External National Validation of the Leicester Self-Assessment Score for Type 2 Diabetes Using Data from the English Longitudinal Study of Ageing

Running title: Leicester Self-Assessment Score Validation

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NOVELTY STATEMENT

- We have externally validated the Leicester Self-Assessment score for use across England to detect those at high risk of undiagnosed Type 2 Diabetes and Non-Diabetic Hyperglycaemia
- Of those found at high risk using the Leicester Self-Assessment score, 89% will go onto have Type 2 Diabetes diagnosed within the next 10 years
- The Leicester Self-Assessment score can be reliably used across England either to detect risk of current undiagnosed disease or to identify those at risk of developing diabetes in the future

ABSTRACT

Aims: The Leicester Self-Assessment score is a non-invasive risk assessment that identifies individuals at risk of Non-Diabetic Hyperglycaemia or undiagnosed Type 2 Diabetes Mellitus (DM). We validated this score using a representative English dataset for detecting prevalent Non-Diabetic Hyperglycaemia or undiagnosed Type 2 DM (defined as HbA1c $\geq 6.0\%$) and for identifying those who go on to develop Type 2 DM within 10 years.

Methods: Data were taken from the English Longitudinal Study of Aging, a nationally representative dataset of people aged ≥ 50 years. The area under the receiver operator curve (AUROC) and performance metrics for the score at the recommended cut-point (≥ 16), were calculated for the outcomes of HbA1c $\geq 6.0\%$ (42 mmol/mol) at baseline and self-reported Type 2 DM within 10 years in those aged 50-75 years at baseline.

Results: 3,203 individuals had a baseline HbA1c measurement, of whom 247 (7.7%) had HbA1c $\geq 6.0\%$ (42 mmol/mol). AUROC was 69.4% (95%CI: 66.0%-72.9%) for baseline HbA1c $\geq 6.0\%$. 3,550 individuals had diabetes status recorded at 10 years, of whom 324 (9.1%) were diagnosed with Type 2 DM within this time; the AUROC for this outcome was 74.9% (95%CI: 72.4%-77.5%). The cut-point of ≥ 16 had a sensitivity of 89.2% (95%CI: 85.3-92.4%) and a specificity of 42.3% (95%CI: 40.5-44.0%) for Type 2 DM within 10 years.

Conclusions: The Leicester Self-Assessment score is validated for use across England to identify people with Non-Diabetic Hyperglycaemia or undiagnosed Type 2 DM. Those with a high score are at high risk of developing diabetes in the future.

PUBLISHED ABSTRACTS

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INTRODUCTION

Three hundred and sixty six million individuals are estimated to have Type 2 Diabetes Mellitus (Type 2 DM); a number predicted to grow, on average, by 2.7% a year (1). Non-Diabetic Hyperglycaemia, also known as 'prediabetes' or Impaired Glucose Regulation (which includes Impaired Glucose Tolerance and Impaired Fasting Glucose), is a condition where an individual's blood glucose is raised above normal levels but remains lower than the diabetes range (2). Recently, the use of Glycated Haemoglobin (HbA1c) to establish Non-Diabetic Hyperglycaemia has been widely supported (3-5), with the International Expert Committee and the UK-based National Institute for Health and Care Excellence (NICE) recommending that HbA1c values of 6.0 – 6.4% (42– 46mmol/mol) be classified as Non-Diabetic Hyperglycaemia (4,5). It was approximated that in 2013, 6.9% of the world's adult population had Non-Diabetic Hyperglycaemia – a figure also expected to rise (6). Individuals with Non-Diabetic Hyperglycaemia are at an increased risk of progressing to Type 2 DM compared to individuals with normal glucose levels (7,8).

