The Prediction and Prevention of Diabetes

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- Introduction/Objectives
- Methods
- Results
- Conclusions
- References

INTRODUCTION AND OBJECTIVES

➢ **Introduction: Diabetes mellitus is a major cause of cardiovascular disease, kidney failure, neuropathy, and blindness.[1]**

➢ **Lifestyle change can significantly decrease diabetes risk.[2]**

➢ **Objectives: To develop a diabetes prediction model and apply it to a large population along with lifestyle change.**

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METHODS-1

➢ **2,414 fasting men and women (mean age 58 years) in the Framingham Offspring Study, free of diabetes at baseline, had glucose, adiponectin, insulin, glycated serum albumin, total cholesterol, triglycerides (TG), high-density lipoprotein cholesterol, body mass index (BMI), parental history of diabetes, blood pressure, and cholesterol-lowering medication use assessed. They were followed for 10 years on average for new diabetes development.**

➢ **Using step-wise multivariate analysis, diabetes risk models were developed and applied to a large fasting population (n=133,764) along with lifestyle modification. Homeostasis model assessment of insulin resistance (HOMA$_{IR}$), and its reciprocal insulin sensitivity, and production (HOMA$_β$) parameters were calculated in all subjects and related to diabetic status.[3]**

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Introduction/Objectives

Methods

Results

Conclusions

References

RESULTS-1

➢ **Glucose, body mass index (BMI), log adiponectin, % log glycated albumin, parental diabetes, TG, and use of cholesterol-lowering medications entered the model (C statistic 0.924 for all parameters, 0.898 for biochemical variables only, and 0.876 for glucose alone). See Tables 1 and 2.**

➢ **In 133,764 subjects, 56.3% were normal, 36.2% were prediabetic, and 7.5% were diabetic, with predicted 10-year diabetes risk rates of 0.3%, 5.5%, and 100.0% (biochem. model). HOMA assessments indicated that diabetic subjects differed markedly in their degree of insulin resistance and insulin production. Some diabetic subjects clearly had markedly decreased insulin production requiring insulin therapy.**

Table 1 Ten Year Diabetes Risk Prediction Complete Model (Framingham Offspring Study)

Parameter ββ	β Value	Error	Odds Ratio*	P Value & C Stat.
Fasting glucose, mg/dL	0.1578	0.014	1.171	< 0.0001 0.924
Body mass index, kg/m^2	0.0943	0.022	1.099	< 0.0001
Log adiponectin	-0.9768	0.258	0.377	0.0002
Log glycated albumin	3.7174	1.063	41.16	0.0005
Parental diabetes, y/n	0.6662	0.238	1.947	0.0051
Fasting triglycerides, mg/dL	0.0032	0.001	1.003	0.0227
Cholesterol treatment, y/n	0.5706	0.285	1.769	0.0454

*The odds ratio represents the value per one unit change in the parameter shown. With fasting glucose only, the beta estimate was 0.1644 (0.010), the odds ratio was 1.179 (p<0.001) for every 1 mg/dL increase,

Table 1 Ten Year Diabetes Risk Prediction Biochemical Model (Framingham Offspring Study)

Parameter	β Value	Error	Odds Ratio	P Value	C Stat.
Fasting glucose, mg/dL	0.1520	0.011	1.164	< 0.0001	0.898
Log adiponectin	-1.0750	0.215	0.3413	< 0.0001	
Fasting triglycerides, mg/dL	0.0042	0.001	1.004	0.0003	
Log glycated albumin	2.8820	0.859	17.85	0.0008	

*The odds ratio represents the value per one unit change in the parameter shown. With fasting glucose only, the beta estimate was 0.1644 (0.010), the odds ratio was 1.179 (p<0.001) for every 1 mg/dL increase,

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RESULTS-3

Introduction/Objectives

Methods

Results

Conclusions

References

➢ **Of 9,738 prediabetics, 12.0% requested a personalized life-plan, and their diabetes risk (biochemical model), decreased from 5.7% to 3.1% (-46%) versus no change in controls (0.0%) (P<0.001).**

➢ **Of 2,017 diabetics, 10.7% received a life-plan; and 8.2% (+141%) were no longer diabetic after lifestyle change versus 3.4% of diabetics in the control group (P<0.001).**

