Effects of Race Are Rarely Included in Clinical Prediction Models for Cardiovascular Disease

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INTRODUCTION

Racial/ethnic status is frequently a strong predictor of clinical outcomes for an array of conditions, including cardiovascular disease (CVD).¹ Several popular clinical prediction models (CPMs) that help guide common medical decisions, such as equations for 10-year atherosclerotic CVD risk, estimated glomerular filtration rate, and pulmonary function, include terms for race. Nevertheless, the use of racial classifications in medicine and biomedical research has been contested based on evidence that there are few biological or genetic differences between races and concern that encoding racial/ethnic differences may reinforce discrimination, racism, and health disparities. To date, there has been no systematic evaluation of the role of race and ethnicity in CPMs. Our objective was to conduct a field synopsis of the role of race/ethnicity in a registry of CVD-related CPMs.

METHODS

We identified CPMs in the Tufts PACE CPM Registry, a systematic review of CVD-related CPMs published from 1/1990–3/2015 (www.pace.tuftsmedicalcenter.org/cpm).² Models developed from race-restricted cohorts (100% white or non-white) were excluded from this analysis ($n = 53$: 30 Asian-only, 21 white-only, 2 black-only). We assessed the proportion of models including the effect of race/ethnicity on CVD incidence or prognosis, and (among race-excluding models) the proportion providing any indication that race/ethnicity was considered as a candidate predictor (e.g., included in a list of candidate variables or a table reporting univariate statistics). We

compared model and cohort characteristics between race-including versus race-excluding models. We summarized the directionality of the effects of minority race (black and non-white) on outcomes.

RESULTS

Of 854 CVD-related CPMs, only 23 (3%) contained a coefficient for race, ethnicity, a combination of race/ethnicity, or presented race-stratified equations. Among the 831 models not including race/ethnicity, only 11% (91/831) reported that race/ethnicity was a candidate predictor, excluded based on statistical criteria. The racial/ethnic composition of the underlying cohort was reported for only 19% of models overall (160/854), but was reported in the majority of models that included race (22/23 (96%)) (Table 1). The proportion of white patients was similar (76%) in models that included versus excluded race. The inclusion of race/ethnicity as a covariate or stratification variable was more common in models predicting incidence of CVD in a general population, versus models predicting outcomes among patients with CVD or a history of CVD (8% (8/99) versus 2% (15/755), respectively, $p = 0.003$). Race/ethnicity was included infrequently in the most commonly occurring CPMs by patient index condition: heart failure (3%, 4/121), revascularization procedures (2%, 2/105), and acute coronary syndromes (3%, 3/89). The inclusion of race did not vary by model publication dates ($p = 0.50$).

Among the 18 models that reported a coefficient for the predictive effect of black or non-white race, 11 (61%) indicated a higher risk for these patients, while 5 (28%) indicated a lower risk (2 models indicated no risk difference between racial groups) (Fig. 1).

DISCUSSION

Despite well-known exceptions,³ race/ethnicity is rarely included as a predictor (or considered as a candidate

Table 1 The Inclusion of Race/Ethnicity in CVD-Related Clinical Prediction Models (n = 854)

	Including race/ethnicity, n (%)
Racial makeup reported?	
Yes, n = 160	22 (14%)
No, n = 694	1 (<1%)
Primary vs. secondary prevention	
Primary prevention, n = 99	8 (8%)
Secondary prevention, n = 755	15 (2%)
Top 5 most common index conditions, n	
Congestive heart failure, n = 115	4 (4%)
Revascularization, n = 104	2 (2%)
Acute coronary syndromes, n = 87	3 (3%)
Population sample, n = 66	7 (11%)
Ischemic stroke, n = 49	2 (4%)
Nationality	
North America, n = 351	21 (6%)
Europe, n = 279	1 (<1%)
Asia, n = 70	0 (0%)
International (> 1 continent), n = 63	1 (<1%)
Other, n = 28	0 (0%)
Not reported, n = 63	0 (0%)

predictor)—even in conditions for which prognostic effects have been documented.¹ When included, the predictive effect of race/ethnicity on outcome risks is often of a clinically significant magnitude; in approximately one third of race-including models, black/non-white patients had $\geq 50\%$ increased or decreased risk.

Fig. 1 The predictive effect of black or non-white race on CVD risk or prognosis by index condition-outcome pair (n = 18 models). Red circles represent estimates of the effect of non-white versus white race on CVD risk or prognosis. Black circles represent estimates of the effect of black versus non-black race on CVD risk or prognosis. Closed circles represent odds ratios and open circles represent hazard ratios.

The CPM literature appears to reflect a lack of consensus regarding “best practice” to cope with risk heterogeneity across different racial/ethnic groups. Concern that prior CVD risk models did not generalize well to non-white cohorts motivated the development of race-specific risk models in the Pooled Cohort Equations.³ Nevertheless, there is a long shameful history of misuse of racial classification in biomedical research,⁴ which may inhibit consideration of race in prediction models for fear of making clinical decisions race-sensitive.⁵ While this is a legitimate concern, excluding race in the presence of significant race effects yields CPM predictions that more closely reflect the prognosis of the majority racial/ethnic group, which may lead to inaccurate prognostication, and harmful decision-making. Establishing consensus and guidance about the appropriate use of race in prediction modeling is needed.

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Compliance with Ethical Standards:

Conflict of Interest: The authors declare that they do not have a conflict of interest.

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