**Supplemental Table 1**: Demographic variables at baseline among individuals with youth-onset diabetes registered by the SEARCH Study, by presence of first and second retinal image. N (%) displayed except for age (mean [standard deviation]).

| | Type 1 | | | Type 2 | | |
|---|---|---|---|---|---|---|
| | Total | First Image | Second[1] Image | Total | First Image | Second[1] Image |
| | n=7277 | n=2519 | n=1014 | n=1919 | n=447 | n=239 |
| **Years from diagnosis** | | | | | | |
| **Age at diagnosis, years** | 9.9 (±4.6) | 9.5 (±4.3) | 9.2 (±4.4) | 14.7 (±2.8) | 14.3 (±2.7) | 14.2 (±2.7) |
| **Sex** | | | | | | |
| Female | 3,426 (47.1) | 1,259 (50.0) | 562 (55.4) | 1,170 (61.0) | 293 (65.5) | 158 (66.1) |
| Male | 3,851 (52.9) | 1,260 (50.0) | 452 (44.6) | 749 (39.0) | 154 (34.5) | 81 (33.9) |
| **Race/ethnicity** | | | | | | |
| Non-Hispanic Black | 887 (12.2) | 303 (12.0) | 171 (16.9) | 705 (36.7) | 203 (45.4) | 107 (44.8) |
| Hispanic | 922 (12.7) | 345 (13.7) | 204 (20.1) | 476 (24.8) | 111 (24.8) | 53 (22.2) |
| Non-Hispanic White | 5,014 (68.9) | 1,794 (71.2) | 601 (59.3) | 409 (21.3) | 86 (19.2) | 55 (23.0) |
| Other | 454 (6.2) | 77 (3.1) | 38 (3.7) | 329 (17.1) | 47 (10.5) | 24 (10.0) |
| **Year of diagnosis** | | | | | | |
| 2002 | 1,007 (13.8) | 323 (12.8) | 151 (14.9) | 265 (13.8) | 56 (12.5) | 41 (17.2) |
| 2003 | 962 (13.2) | 353 (14.0) | 163 (16.1) | 259 (13.5) | 44 (9.8) | 34 (14.2) |
| 2004 | 965 (13.3) | 365 (14.5) | 172 (17.0) | 247 (12.9) | 52 (11.6) | 37 (15.5) |
| 2005 | 1,080 (14.8) | 336 (13.3) | 154 (15.2) | 256 (13.3) | 54 (12.1) | 41 (17.2) |
| 2006 | 1,069 (14.7) | 383 (15.2) | 155 (15.3) | 274 (14.3) | 49 (11.0) | 32 (13.4) |
| 2008 | 1,117 (15.3) | 485 (19.3) | 219 (21.6) | 288 (15.0) | 74 (16.6) | 54 (22.6) |
| 2012 | 1,077 (14.8) | 274 (10.9) | 0 (0.0) | 330 (17.2) | 118 (26.4) | 0 (0.0) |
| **Site** | | | | | | |
| South Carolina | 1,562 (21.5) | 506 (20.1) | 197 (19.4) | 644 (33.6) | 154 (34.5) | 91 (38.1) |
| Ohio | 959 (13.2) | 433 (17.2) | 167 (16.5) | 218 (11.4) | 82 (18.3) | 46 (19.2) |
| Colorado/Arizona/ New Mexico | 2,234 (30.7) | 840 (33.3) | 316 (31.2) | 359 (18.7) | 87 (19.5) | 49 (20.5) |
| California | 888 (12.2) | 303 (12.0) | 191 (18.8) | 471 (24.5) | 99 (22.1) | 43 (18.0) |
| Washington | 1,634 (22.5) | 437 (17.3) | 143 (14.1) | 227 (11.8) | 25 (5.6) | 10 (4.2) |

[1]For type 1 diabetes, all non-Hispanic black, Hispanic, and other non-White racial/ethnic groups invited for the second follow-up and a random sample of participants with non-Hispanic White race/ethnicity invited for the second follow-up visit