NICE recommend identifying individuals between the age of 40 and 75 years with Non-Diabetic Hyperglycaemia or undiagnosed Type 2 DM using a two-stage screening approach involving a non-invasive risk tool, ideally using a computer-based risk-assessment tool that uses routinely collected data, followed by a blood test (5). If a computer-based risk-assessment tool is not available or opportunistic screening is being undertaken, NICE recommend using a validated self-assessment questionnaire, such as the Leicester Self-Assessment score. Proven lifestyle interventions to prevent or delay the onset of Type 2 DM should then be provided to those with Non-Diabetic Hyperglycaemia (5). Risk assessment tools use an individual's risk factors to calculate their probability of having a particular health outcome or to calculate a risk score based on this probability (9). Risk assessment tools help to optimise resources required for detecting diseases by allowing screening to be targeted at those at highest risk (10). Risk assessment tools can be developed for a cross-sectional outcome, such as Non-Diabetic Hyperglycaemia or undiagnosed Type 2 DM (11), or

for a prospective outcome, for instance developing Type 2 DM within the next 10 years (12,13). The Leicester Self-Assessment score contains seven risk factors and was designed to be completed by members of the public for opportunistic screening. The score was developed to detect those with Non-Diabetic Hyperglycaemia or undiagnosed Type 2 DM using a multi-ethnic dataset of people aged 40-75 years old (14).

To date, the Leicester Self-Assessment score has only been validated for cross-sectional outcomes, predominately using Leicester-based data (2,14). This external validation uses the English Longitudinal Study of Aging (ELSA) (15) to validate the Leicester Self-Assessment score for the cross-sectional outcome of Non-Diabetic Hyperglycaemia or undiagnosed Type 2 DM by HbA1c, and prospectively for the outcome of 10 year self-reported doctor-diagnosed diabetes. Finally, we evaluate the use of the two-stage screening programme as recommended by NICE (5), with the Leicester Self-Assessment score as the first stage and HbA1c as the second stage, in identifying the individuals who prospectively develop Type 2 DM.

PATIENTS AND METHODS

Data source

Data were taken from the ELSA, an ongoing panel study of a nationally representative cohort of people aged 50 years and older living in England (15). ELSA collected data from participants every two years; each round of data collection is known as a wave. The first wave (conducted in 2002 and 2003) of the study recruited individuals living in private housing aged 50 years or older and their partners, irrespective of age, from households in which an individual participated in the Health Survey for England in 1998, 1999 or 2001 and agreed to follow-up (16). Refreshment samples of people aged between 50- 53 years were added to the study cohort in waves 3, 4 and 6, to ensure the cohort continued to be representative of individuals of this age. The study collects an extensive array of data including demographic, economic, social, psychological, mental and physical factors, along with various blood assays (16). The socio-demographics of the ELSA dataset have been found to be broadly reflective of the English population (16). Ethical approval for the study was granted by the NHS Research Committee and participants gave fully informed consent in writing (17).

Participants were asked to complete a questionnaire every wave, with nurse visits being conducted every other wave (every four years) to collect further information, such as blood glucose levels. The analyses in this paper use data from wave 2 (conducted in 2004 and 2005) as the baseline, as this is the first wave that included nurse visits and therefore blood glucose measurements. 9,432 individuals participated in wave 2 of the study (16).

ELSA was purposefully designed with the ability to study the prevalence of Non-Diabetic Hyperglycaemia and/or undiagnosed diabetes at waves 2, 4 and 6, as well as the incidence of diagnosed diabetes at every wave (18). Individuals were asked to give one fasting blood glucose measurement and one HbA1c measurement every four years, during nurse visits. Here we use the HbA1c data collected at wave 2 to define Non-Diabetic Hyperglycaemia/undiagnosed diabetes

(HbA1c $\geq 6.0\%$ [42 mmol/mol]) at baseline. Participants were also asked at each wave whether they had ever been told they have diabetes by a doctor and if they were taking insulin or medication for diabetes (18). This data, up to wave 7, was used to define self-reported doctor-diagnosed Type 2 DM for the 10 year incidence data. Given the way this data was collected, we do not know which method was used to diagnose Type 2 DM for individual participants. ELSA is a freely available dataset accessed through the UK Data Archive (19).

