plasma glucose value and/or oral glucose tolerance test. The ADA now recommends that screening be considered in everyone aged ≥45 years and particularly overweight or obese individuals. Testing can be done using either the fasting plasma glucose or oral glucose tolerance test; if negative, retesting should be done at 3-year intervals. Overweight or obesity (along with other risk factors) extends these recommendations to younger people and suggests more frequent testing. Clearly, this is an ambitious goal, as current screening efforts are not capturing everyone with acknowledged risk factors. However, the study findings indicate that the symptoms checklist will not alert a large portion of at-risk individuals; thus, detection efforts may be better focused on routine testing of blood glucose in the physician's office.

Another dimension to this problem is the large segment of the population, skewed toward lower-income households, that is not receiving routine (annual) examinations, making screening for diabetes unlikely, even in high-risk individuals (13). Even those with diagnosed diabetes are not getting much-needed care. A meta-analysis covering studies from 1993 to 2003 found that despite availability of evidence-based guidelines, rates of preventive care for diabetes and its complications (glycemia testing, lipid testing, and eye, foot, and kidney care) were low for U.S. adults and especially for certain minorities (13). Reminders from doctors' offices are helpful in this regard but do not address patient barriers to scheduling appointments such as inability to pay and lack of health insurance coverage. Curbing the diabetes epidemic will require efforts by individuals at all levels, including patients, physicians, and government policymakers.

Limitations of this study include the possible bias introduced by having a self-selected (5–8% of those solicited) household panel as the study population. Underrepresentation of the very wealthy and very poor sectors of society and exclusion of military and institutionalized individuals are shortcomings associated with household panels.

The occurrence of one or more diabetes symptoms alone may not adequately identify those who should be screened for

type 2 diabetes. Longitudinal data from SHIELD will evaluate whether combinations of these symptoms are more predictive of receiving a diabetes diagnosis or if the addition of other conditions or symptoms can better identify people who should be screened for type 2 diabetes.

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APPENDIX

SHIELD Study Group members

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Tina Fanning of Vedanta Research, Chapel Hill, NC, and Richard Chapman of ValueMedics, Falls Church, VA, also contributed to this report, performing data collection and analysis.

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