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Objective

To estimate the extent to which diabetes interventions that achieve ethical criteria of health equity will reduce educational inequities in diabetes

Why Is This Important?

- Reducing health inequities is an important national and international public health priority
- Ethical criteria determine whether health differences between populations (i.e., inequalities) are unjust or unfair (i.e., inequities)
- Implicit in this definition is:
 - an indicator across which equity is being measured (e.g., health outcome)
 - the ethical criteria used to define the inequity (i.e., principles)
- In practice, ethical criteria of health equity are rarely defined; an important step for justifying action, identifying optimal interventions and measuring progress towards reducing inequities

Case Study

- The burden of diabetes continues to rise in Canada, with 8% of Canadians currently living with diabetes
- Social inequities in diabetes exist, with uncertainty regarding which interventions will optimally reduce the observed inequities
- Understanding the impact of diabetes intervention strategies informed by ethical criteria of health equity on diabetes burden and social inequities in diabetes is an important challenge requiring further investigation

Methods

Study Population

- Data from the cross-sectional 2015-16 Canadian Community Health Survey (CCHS)
- CCHS collects self-reported information related to the health status, health care utilization and health determinants of the Canadian population
- Of the 103,766 CCHS respondents, the study population was restricted to individuals over 28 years of age, diabetes free, not pregnant and with complete covariate information (n=67,867, 57% women)

Diabetes Population Risk Tool (DPoRT)

- DPoRT 2.0 is validated to calculate up to 10-year diabetes risk in individuals over 20 years of age and without diabetes
- Weibull survival distribution is used to predict an individual's risk of developing physician diagnosed diabetes based on self-reported risk factors
- DPoRT covariates include: age, sex, body mass index, ethnicity, immigrant status, education, income, smoking, history of hypertension and heart disease
- DPoRT 2.0 has demonstrated strong calibration (H-L $X^2 < 20$, $p < 0.01$) and discrimination (C-statistic = 0.77)

Estimating Diabetes Risk Using DPoRT

- Outcomes: 10-year DPoRT Risk and diabetes incidence measured across education categories
- Education was classified into 4 groups: less than secondary graduation, secondary graduation, some post-secondary, bachelors level or higher
- High-risk individuals were identified using a derived DPoRT high-risk cut off $\geq 16.5\%$
- Survey weights are summed to provide a total count of diabetes incidence at the population level
- Confidence intervals were calculated using bootstrap techniques to account for the complex survey design

Intervention Scenarios

Intervention effectiveness =

average baseline risk (DPoRT risk)*population size* intervention efficacy*intervention coverage

- Hypothetical percent weight-loss interventions in overweight and obese individuals were modelled for each ethical criterion, increasing until inequities were eliminated (Table 1)
- Educational inequities in diabetes were measured on the relative scale by comparing the lowest to the highest education categories

Table 1: Modelling ethical criteria of health equity

Principles of equity	Equity of diabetes outcomes
Simple equality:	<ul style="list-style-type: none"> equalize diabetes risk by targeting education categories disproportionately according to baseline diabetes risk
'Equality of health'	
Sufficiency:	<ul style="list-style-type: none"> reduce risk below the DPoRT high-risk threshold ($\geq 16.5\%$) in high-risk individuals, beyond which remaining inequalities are not considered ethically important
'Sufficiency of health'	

