Adiposity, Age, and Family History as a Simplified Prediction of Future Diabetes Mellitus from the SHIELD Study

Harold E. Bays, MD[1], Kathleen M. Fox, PhD[2], Susan Grandy, PhD[3], for the SHIELD Study Group

[1]Louisville Metabolic and Atherosclerosis Research Center, Louisville, KY; [2]Strategic Healthcare Solutions, LLC, Monkton, MD; [3]AstraZeneca LP, Wilmington, DE

BACKGROUND

- Approximately 8% of the United States population have diabetes mellitus[1]

- An additional 79 million people (35% of US adults aged 20 years or older) have prediabetes mellitus, defined as elevated fasting glucose or hemoglobin A1c levels[1]

- National surveys report that 66% of Americans are overweight, and 32% are obese[2]

- Diabetes mellitus is the seventh leading cause of death, a major cause of heart disease and stroke, and the leading cause of kidney failure, nontraumatic lower-limb amputations, and new cases of blindness among adults in the US[3]

- To begin to address this disease burden, it is important to first be able to efficiently identify individuals at risk for developing diabetes

- The American Diabetes Association encourages adults to assess their risk of developing T2DM using the Diabetes Risk Test[4], which includes parameters of age, race, family history of diabetes, obesity, physical activity, hypertension, and gestational diabetes as risk predictors

- Other risk assessments use different characteristics to predict the risk of developing T2DM.[5-7] Both clinicians and patients may benefit from a targeted and simplified subjective risk predictor model, which may encourage individuals at higher risk for T2DM to seek objective testing (such as blood testing)

OBJECTIVE

To ascertain whether the incidence of self-reported T2DM differed among respondents with and without a simplified set of risk factors for developing T2DM

METHODS

Study Design

- The **S**tudy to **H**elp **I**mprove **E**arly evaluation and management of risk factors **L**eading to **D**iabetes (SHIELD) was a 5-year population-based survey conducted to better understand the risk for the development of diabetes mellitus, as well as disease burden
  - Survey respondents included 211,097 adults from 127,420 households (64% response rate), based upon a screening questionnaire mailed to 200,000 representative US households
  - In 2004, a baseline survey was sent to 22,001 selected individuals derived from the screening respondents. From 2005 to 2009, annual SHIELD surveys captured self-reported information on health status, attitudes and behaviors, quality of life and anthropometry from this representative sample of the US population

- This investigation was a longitudinal analysis of data from SHIELD estimating the incidence rate for developing T2DM over 5 years

Study Population

- Respondents were 18 years of age or older

- Self-reported diagnosis of T2DM, T1DM, or gestational diabetes was based on being told by a doctor, nurse, or other healthcare professional that the respondent had the condition

- T2DM respondents were >21 years of age at diagnosis

- Respondents who reported no diagnosis of T2DM, T1DM, or gestational diabetes at baseline (2004) and who reported their BMI, age, and family history of diabetes at baseline and 5 years later (2009) were included in this analysis

Study Measures

- Obesity was defined as BMI $\geq$30 kg/m^{2}, and normal weight was defined as BMI <25 kg/m^{2}

- Family history of diabetes was self-reported as yes or no

Statistical Analyses

- A high-risk group was defined as those reporting obesity (BMI $\geq$30 kg/m^{2}) at baseline, being $\geq$55 years of age, and with a family history of diabetes mellitus. This group was compared with respondents who reported normal weight, being <55 years of age, and no family history of diabetes mellitus (low-risk group)

Statistical Analyses (Continued)

- Incidence rate of self-reported T2DM over 5 years was computed as the number of respondents in each group who reported a diagnosis of T2DM from 2004 to 2009 as the numerator and the total number of respondents in each group at baseline as the denominator

- Comparisons between high-risk and low-risk groups were conducted using chi-square test for categorical variables and t-tests for continuous variables. Statistical significance was set *a priori* as p <0.05