Leicester Self-Assessment score

Table 1 displays risk factors included in Leicester Self-Assessment score, along with the number of points assigned for each of the categories and the variables from ELSA used for each risk factor. Due to the absence of any information on family history of diabetes in wave 2, we used data for this risk factor from wave 6 (2012/13) and 7 (2014/15), which assumes constant family history between 2004 and 2012. Additionally, the family history variable recorded in wave 6 and 7 was defined as whether an individual has/had a parent who has/had diabetes; this is a slight variation to the risk factor question used in the Leicester Self-Assessment score, which asks whether an individual has/had a first degree family member who has/had diabetes. All other risk factors of the score were recorded in wave 2 and their actual value from baseline could be used in the calculation of the risk score.

The total score is used to place individuals into four risk groupings: low risk (0 to 6 points), medium risk (7 to 15 points), high risk (16 to 24 points) and very high risk (25 or more points) (14). Using a cut-point of ≥ 16 for the Leicester Self-Assessment score is recommended for identifying individuals who are at high risk and require a blood test (14).

Study population and subsets for different analyses

The score was calculated for individuals in the eligible study population with the required data available. In order to be in the eligible study population individuals had to be aged between 50–75 years old, free of diagnosed diabetes at baseline and have complete data for the seven risk factors

used to calculate the Leicester Self-Assessment score. Fig 1 shows 3,983 in the population of interest had complete data for the seven risk factors of the risk score. To be included in the analysis for Non-Diabetic Hyperglycaemia/undiagnosed Type 2 DM (HbA1c $\geq 6.0\%$ [42 mmol/mol]) individuals also required a baseline HbA1c measurement; whilst individuals were required to also have self-reported Type 2 DM status at 10 years to be included in the analysis of 10 year diabetes incidence. Finally, only individuals that had both a baseline HbA1c measurement and self-reported Type 2 DM status at 10 years in addition to having complete data for the seven risk factors were included in the subset used to analyse the utility of a two-stage screening (risk score followed by HbA1c) for detecting the prospective outcome of 10 year diabetes incidence.

Statistical Methods

Complete-case analyses were used for the main analysis. The area under the receiver operator curve (AUROC) of the score, as well as the sensitivity, specificity, proportion classified as high risk, proportion correctly classified, positive predictive value and negative predictive value for the score's recommended cut-point (≥ 16), were calculated for the following binary outcomes: baseline HbA1c $\geq 6.0\%$ (42 mmol/mol) – i.e. the scores ability to detect those with undiagnosed current Non-Diabetic Hyperglycaemia and Type 2 DM; and self-reported, doctor-diagnosed diabetes within 10 years. The prevalence of both outcomes was calculated across the Leicester Self-Assessment score's four risk groupings. Two sensitivity analyses were conducted which assessed the robustness of the main results to the level of missing: (i) replacing missing values with the lowest possible value; (ii) replacing missing values with the highest possible value. We also assessed using a cut-point of ≥ 25 , which is currently used to define very high risk.

To assess the validity of the score when used as part of the two-stage screening programme, as recommended by NICE (5), the proportion of individuals diagnosed with diabetes within 10 years was calculated for the following three groups: individuals with a score < 16 ; individuals a score ≥ 16 and HbA1c $< 6.0\%$ (42 mmol/mol); and individuals with a score ≥ 16 and HbA1c $\geq 6.0\%$ (42 mmol/mol).

RESULTS

As Fig 1 displays, of the 9,432 participants who participated in wave 2, 3,983 individuals met the inclusion criteria for this study. Baseline HbA1c was measured in 3,203 (80.4%) of the eligible study population; while 3,550 (89.1%) had diabetes status recorded at 10 years. When considering the two-stage screening process, 2,866 (72.0%) individuals had both baseline HbA1c and 10 year diabetes data available. Table S1 shows the reduction in study population due to individuals of interest (those aged between 50-75 years old and free from diagnosed diabetes) having missing data for the seven risk factors used to calculate the Leicester Self-Assessment score.