**Supplemental Table 2a**: Inputs for population prevalence estimation in persons with type 1 diabetes by image time period, standardized by sex and race/ethnicity. Retinopathy defined as mild or moderate non-proliferative, or proliferative diabetic retinopathy. Missing retinopathy outcomes (n=73 for at first photo and n=38 at second image) excluded from sample numerator and denominators. Population prevalence estimated using http://krothman.org/Episheet.xls

| Stratum | First retinal imaging (n=2519) | | Second retinal imaging (n=1014) | |
|---|---|---|---|---|
| | Registered cases (n=7277) | N DR/N screened (509/2446) | Registered cases (n=7277) | N DR/N screened (511/976) |
| Female, Asian/Pacific Islander | 103 | 7/33 (21.2%) | 103 | 7/19 (36.8%) |
| Female, Black | 468 | 58/173 (33.5%) | 468 | 67/107 (62.6%) |
| Female, Hispanic | 449 | 40/176 (22.7%) | 449 | 54/112 (48.2%) |
| Female, Native American[1] | 19 | 2/5 (40.0%) | 19 | 2/4 (50.0%) |
| Female, Other[1] | 36 | 2/2 (100.0%) | 36 | 1/2 (50.0%) |
| Female, Unknown[1] | 79 | 0/1 (0.0%) | 79 | 0/1 (0.0%) |
| Female, White | 2272 | 158/833 (19.0%) | 2272 | 155/294 (52.7%) |
| Male, Asian/Pacific Islander | 72 | 3/21 (14.3%) | 72 | 4/6 (66.7%) |
| Male, Black | 419 | 29/118 (24.6%) | 419 | 34/56 (60.7%) |
| Male, Hispanic | 473 | 33/162 (20.4%) | 473 | 49/84 (58.3%) |
| Male, Native American[2] | 23 | 2/8 (25.0%) | 23 | 3/3 (100.0%) |
| Male, Other[2] | 31 | 1/4 (25.0%) | 31 | 1/2 (50.0%) |
| Male, Unknown[2] | 91 | 0/0 (0.0%) | 91 | 0/0 (0.0%) |
| Male, White | 2742 | 174/910 (19.1%) | 2742 | 134/286 (46.9%) |
| **Population prevalence (95% CI)** | **0.21 (0.20, 0.23)** | | **0.52 (0.49, 0.55)** | |

[1]Combined into one group (Group 1) for standardized prevalence estimation
[2]Combined into one group (Group 2) for standardized prevalence estimation

**Supplemental Table 2b**: Inputs for population prevalence estimation in type 2 diabetics by image, standardized by sex and race/ethnicity. Retinopathy defined as mild or moderate non-proliferative, or proliferative diabetic retinoapthy. Missing retinopathy outcomes (n=12 at first photo and n=10 at second photo) excluded from sample numerator and denominators. Population prevalence estimated using http://krothman.org/Episheet.xls

| Stratum | First retinal imaging (n=447) | | Second retinal imaging (n=239) | |
| --- | --- | --- | --- | --- |
| | Registered cases (n=1919) | N DR/N screened (135/435) | Registered cases (n=1919) | N DR/N screened (126/229) |
| Female, Asian/Pacific Islander | 47 | 1/7 (14.3%) | 47 | 0/1[3] (0.0%) |
| Female, Black | 476 | 41/142 (28.9%) | 476 | 45/73 (61.6%) |
| Female, Hispanic | 276 | 19/69 (27.5%) | 276 | 16/36 (44.4%) |
| Female, Native American[1] | 77 | 7/17 (41.2%) | 77 | 5/7 (71.4%) |
| Female, Other[1] | 17 | 0/1 (0.0%) | 17 | 0/1 (0.0%) |
| Female, Unknown[1] | 54 | 0/0 (0.0%) | 54 | 0/0 (0.0%) |
| Female, White | 223 | 13/47 (27.7%) | 223 | 15/34 (44.1%) |
| Male, Asian/Pacific Islander | 32 | 3/7 (42.9%) | 32 | 1/2 (50.0%) |
| Male, Black | 229 | 19/55 (34.5%) | 229 | 19/27 (70.4%) |
| Male, Hispanic | 200 | 14/39 (35.9%) | 200 | 11/15 (73.3%) |
| Male, Native American[2] | 51 | 3/13 (23.1%) | 51 | 4/12 (33.3%) |
| Male, Other[2] | 11 | 0/0 (0.0%) | 11 | 0/0 (0.0%) |
| Male, Unknown[2] | 40 | 0/0 (0.0%) | 40 | 0/0 (0.0%) |
| Male, White | 186 | 15/38 (39.5%) | 186 | 10/21 (47.6%) |
| **Population prevalence (95% CI)** | **0.3132 (0.2675, 0.3589)** | | **0.5572 (0.4871, 0.6272)** | |

