Comparison of risk prediction models for renal disease: an external validation using 0.5 million UK Biobank participants

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Background

Kidney disease is both prevalent and costly to treat, necessitating early detection and management to improve outcomes. Risk prediction models are essential tools to identify individuals at risk. We compared the external validation performance of existing kidney disease risk prediction models using 0.5 million participants in the UK Biobank.

Objectives

To compare the external validation performance of existing kidney risk prediction models among people with and without type 2 diabetes.

Methods

We identified 14 prediction models from 3 recent systematic reviews (1-3) for chronic kidney disease (5 models for whole population and 9 models specific for type 2 diabetes) (Figure 1). A total of 497,896 adults in the UK Biobank were included; of which 4.7% had type 2 diabetes.

Model performance was assessed using discrimination and calibration. Discrimination was measured using the concordance index (c-index). The 95% confidence intervals were calculated by bootstrapping 100 replications. Calibration was assessed using the calibration plots with the ideal values for slope (optimal=1) and intercept (optimal=0), respectively. Subgroup analyses were conducted according to sex, age, ethnicity and presence of hypertension to further examine model performance.

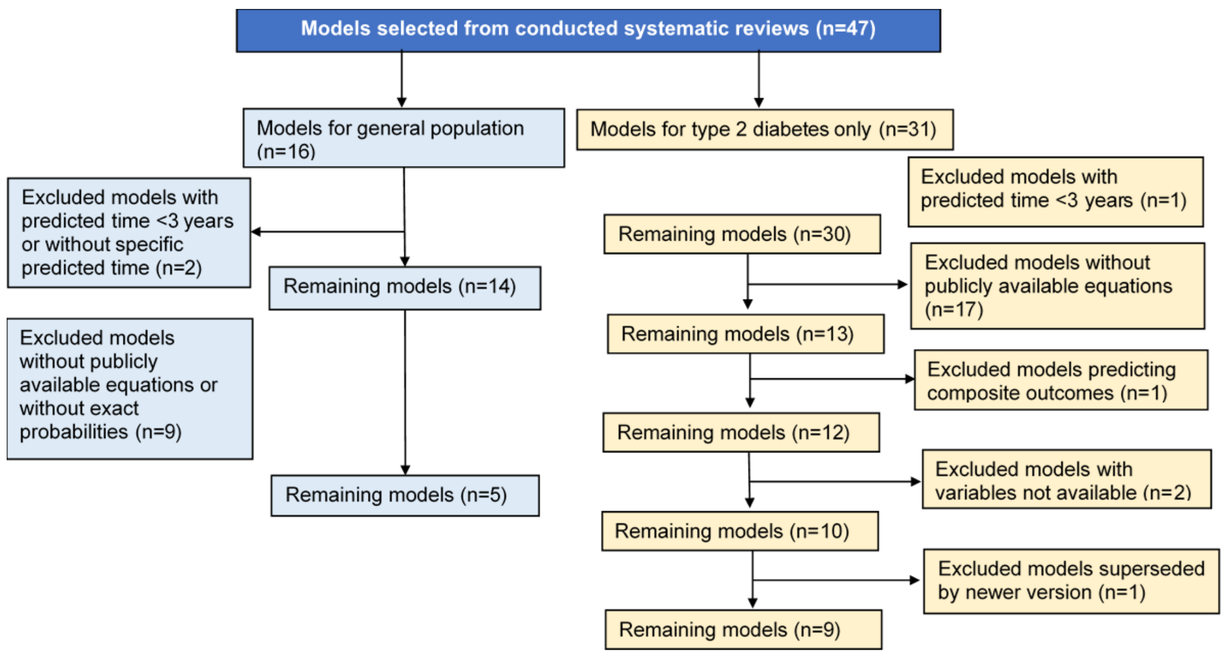


Figure 1. Selection of models for validation

Results

We evaluated a total of 14 models, five models developed for both people without diabetes and people with type 2 diabetes and nine models specifically for individuals with type 2 diabetes. Models were developed from 2010 to 2019 and were developed in Western countries, Asia, or multi-national populations.

Discrimination

The models showed good to excellent discrimination in predicting chronic kidney disease among individuals without diabetes (Table 1). For individuals with type 2 diabetes, the models demonstrated lower performance in predicting chronic kidney disease, but had good-to-excellent discrimination in predicting end-stage kidney disease (Table 2).