Table S2 displays the characteristics of the eligible study population and the three subsets used for the different analyses. The majority of characteristics across the three subsets were very similar to those seen for the whole study population. Additionally, Table S2 includes the characteristics of all individuals aged between 50- 75 years old and free from diagnosed diabetes, to check whether using a complete case approach may have biased the results. The only noticeable differences between the fuller dataset and the eligible study population were higher proportions of individuals who currently smoke (17.6% versus 14.6%) and have a history of high blood pressure (38.5% versus 36.2%).

Table S3 shows the proportion of individuals with each of the outcomes across the datasets being used. The proportion of both prevalent HbA1c $\geq 6.0\%$ (42 mmol/mol) and 10 year diabetes incidence were higher before individuals were removed for having missing Leicester Self-Assessment score data, for example 10.9% of those aged 50- 75 years and free of diabetes in wave 2 developed diabetes within 10 years, compared to 9.1% of the population with Leicester Self-Assessment score and 10 year diabetes status recorded.

Performance of Leicester Self-Assessment score

Table 2 shows the Leicester Self-Assessment score had good levels of discrimination for both outcomes assessed (See Tables S4 and S5 for 2x2 contingency tables). Using the score's recommended cut-point (≥ 16) resulted in roughly 61% of individuals being classified as high risk and requiring a blood test across all data subsets. At baseline, 7.7% of the population analysed had Non-Diabetic Hyperglycaemia or undiagnosed Type 2 DM, of these, 82.2% were correctly identified. At 10 years, 9.1% had developed diabetes, of those, 89.2% were correctly identified. Both outcomes were associated with a high negative predictive value suggesting that the majority of individuals with a score of less than 16 do not have or go on to develop the disease.

Fig 2 shows that the Leicester Self-Assessment score risk groupings discriminated well for the outcome of HbA1c $\geq 6.0\%$ (42 mmol/mol); the very high risk category had more than double the prevalence than that of the high risk category, which in turn had approximately twice the prevalence of the medium risk category. Fig 3 illustrates that the Leicester Self-Assessment score risk groupings also differentiated well for the outcome of diabetes at 10 year follow-up. The incidence of diabetes within 10 years in the very high risk category was over twice the incidence seen in the high risk category, more than seven times the incidence observed in the medium risk category and in excess of 20 times the incidence of the low risk category.

The sensitivity analyses assessing the robustness of these results to the missing data assumptions are shown in Table S6. Generally the results seen were pretty stable in terms of the interpretation. For example, for detecting HbA1c $\geq 6.0\%$ (42 mmol/mol) the percentage of those classified at high risk slightly decreased when imputing the lowest values (53.6% versus 60.5%) and increased when the highest values were imputed (68.0%).

Increasing the cut-point used on the risk score to define high risk to ≥ 25 gives a much lower sensitivity and higher specificity for both outcomes (see Table S7), showing that the ≥ 16 cut point is more suitable for identifying those requiring a blood test.

Performance of two-stage screening (risk score followed by HbA1c test)

