Internal Validation of the Metabo-Reno-Cardiovascular Disease Model: Cardiovascular outcomes in Type 1 Diabetes

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ISPOR Congress, November 18-20 2024, Barcelona, Spain.

Background

- The Metabo-Reno-Cardiovascular Disease Model (MRCDM) is a patient-level model with individuals with or without diabetes (type 1 or 2), obesity (defined by BMI), CVD or chronic kidney disease.
- It was developed to predict the risk of complications and mortality in these individuals.
- To predict the risk of cardiovascular disease (CVD) in type 1 diabetes (T1D) in Western countries, different approaches are available: Swedish National Diabetes Registry (SweNDR)[1], Scottish Registry Linkage (SRL)[2], DCCT-EDIC[3], Pittsburgh[4] and Framingham[5-7] equations were implemented.

Objectives

- This study aims to validate the prediction of CVD in individuals with T1D using the MRCDM.

Methods

- The MRCDM is a microsimulation model, with specific disease submodules and complications represented within a structure of Markov Health states.
- Individuals that enter the model can be with or without diabetes (type 1 or 2), obesity, CVD and chronic kidney disease.
- To predict CVD in Western countries in T1D, 4 approaches can be used: the SweNDR[1] CVD equation, Scottish SRL[2] data, DCCT-EDIC[3], Pittsburgh[4] and Framingham[5-7].
- The model was populated with Swedish[8] and Scottish[2] country specific baseline characteristics and assuming no history of CVD.
- The EDIC progression of risk factors equations were used[9].
- With the different approaches, life expectancy (LE) predictions were compared to the SweNDR and SRL study outcomes.
- The observed Swedish[10] and Scottish[2] 50-year MI and stroke cumulative incidences were compared to incidences predicted with the other risk options.

Table 1 – MRCDM Cohort inputs

Baseline characteristics	Sweden	Scotland
HbA1c (%)	7.90	8.56
Start age (years)	23	22
Duration of diabetes (years)	0	0
Proportion male (%)	58	56
SBP (mmHg)	124	125
DBP (mmHg)	75	76
Total cholesterol (mg/dL)	180	181
HDL (mg/dL)	56	54
LDL (mg/dL)	103	106
Triglycerides (mg/dL)	103	108
BMI (kg/m²)	25.4	25.9
eGFR (mL/min/1.73m²)	102	102

HbA1c: hemoglobin A1c, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, HDL: High-density lipoprotein cholesterol, LDL: Low-density lipoprotein cholesterol, BMI: Body mass index, eGFR: Estimated glomerular filtration rate