➢ **Lifestyle changes were effective in decreasing insulin resistance, but did not significantly increase insulin production. Diabetics were almost all insulin resistant with decreased insulin sensitivity, and 25% had decreased insulin production. See Fig. 1**
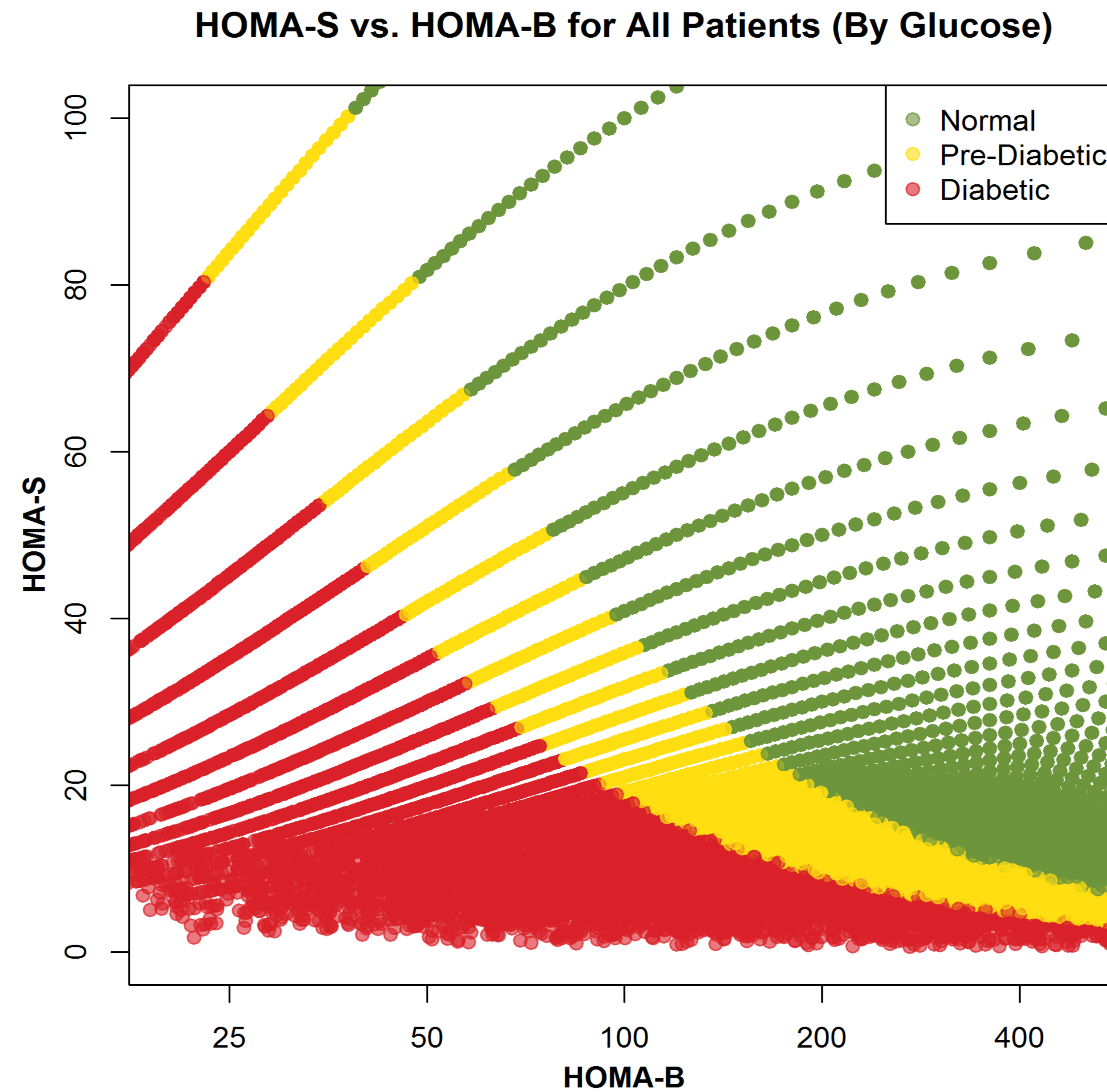
Red = Diabetics, Yellow = Prediabetics, and Green = Normals. The plot indicates that about 25% of diabetic subjects have decreased insulin production.

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Introduction/Objectives

Methods

Results

Conclusions

References

CONCLUSIONS

➤ **Accurate diabetes risk prediction models were developed and were found to be very accurate as compared to prior models.[4,5]**

➤ **Our biochemical model was useful in targeting pre-diabetic and diabetic subjects for lifestyle change; although fasting glucose alone was also highly predictive of future diabetes development.**

➤ **HOMA-IR and β assessment was found to be valuable in diabetes therapy because one can readily identify patients with decreased insulin production who require insulin therapy.**

➤ **Lifestyle change significantly lowered diabetes risk in prediabetic patients and was able to convert diabetics to nondiabetic status in a subset of diabetic patients.**

The Prediction and Prevention of Diabetes

Introduction/Objectives

Methods

Results

Conclusions

References

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