Results

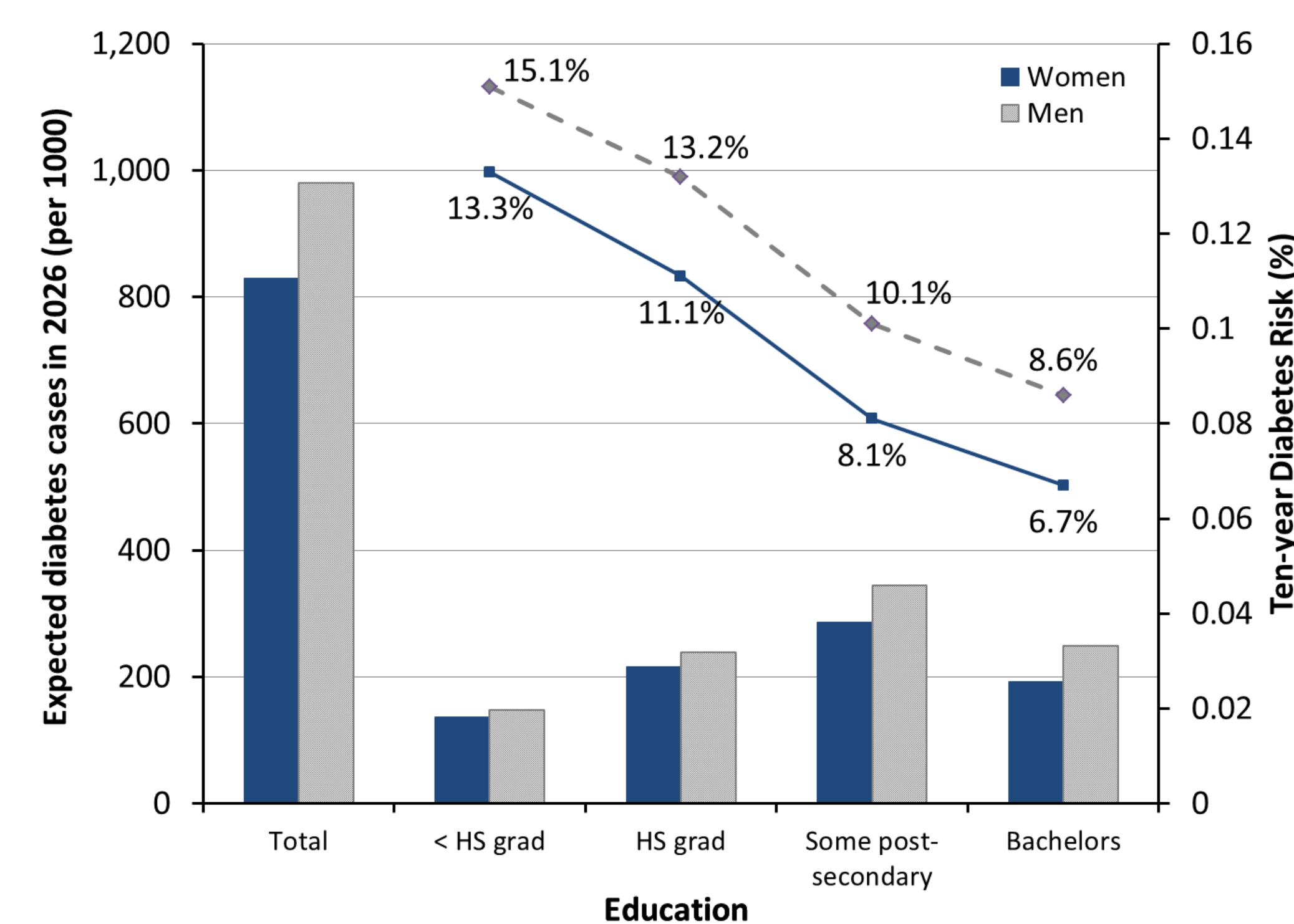


Figure 1: Ten-year predicted number of diabetes cases and diabetes risk by categories of education