Around 4 out of every 10 individuals, 1,157 of 2,866 (40.4%) on whom the two-stage screening was assessed had a risk score < 16 and therefore would not have required an HbA1c test (See Table S8). Of these, 27 (2.3%) went on to develop Type 2 DM within the next 10 years. Of the individuals with a risk score ≥ 16 , 89.5% had a baseline HbA1c $< 6.0\%$ (42 mmol/mol) and would therefore have been identified as low risk after the blood test. Two-stage screening would have deemed the 6.6% of individuals with risk score ≥ 16 and HbA1c $\geq 6.0\%$ (42 mmol/mol) to be at high risk of developing diabetes. Fig 4 illustrates that the incidence of diabetes diagnosis within 10 years is considerably higher in individuals with a risk score ≥ 16 and HbA1c $\geq 6.0\%$ (42 mmol/mol) at baseline, with 54.8% being diagnosed with diabetes within 10 years. This group contained 43.8% of the cases of diabetes diagnosed within 10 years, despite only having been 6.6% of the population. One hundred and five (6.9%) of the 1,521 individuals with a risk score of ≥ 16 , but a low HbA1c ($< 6.0\%$) went onto develop Type 2 DM over 10 years.

DISCUSSION

We report the first prospective external validation using a nationally representative data set of the Leicester Self-Assessment score. We have shown that this score discriminates well in this population for both baseline abnormal HbA1c and diabetes diagnosis in the years that follow. The recommended cut-point of ≥ 16 leads to very few people who will be diagnosed with diabetes in the future being missed; however many individuals who were not diagnosed with diabetes within 10 years were identified as high risk. We believe this is acceptable since the risk score is intended to be the first stage of a two-stage screening programme, thus it should be viewed as reducing the number of individuals requiring a blood test. Although, given the cost of testing HbA1c (currently around £7.70 within the NHS) a full cost-benefit analysis is warranted (20). Two-stage screening with the Leicester Self-Assessment score as the first stage and HbA1c as the second, results in a small proportion (6.6%) of the population with a substantially increased risk of developing diabetes in the years that follow being identified.

A key strength of this validation is that it used the ELSA cohort, which was collected with the aim of being nationally representative and thus provides a national external validation in 50-75 year olds. Another strength is that, in addition to assessing the Leicester Self-Assessment score alone for detecting the outcomes, the Leicester Self-Assessment score is evaluated as part of the two-stage screening process in which it is intended to be used – none of the other validations to date have assessed this. This validation did not include analyses of the calibration of the Leicester Self-Assessment score for different outcomes, as probabilities for the different scores have not been published and are not used in practice. This is because the Leicester Self-Assessment score was developed to be used as a paper-based tool, so a simple scoring system without probabilities was elected to allow ease of completion for members of the public (14).

First degree family history of diabetes was not collected at baseline (wave 2) in the ELSA data and therefore parents' history of diabetes was back imputed from the eight year follow-up. Given the

age range of the participants, we assumed that family history would be relatively stable over time and therefore we believe this imputation will not have overly adversely affected the results (21). Family history data was also not available in the Health Survey for England (HSE) data, which was used for another external validation of the Leicester Self-Assessment score. In the HSE validation, data were not imputed and this therefore led to the risk of Non-Diabetic Hyperglycaemia / Type 2 DM being underestimated for those with a family history of diabetes (2). Another limitation is the amount of missing data; the subsets used for the analyses carried out are considerably smaller, around half the size, of the total number of individuals in the dataset who were aged 50-75 years old and free from diagnosed diabetes at baseline. The small decreases in the outcomes for the subsets analysed indicate the individuals excluded for having missing data for at least one of the Leicester Self-Assessment score risk factors were slightly more likely to have each of the outcomes. However the majority of characteristics were similar in the three subsets used for the analyses to those observed for all individuals aged 50- 75 years old and free from diagnosed diabetes at baseline. When we repeated the analysis imputing missing items, the results seemed robust to the assumptions made.

Numerous risk assessment tools have been developed for Non-Diabetic Hyperglycaemia and/or diabetes outcomes (22,23), however many of these have not been externally validated and few are implemented in practice (9,11). Implementation of the Leicester Self-Assessment score has been recommended by NICE and the score has been widely used; it is available across the UK in national pharmacy chains and online at the Diabetes UK website (24). This is the first prospective validation of the Leicester Self-Assessment score for future diabetes diagnosis.