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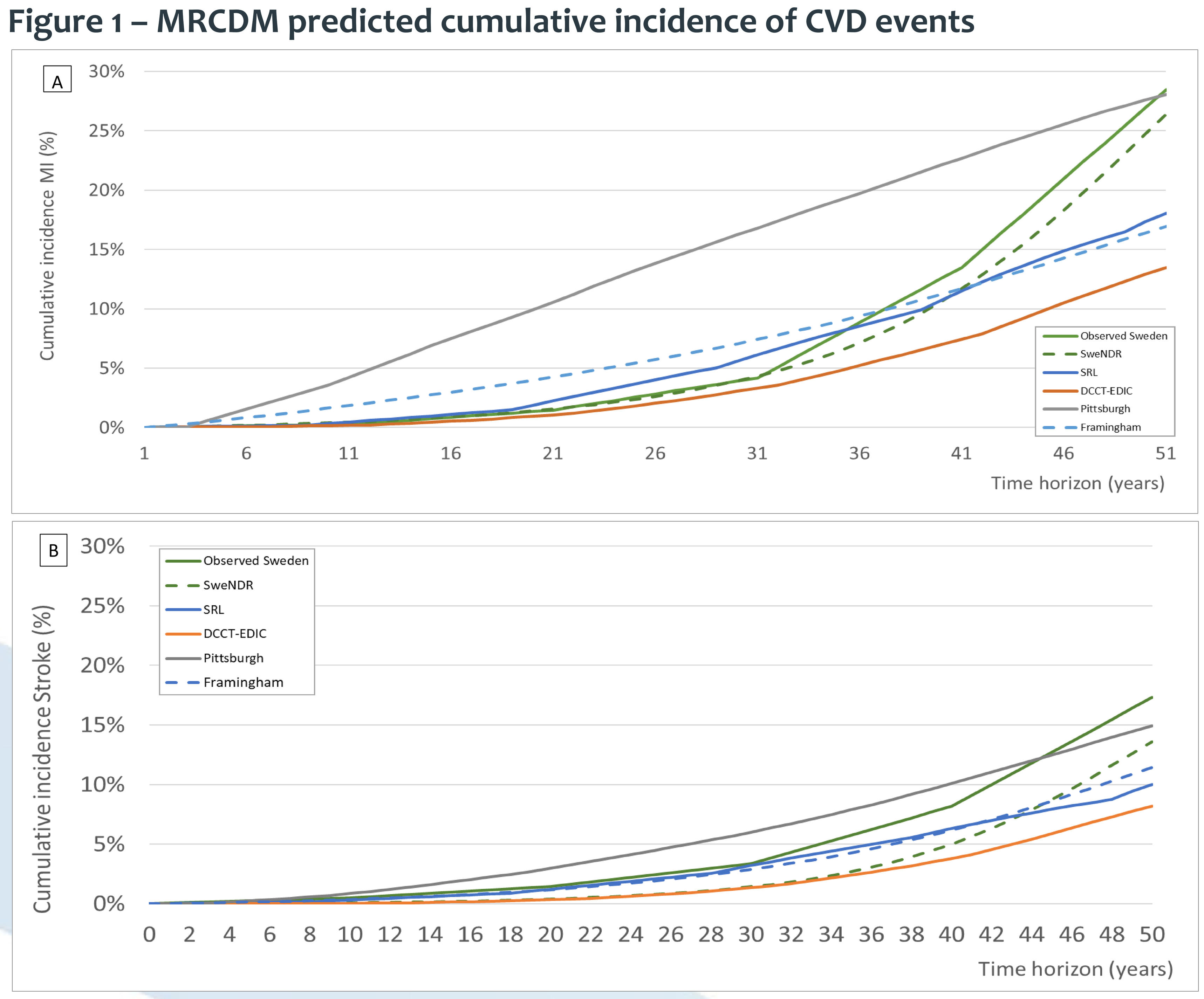
Table 2 – MRCDM predicted CVD cumulative incidence

Outcome	MI	Stroke
SweNDR[10] observed	*28%*	*17%*
MRCDM SweNDR[1] predicted	26%	14%
MRCDM Pittsburgh predicted	28%	15%
SLR[2] observed	*17%*	*10%*
MRCDM SLR[2] predicted	18%	10%
MRCDM Framingham predicted	17%	11.5%
MRCDM DCCT-EDIC predicted	13.5%	8%

Results

- In Table 2, the observed 50-years MI and stroke incidences and the predictions obtained with the five MRCDM risk equations covering different regions are shown.
- The MRCDM predictions with the SweNDR and SRL CVD equations are predicting very similar outcomes compared with the observed data.
- Concerning the three US equations: the Pittsburgh equation predicts similar to the SweNDR equation. The Framingham equations predict similar to the Scottish equation.
- The DCCT-EDIC risk option predicts lower incidences. Nevertheless, the latter is in line with the observed data published by Nathan et al[3].
- In Figure 1, the observed (Sweden) and predicted cumulative incidence over time of MI (A) and stroke (B) are shown.
- Except for the Pittsburgh analysis, the other equations show a lower annual incidence in the first years and a higher annual incidence in the longer years.
- The Pittsburgh equation curve reflects a similar trend of the Kaplan Meier curve presented in the Pittsburgh manuscript[4]. The same is true for the DCCT-EDIC curve with predictions that are much lower[3].

Figure 1 – MRCDM predicted cumulative incidence of CVD events



Conclusions

- **In the MRCDM, SweNDR and SRL risk equations predict similar CVD outcomes compared to the outcomes published in source studies.**
- **Framingham and EDIC predict in general lower risks, more in line with SRL observed.**

Want to know more about the MRCDM? team@this2modeling.com