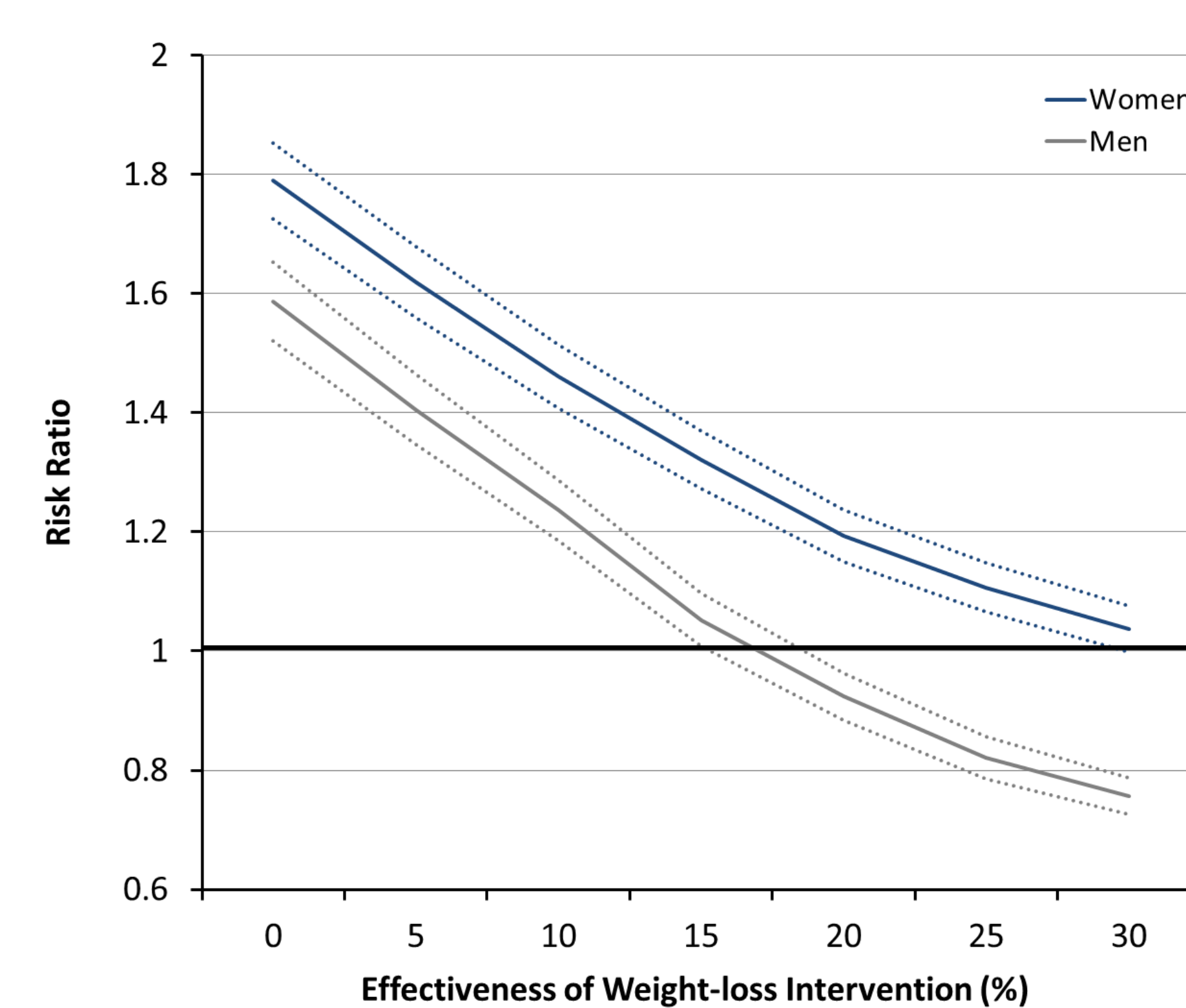


Figure 2: Sex-specific relative educational inequalities in diabetes comparing lowest to highest education categories with increasing hypothetical weight-loss interventions