Three previous cross-sectional validations have been published (one internal, using the development data set, and two external) (2, 14). This cross-sectional validation for HbA1c $\geq 6.0\%$ (42 mmol/mol) had similar levels of discrimination (AUROC: 69%) to those seen in the development dataset for the outcome of Non-Diabetic Hyperglycaemia or undiagnosed Type 2 DM (both defined using Oral

Glucose Tolerance test [OGTT], AUROC: 69%). Higher levels were seen in an external validation using the HSE dataset for the outcome of Non-Diabetic Hyperglycaemia alone defined by HbA1c (AUROC: 78%) (2). The HSE dataset included individuals over 16 years of age leading to a much lower percentage (28%) with a score ≥ 16 compared to that found in this study population (61%).

To date four risk scores have been developed for use in the UK, the Leicester Self-Assessment score is the only score developed for self-completion by members of the public. The three other scores were all developed for use in primary care using data from electronic medical records: (i) Leicester Practice risk score (25); (ii) QDScore (13); (iii) Cambridge risk score (26). Of these the most widely validated is the QDScore, this score estimates an individual's 10 year risk of developing Type 2 DM. The QDScore has been externally validated using The Health Improvement Network dataset, with an AUROC of over 80% for both males and females (27), although this is higher than the 74.9% seen here for the 10 year progression to diabetes, this is not surprising given the QDScore was developed for this outcome and has increased sensitivity due to the inclusion of continuous independent variables in its risk equation. Given the Leicester Self-Assessment score was developed to be completed by hand, all continuous risk factors have been collapsed into categorical variables which leads to a loss of sensitivity (28). A comparison of the four UK scores using the HSE dataset found that all scores gave an acceptable level of sensitivity and specificity for detecting those at high risk of Non-Diabetic Hyperglycaemia (Leicester Self-Assessment score 77.9% and 66.1%, Leicester Practice risk score 79.7% and 66.8%, QDScore 77.6% and 65.6%, Cambridge risk score 70.3% and 68.9% respectively) (2).

The prevalence of individuals with either Non-Diabetic Hyperglycaemia or undiagnosed Type 2 DM at baseline: 7.7%, was considerably lower than in other cross-sectional validations of the Leicester Self-Assessment score (2,14). The data used to develop the score had a Non-Diabetic Hyperglycaemia or undiagnosed Type 2 DM prevalence of 19.5%, although Non-Diabetic Hyperglycaemia was defined using fasting plasma glucose instead of HbA1c. Furthermore, the

development dataset had a higher proportion of Black and Ethnic Minorities, who have been found to have increased prevalence of the outcome. Prevalence affects the positive predictive value, which means that the risk score will have a different positive predictive value depending on the population it's applied to. For example, here we saw a positive predictive value of 10.5% with a prevalence of 7.7%. If the prevalence is doubled, but holding the sensitivity and specificity at the same level, the positive predictive value increases to 20.3%. This explains why a lower positive predictive value is seen in this data compared to than seen in the development data for the recommended-cut point of ≥ 16 . This suggests that the biggest gains in using the score are seen as the baseline risk of the population increases.

Conclusion

This study assessed the prospective validity of the Leicester Self-Assessment score in a nationally representative dataset of individuals aged 50-75 years old. The Leicester Self-Assessment score is a useful tool for identifying individuals with prevalent Non-Diabetic Hyperglycaemia or undiagnosed Type 2 DM, defined by HbA1c. In addition, the score discriminated well the individuals who go on to develop diabetes. Using a two-stage screening process that classifies individuals with a risk score ≥ 16 and HbA1c $\geq 6.0\%$ (42 mmol/mol) as high risk is an effective way of identifying a small proportion of individuals in whom a large proportion will be diagnosed with diabetes in the near future. This two-stage screening process could be implemented in the NHS Diabetes Prevention Programme to identify individuals to whom intensive lifestyle interventions should be offered.