Model	n	c-index [95% CI]
Chien	438,141	0.72 [0.72-0.72]
Nelson	120,179	0.80 [0.79-0.80]
O'Seaghdha	129,476	0.80 [0.79-0.80]
Saranburut	412,938	0.77 [0.77-0.77]
Umesawa	412,938	0.80 [0.79-0.80]

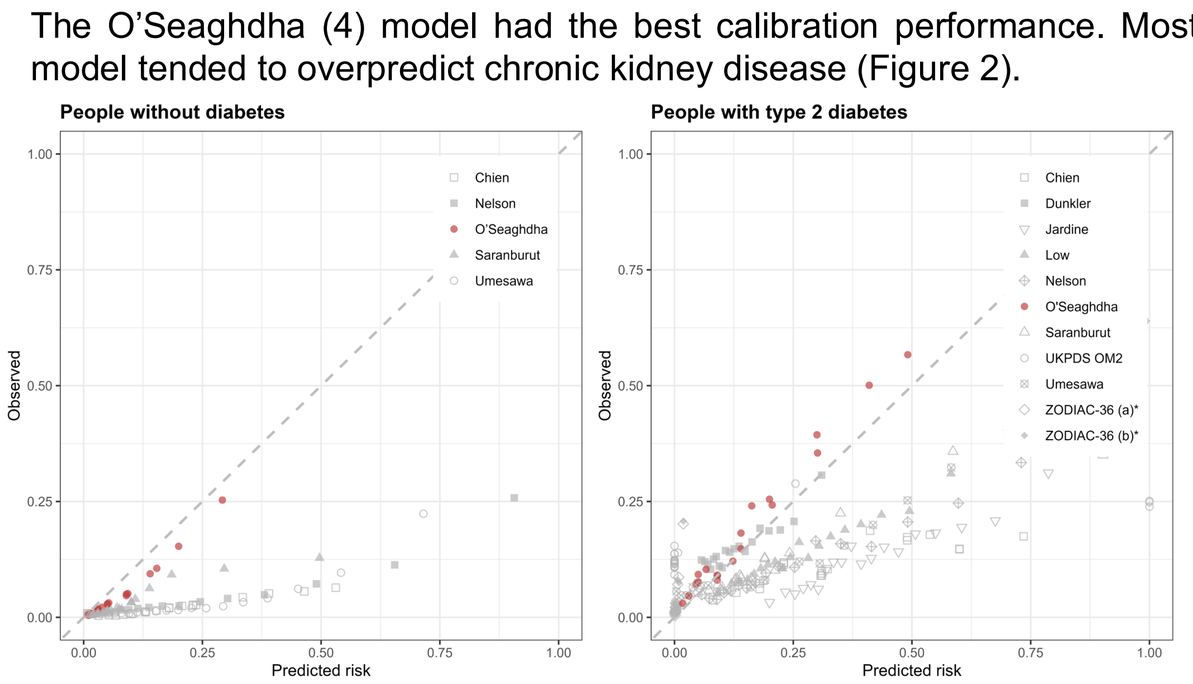
Table 1. Discriminative performance of the prediction models for people without diabetes

Model	n	c-index [95% CI]
Chronic Kidney Disease		
Chien	21414	0.60 [0.60-0.61]
Nelson	9,775	0.75 [0.74-0.76]
O'Seaghdha	11160	0.74 [0.73-0.75]
Saranburut	20177	0.71 [0.70-0.72]
Umesawa	20177	0.75 [0.73-0.76]
Dunkler	10,761	0.59 [0.58-0.61]
Low	9,813	0.67 [0.66-0.69]
ZODIAC-36 (cox regression model)	10,360	0.77 [0.74-0.80]
ZODIAC-36 (competing risk model)	10,360	0.77 [0.74-0.80]
UKPDS OM2	8,222	0.59 [0.57-0.61]
Jardine	9,823	0.69 [0.68-0.71]
End-stage Kidney Disease		
RECODe	8,995	0.75 [0.73-0.78]
Jardine	7,373	0.83 [0.79-0.85]
ZODIAC-36 (cox regression model)	11,040	0.75 [0.73-0.76]
ZODIAC-36 (competing risk model)	11,040	0.73 [0.71-0.75]
Wan	9,831	0.70 [0.67-0.73]
Elley	9,853	0.89 [0.86-0.92]

Table 2. Discriminative performance of the prediction models for people with diabetes

Calibration

The O'Seaghdha (4) model had the best calibration performance. Most model tended to overpredict chronic kidney disease (Figure 2).



* ZODIAC-36 (a): ZODIAC-36 (cox regression model), ZODIAC-36 (b): ZODIAC-36 (competing risk model)

Figure 2. Calibration plots for models predicting chronic kidney disease

Conclusion

The models exhibited acceptable discrimination performance but fair calibration performance. The O'Seaghdha model had the best overall performance. Further validation is needed for people with diabetes.

Reference

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