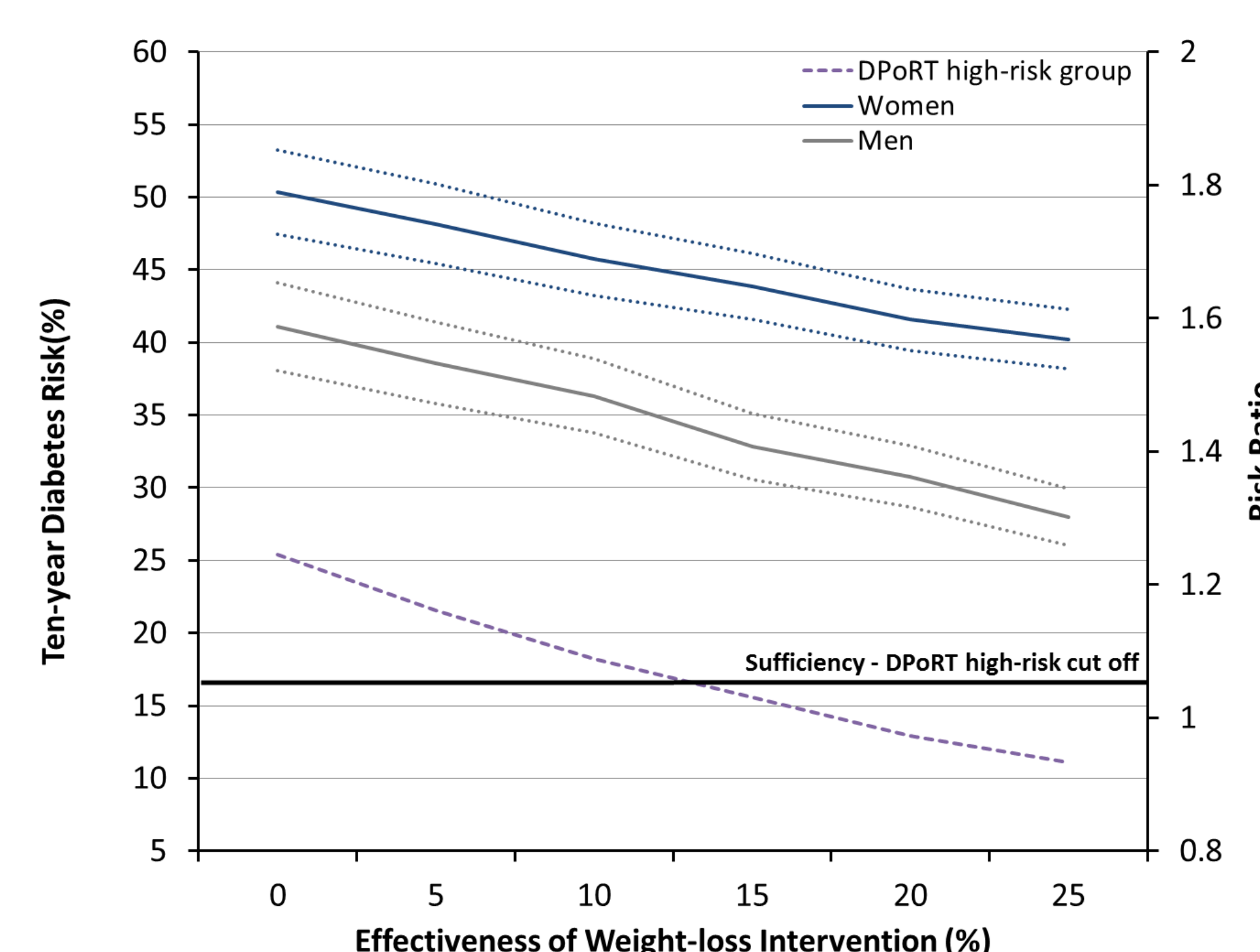


Figure 3: DPoRT risk and relative educational inequalities in diabetes comparing lowest to highest education categories with increasing hypothetical weight-loss interventions

Results (continued)

Projected Diabetes Burden in Baseline Scenario (Figure 1)

- 1.81 million new diabetes cases were predicted by 2026, with diabetes incidence higher in men than women
- An inverse gradient in 10-year diabetes risk was observed across education categories in women and men
- Education inequities in diabetes were higher in women (risk ratio (RR)=1.79, 95% confidence interval (CI): 1.73,1.85) than men (RR=1.59, 95%CI: 1.52, 1.65) comparing low to high education categories

Achieving Simple Equality (Figure 2)

- Implementing 30% and 22% weight-loss interventions in low and medium education categories respectively eliminated relative educational inequities in women and men
- The level of intervention required to eliminate diabetes inequities was higher in women than men
- In total, 308,485 diabetes cases were prevented or delayed

Achieving Sufficiency of Health (Figure 3)

- 'Sufficiency' was achieved by a 14% weight-loss intervention in high-risk individuals
- Large educational inequalities in diabetes remained at this level of intervention in both women and men (women: RR= 1.65, 95%CI: 1.60-1.70; men: RR= 1.41, 95%CI: 1.36-1.46 comparing low to high education categories)
- In total, 267,690 diabetes cases were prevented or delayed

Strengths and Limitations

Strengths

- This study quantifies intervention benefits of achieving ethical criteria for health equity, a noted gap in bridging ethics and epidemiology
- Baseline diabetes risk and intervention impacts estimated with a well validated risk prediction tool (DPoRT)

Limitations

- Intervention benefits may be overestimated if high-risk individuals are already receiving preventive interventions
- Next steps of this work will more directly link hypothetical to real-world diabetes interventions

Key Messages

- Using the case study of diabetes in Canada, the choice of ethical criteria of health equity was demonstrated to have a significant impact on:
 - intervention scope and target population
 - intervention benefit
 - remaining differences (inequalities) in diabetes across education groups
- Modelling two ethical criteria, both with the aim of reducing diabetes inequities, demonstrated disparate effects on population-level and social inequities in diabetes
- An explicit definition of ethical criteria of health equity is essential to informing interventions that aim to reduce health inequities