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CONFLICTS OF INTEREST

SRB declares no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, and no other relationships or activities that could appear to have influenced the submitted work. Nafeesa N Dhalwani declares no support from any organisation for the submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, and no other relationships or activities that could appear to have influenced the submitted work. Laura J Gray declares no support from any organisation for the submitted work and no financial relationships with any organisations that might have an interest in the submitted work in the previous three years. Melanie J Davies and Kamlesh Khunti declare no support from any organisation for the submitted work and no financial relationships with any organisations that might have an interest in the submitted work in the previous three years. MJD and KK (Chair) were members of the NICE PH 38 (Preventing type 2 diabetes: risk identification and interventions for individuals at high risk) Programme Development Group. MJD, KK and LJG were authors on the paper which originally developed and validated the Leicester Self-Assessment score.

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Table 1 Risk factors in Leicester Self-Assessment score, the score assigned for each of their categories and the ELSA variable used for each risk factor

Risk factor	Question	Score for each category	ELSA variable used
Age	Which age group are you in?	40-49 years: 0 50-59 years: 5 60-69 years: 9 70-75 years: 13	Age at Wave 2
Sex	Are you male or female?	Female: 0 Male:1	Sex at Wave 2
Ethnicity	How would you describe your ethnicity?	White European: 0 Any other ethnic group: 6	Ethnicity at Wave 2
Family history of Type 2 DM	Do you have a parent, brother, sister and/or child with Type 1 or Type 2 diabetes? (Do not count step-relatives)	No: 0 Yes: 5	Parents' history of diabetes at Wave 6 and/or Wave 7
Waist circumference (cm)	Which waist size group are you in?	<90cm: 0 90-99cm: 4 100-109cm: 6 ≥110cm: 9	Waist circumference at Wave 2
Body mass index (kg/m ²)	What Body Mass Index (BMI) group are you in?	<25: 0 25-29: 3 30-34: 5 ≥35: 8	BMI at Wave 2
High blood pressure	Has you ever been told by a doctor or nurse that you have high blood pressure?	No: 0 Yes: 5	Reported as having been diagnosed with high blood pressure before Wave 2

Table 2 Prevalence, AUROC of Leicester Self-Assessment score and other statistical metrics of using Leicester Self-Assessment score with cut-point ≥ 16 for outcomes of baseline HbA1c $\geq 6.0\%$ (42 mmol/mol) and doctor-diagnosed diabetes within 10 years in the ELSA dataset. Values are percentages (95% CI)

	Baseline HbA1c $\geq 6.0\%$ (42 mmol/mol) (n=3,203)	Doctor-diagnosed diabetes within 10 years (n=3,550)
Prevalence	7.7 (6.8, 8.7)	9.1 (8.2, 10.1)
AUROC	69.4 (66.0, 72.9)	74.9 (72.4, 77.5)
Classified as high risk	60.5 (58.8, 62.2)	60.6 (59.0, 62.2)
Correctly Classified	45.1 (43.4, 46.9)	46.5 (44.9, 48.2)
Sensitivity	82.2 (76.8, 86.7)	89.2 (85.3, 92.4)
Specificity	41.3 (39.6, 43.1)	42.3 (40.5, 44.0)
Positive predictive value	10.5 (9.2, 11.9)	13.4 (12.0, 14.9)
Negative predictive value	96.5 (95.4, 97.5)	97.5 (96.5, 98.3)

FIGURE LEGENDS

Figure 1. Diagram showing the number of individuals meeting the inclusion criteria to be included in each analysis

Figure 2. Percentage of individuals in each Leicester Self-Assessment score risk category with prevalent HbA1c $\geq 6.0\%$ (42 mmol/mol) at baseline

Figure 3. Percentage of individuals in each Leicester Self-Assessment score risk category with doctor-diagnosed diabetes within 10 years

Figure 4. Percentage of individuals from different groupings of two-stage baseline screening being diagnosed with diabetes by a doctor within 10 years