Individualized risk prediction for type 2 diabetes

Table 0: Participants included.

| **Inclusion criteria** | **DPP** | **MESA** |
| --- | --- | --- |
| Study participants | 3,665 | 6,814 |
| Pre-diabetic at baseline1 | 3,152 | 1,067 |
| Randomized to placebo, metformin, or lifestyle | 2,640 | -- |
| *Abbreviations: DPP = Diabetes Prevention Program; and MESA = Multi-Ethnic Study of Atherosclerosis* | | |
| *1Baseline for Multi-Ethnic Study of Atherosclerosis participants was visit 1 or 2 dependent on pre-diabetes status* | | |

Table 1: Descriptive table of Diabetes Prevention Program and Multi-Ethnic Study of Atherosclerosis participants included in the current analysis

| **Characteristic** | **DPP, N = 2,640** | **MESA, N = 1,067** |
| --- | --- | --- |
| Age, years | 51 (11) | 64 (10) |
| Sex |  |  |
| Male | 864 (33%) | 579 (54%) |
| Female | 1,776 (67%) | 488 (46%) |
| Race/ethnicity |  |  |
| Non-Hispanic White | 1,626 (62%) | 326 (31%) |
| Non-Hispanic Black | 423 (16%) | 197 (18%) |
| Hispanic | 448 (17%) | 311 (29%) |
| Other/Chinese | 143 (5.4%) | 233 (22%) |
| Educational attainment |  |  |
| < High School | 1,352 (51%) | 196 (23%) |
| High School Graduate | 574 (22%) | 168 (20%) |
| Some College or College Graduate | 714 (27%) | 496 (58%) |
| Fasting glucose, mg/dl | 106 (7) | 107 (7) |
| Glycated Hemoglobin, % | 5.78 (0.40) | 5.99 (0.18) |
| HOMA-Insulin Resistance | 6.0 (4.2, 8.6) | --- |
| HOMA-Beta cell function | 199 (136, 272) | --- |
| Body mass index, kg/m2 | 34 (7) | 30 (6) |
| Triglycerides, mg/dl | 144 (101, 205) | 124 (88, 176) |
| Low-density lipoprotein cholesterol, mg/dl | 107 (27) | --- |
| High-density lipoprotein cholesterol, mg/dl | 46 (12) | --- |

Table 2: Descriptive table of Diabetes Prevention Program and Multi-Ethnic Study of Atherosclerosis participants excluded from the current analysis

| **Characteristic** | **DPP, N = 1,025** | **MESA, N = 9,565** |
| --- | --- | --- |
| Age, years | 52 (10) | 62 (10) |
| Sex |  |  |
| Male | 364 (36%) | 4,390 (46%) |
| Female | 661 (64%) | 5,175 (54%) |
| Race/ethnicity |  |  |
| Non-Hispanic White | 491 (48%) | 4,208 (44%) |
| Non-Hispanic Black | 328 (32%) | 1,716 (18%) |
| Hispanic | 161 (16%) | 2,130 (22%) |
| Other/Chinese | 45 (4.4%) | 1,511 (16%) |
| Educational attainment |  |  |
| < High School | 550 (54%) | 677 (14%) |
| High School Graduate | 186 (18%) | 837 (18%) |
| Some College or College Graduate | 289 (28%) | 3,241 (68%) |
| Fasting glucose, mg/dl | 110 (9) | 89 (8) |
| Glycated Hemoglobin, % | 6.23 (0.60) | 5.39 (0.37) |
| HOMA-Insulin Resistance | 6.7 (4.5, 9.1) | --- |
| HOMA-Beta cell function | 188 (130, 263) | --- |
| Body mass index, kg/m2 | 34.4 (6.8) | 27.7 (5.2) |
| Triglycerides, mg/dl | 133 (96, 194) | 107 (76, 153) |
| Low-density lipoprotein cholesterol, mg/dl | 108 (28) | --- |
| High-density lipoprotein cholesterol, mg/dl | 45 (12) | --- |

Table 3. Cumulative incidence of diabetes over follow-up in the Diabetes Prevention Program and Multi-Ethnic Study of Atherosclerosis

|  | **DPP** | **MESA** |
| --- | --- | --- |
| Over all follow-up time | | |
| Number at risk | 2,640 | 1,067 |
| Total follow-up time, person-years | 7,305 | 8,143 |
| Median (95% CI) follow-up time, years | 3.0 (3.0, 3.0) | 10 (9.5, 14) |
| Up to three years after baseline | | |
| Number of incident cases | 386 | 186 |
| Incidence rate, per 100 years | 5.9 | 6.4 |
| Cumulative incidence (95% CI), % | 17 (16, 19) | 18 (15, 20) |

Table 4. Comparison of the individualized model with standard model.

