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

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BACKGROUND

Approximately 8% of the United States population have diabetes mellitus1

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.

National surveys report that 66% of Americans are overweight, and 32% are obese2

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.

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

The American Diabetes Association encourages adults to assess their risk of developing T2DM using the Diabetes Risk Test3, 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. Both clinicians and patients may benefit from a targeted and simplified approach to risk factor assessment and management of risk factors Leading to Diabetes (SHIELD)4, which includes parameters of age, BMI, and family history.

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 study to Help Improve Early evaluation and treatment of risk factors leading to Diabetes (SHIELD) was a 5-year population-based survey conducted to better understand the risk for the development of diabetes mellitus, as well as diabetes 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 estimates 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 ≥25 kg/m², and normal weight was defined as BMI <25 kg/m².

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

Statistical Analyses

A high-risk group was defined as those reporting obesity (BMI ≥25 kg/m²) at baseline, being ≥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).

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

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>High-risk respondents (n=290)</th>
<th>Low-risk respondents (n=408)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years, mean (SD)</td>
<td>47.0 (7.3)</td>
<td>44.1 (9.0)</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>87.7</td>
<td>65.9</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>35.3 (5.3)</td>
<td>22.0 (2.1)</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Women, %</td>
<td>55.9</td>
<td>67.6</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Race, %</td>
<td>64.7 (7.8)</td>
<td>38.3 (7.8)</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Other, %</td>
<td>39.8</td>
<td>61.2</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Income, % with &lt; $40,000/year</td>
<td>29.4</td>
<td>18.6</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Other, %</td>
<td>29.4</td>
<td>18.6</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Circulatory problems</td>
<td>25.6</td>
<td>13.3</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Asthma</td>
<td>15.4</td>
<td>11.7</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Other, %</td>
<td>15.4</td>
<td>11.7</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Diabetes, %</td>
<td>7.8</td>
<td>0.3</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Other, %</td>
<td>7.8</td>
<td>0.3</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Hypertension, %</td>
<td>25.6</td>
<td>13.3</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Other, %</td>
<td>25.6</td>
<td>13.3</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Heart failure, %</td>
<td>3.0</td>
<td>0.2</td>
<td>&lt;0.0001*</td>
</tr>
<tr>
<td>Other, %</td>
<td>3.0</td>
<td>0.2</td>
<td>&lt;0.0001*</td>
</tr>
</tbody>
</table>

Using just three questions in the SHIELD 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). Using just three questions in the SHIELD 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).

SHEILD questions:
1. Age ≥55 years
2. Obese (BMI ≥20 kg/m²)
3. Family history of diabetes mellitus

Figure 1. Proportion of SHIELD respondents reporting a new diagnosis of T2DM over 5 years

<table>
<thead>
<tr>
<th>High-risk</th>
<th>Low-risk</th>
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<tr>
<td>19.9</td>
<td>0.3</td>
</tr>
</tbody>
</table>

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.

REFERENCES


ABBREVIATIONS

BMI Body mass index

SHIELD Study to Help Improve Early evaluation and treatment of risk factors leading to Diabetes

TIDM Type 1 diabetes mellitus

T2DM Type 2 diabetes mellitus

US United States

This research was supported by AstraZeneca LP.

Presented at the 2011 Annual Meeting of The Obesity Society, Orlando, FL, October 3-5, 2011.