RESULTS

- A total of 290 high-risk and 408 low-risk respondents were identified

**Table 1. Baseline characteristics of SHIELD respondents with and without risk factors for developing T2DM**

Characteristics	High-risk respondents (n=290)	Low-risk respondents (n=408)	p-value
Age, years, mean (SD)	64.7 (7.8)	41.1 (9.4)	<0.0001*
Women, %	67.6	65.4	0.31
Race, %			0.40
White	94.4	93.8	
Black	3.9	3.0	
Other	1.7	3.2	
Income, % with <$40,000/year	49.7	28.9	<0.0001
Members in the household, %			<0.0001
1 member	38.3	14.7	
2 members	43.1	29.4	
$\geq$3 members	18.6	55.9	
BMI, kg/m^{2}, mean (SD)	35.3 (5.3)	22.0 (2.1)	<0.0001*
Health status, %			<0.0001
Very good or excellent	25.6	72.6	
Good	39.8	18.7	
Fair or poor	34.6	8.7	
Comorbid conditions, %			
Asthma	15.2	7.8	0.002
Circulatory problems	20.7	3.4	<0.0001

*differences in age and BMI were by design, as the high-risk group is defined as older, with obesity, and with a family history of diabetes mellitus

RESULTS (Continued)

- A greater proportion of high-risk respondents had low household income, smaller household size, fair or poor health status, asthma, and circulatory problems than low-risk respondents (Table 1)

Figure 1. Proportion of SHIELD respondents reporting a new diagnosis of T2DM over 5 years
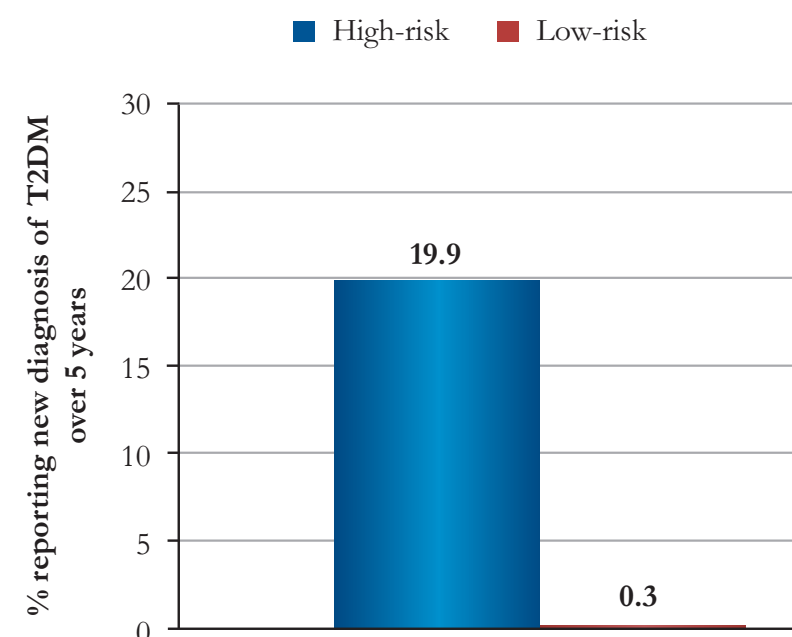
- Using just three questions in the SHEILD survey, significantly more high-risk respondents self-reported a diagnosis of T2DM over 5 years, compared with low-risk respondents (19.9% vs. 0.3%, p <0.0001) (Figure 1)

SHIELD questions:

1. Age $\geq$55 years

2. Obese (BMI $\geq$30 kg/m^{2})

3. Family history of diabetes mellitus

LIMITATIONS

- Diagnosis of diabetes mellitus and other comorbid conditions were self-reported and not validated with medical record review or administrative claims data

- Household panels, like the SHIELD study, tend to under-represent the very wealthy and very poor segments of the population and do not include military or institutionalized individuals

CONCLUSIONS

- Using a simplified set of self-reported predictors for T2DM composed of age, BMI, and family history, 20% of individuals at risk for T2DM reported developing T2DM in 5 years, compared with 0.3% of individuals at low risk

- Other risk tests and prediction models use 7 or more risk predictors to calculate risk of developing diabetes, which may be more cumbersome for individuals to use in estimating their risk and motivating them to seek medical care

- With these 3 predictors (age, BMI, and family history), patients and physicians may be able to better identify undiagnosed diabetes and initiate preventive measures

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Abbreviations
BMI	Body mass index
SHIELD	Study to Help Improve Early evaluation and management of risk factors Leading to Diabetes
T1DM	Type 1 diabetes mellitus
T2DM	Type 2 diabetes mellitus
US	United States