| **Evaluation statistic1** | **Internal Validation2** | | **External Validation** | |
| --- | --- | --- | --- | --- |
| **Standard** | **Individualized** | **Standard** | **Individualized** |
| NRI | 0 (ref) | 3.4 (-0.38, 7.1) | 0 (ref) | -2.9 (-4.6, -0.83) |
| NRI+ | 0 (ref) | 1.8 (-1.5, 5.1) | 0 (ref) | 0.04 (-1.5, 1.7) |
| NRI- | 0 (ref) | 1.6 (-0.04, 3.0) | 0 (ref) | -3.0 (-4.2, -1.8) |
| AUC | 69.8 (66.7 73.0) | 70.7 (67.6 73.9) | 78.7 (75.2 82.3) | 78.4 (74.9 82.0) |
| IPA | 9.9 | 10.4 | 14.8 | 14.8 |
| Race/ethnicity | | | | |
| Demographic parity | 92 | 88 | 89 | 91 |
| Equal opportunity | 89 | 94 | 91 | 97 |
| Equal odds | 89 | 87 | 91 | 92 |
| Sex | | | | |
| Demographic parity | 100 | 100 | 80 | 81 |
| Equal opportunity | 95 | 97 | 92 | 93 |
| Equal odds | 95 | 97 | 80 | 79 |
| Abbreviations: AUC = Area underneath the receiver-operator characteristic curve; IPA = Index of prediction accuracy; and NRI = Net reclassification index | | | | |
| 1Table values are scaled by a factor of 100 for ease of interpretation. | | | | |
| 2Internal validation results are based on 10-fold cross-validation in the Diabetes Prevention Program data | | | | |
| 3External validation results are based on application of models fitted to the Diabetes Prevention Program data to the Multi-Ethnic Study of Atherosclerosis data. | | | | |

Table 5A: Reclassification matrix comparing individualized versus standard risk classification among participants in the Diabetes Prevention Program (internal) and the Multi-Ethnic Study of Atherosclerosis (external)

| **Standard risk categories** | **Individualized risk categories** | | |
| --- | --- | --- | --- |
| **0 to < 10%** | **10% to < 20%** | **≥ 20%** |
| Internal data | | | |
| 0 to < 10% | 706 (27%) | 158 (6.0%) | 3 (0.11%) |
| 10% to < 20% | 170 (6.4%) | 791 (30%) | 61 (2.3%) |
| ≥ 20% | 0 | 114 (4.3%) | 637 (24%) |
| External data | | | |
| 0 to < 10% | 283 (27%) | 29 (2.7%) | 0 |
| 10% to < 20% | 3 (0.28%) | 500 (47%) | 8 (0.75%) |
| ≥ 20% | 0 | 0 | 244 (23%) |

Table 5B: Reclassification matrix comparing individualized versus standard risk classification among men and women.

| **Standard risk categories** | **Individualized risk categories** | | |
| --- | --- | --- | --- |
| **0 to < 10%** | **10% to < 20%** | **≥ 20%** |
| Men | | | |
| 0 to < 10% | 410 (28%) | 72 (5.0%) | 0 |
| 10% to < 20% | 63 (4.4%) | 499 (35%) | 26 (1.8%) |
| ≥ 20% | 0 | 33 (2.3%) | 340 (24%) |
| Women | | | |
| 0 to < 10% | 579 (26%) | 115 (5.1%) | 3 (0.13%) |
| 10% to < 20% | 110 (4.9%) | 792 (35%) | 43 (1.9%) |
| ≥ 20% | 0 | 81 (3.6%) | 541 (24%) |

Table 5C: Reclassification matrix comparing individualized versus standard risk classification among men and women.

| **Standard risk categories** | **Individualized risk categories** | | |
| --- | --- | --- | --- |
| **0 to < 10%** | **10% to < 20%** | **≥ 20%** |
| Caucasian | | | |
| 0 to < 10% | 504 (26%) | 104 (5.3%) | 2 (0.10%) |
| 10% to < 20% | 97 (5.0%) | 656 (34%) | 47 (2.4%) |
| ≥ 20% | 0 | 73 (3.7%) | 469 (24%) |
| African American | | | |
| 0 to < 10% | 170 (27%) | 37 (6.0%) | 1 (0.16%) |
| 10% to < 20% | 33 (5.3%) | 209 (34%) | 9 (1.5%) |
| ≥ 20% | 0 | 19 (3.1%) | 142 (23%) |
| Hispanic | | | |
| 0 to < 10% | 236 (31%) | 34 (4.5%) | 0 |
| 10% to < 20% | 28 (3.7%) | 268 (35%) | 7 (0.92%) |
| ≥ 20% | 0 | 16 (2.1%) | 170 (22%) |
| Other | | | |
| 0 to < 10% | 79 (21%) | 12 (3.2%) | 0 |
| 10% to < 20% | 15 (4.0%) | 158 (42%) | 6 (1.6%) |
| ≥ 20% | 0 | 6 (1.6%) | 100 (27%) |