[1]Combined into one group (Group 1) for standardized prevalence estimation
[2]Combined into one group (Group 2) for standardized prevalence estimation
[3]Added into Group 1 for prevalence estimation

**Supplemental Table 3a**: Retinopathy progression from first retinal imaging to second retinal imaging for participants with youth-onset type 1 diabetes (n=1014).

| First image | Second image | | | | | |
|---|---|---|---|---|---|---|
| | None n (%)[1] | Mild, non-proliferative n (%)[1] | Moderate, non-proliferative n (%)[1] | Proliferative n (%)[1] | *Missing* | Total |
| None | 414 (55.7) | 306 (40.9) | 27 (3.6) | 2 (0.2) | 19 | 768 |
| Mild | 39 (20.6) | 120 (63.5) | 28 (14.8) | 2 (1.1) | 13 | 202 |
| Moderate | 0 (0.0) | 5 (45.5) | 3 (27.3) | 3 (27.3) | 1 | 12 |
| Proliferative | 0 (0.0) | 0 (0.0) | 0 (0.0) | 1 (100.0) | 0 | 1 |
| *Missing* | 12 | 11 | 1 | 2 | 5 | 31 |
| Total | 465 | 442 | 59 | 10 | 38 | 1014 |

[1]Row percentages displayed, e.g., percent of none at first image that remain none at second image

**Supplemental Table 3b**: Retinopathy progression from first retinal imaging to second retinal imaging for participants with youth-onset type 2 diabetes (n=239).

| First image | Second image | | | | | |
|---|---|---|---|---|---|---|
| | None n (%)[1] | Mild, non-proliferative n (%)[1] | Moderate, non-proliferative n (%)[1] | Proliferative n (%)[1] | *Missing* | Total |
| None | 90 (59.6) | 54 (35.8) | 6 (4.0) | 1 (0.6) | 3 | 154 |
| Mild | 9 (14.8) | 34 (55.7) | 14 (23.0) | 4 (6.6) | 5 | 66 |
| Moderate | 1 (7.7) | 2 (15.4) | 6 (46.2) | 4 (30.8) | 0 | 13 |
| Proliferative | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 | 0 |
| *Missing* | 3 | 1 | 0 | 0 | 2 | 6 |
| Total | 103 | 91 | 26 | 9 | 10 | 239 |

[1]Row percentages displayed, e.g., percent of none at first image that remain none at second image

**Supplementary Table 4**. Associations between modifiable risk factors and diabetic retinopathy, youth-onset type 1 diabetes – The SEARCH for Diabetes in Youth Study (2002-2019). Unweighted estimates.

| | First retinal image | | Second retinal image | |
|---|---|---|---|---|
| | Crude RR (95% CI) | Adjusted RR (95% CI) | Crude RR (95% CI) | Adjusted RR (95% CI) |
| **Baseline A1C[1]** | 1.16 (1.11, 1.2) | 1.12 (1.07, 1.17) | 1.07 (1.04, 1.10) | 1.05 (1.03, 1.08) |
| **A1C AUC[2]** | 1.28 (1.27, 1.30) | 1.22 (1.16, 1.29) | 1.06 (1.03, 1.09) | 1.15 (1.10, 1.19) |
| **BMIz at baseline[3]** | 1.10 (1.02, 1.19) | 1.08 (0.99, 1.16) | 1.07 (1.01, 1.13) | 1.06 (1.01, 1.12) |
| **BMI category (ref: normal)[3]** | | | | |
| Overweight | 1.09 (0.89, 1.34) | 1.09 (0.88, 1.35) | 0.99 (0.84, 1.16) | 0.97 (0.84, 1.12) |
| Obese | 1.36 (1.1, 1.68) | 1.27 (1.02, 1.58) | 1.11 (0.95, 1.30) | 1.08 (0.95, 1.24) |
| **Waist-height ratio at baseline[3,7]** | 1.12 (0.97, 1.30) | 1.03 (0.90, 1.20) | 1.08 (0.98, 1.20) | 1.07 (0.99, 1.16) |
| **Change in BMI z-score[4]** | 0.87 (0.80, 0.95) | 0.89 (0.82, 0.97) | 0.93 (0.88, 0.99) | 0.95 (0.91, 0.99) |
| **Change in BMI category (ref: normal/normal)[4]** | | | | |
| Normal/overweight | 0.87 (0.49, 1.54) | 0.65 (0.38, 1.11) | 1.08 (0.93, 1.27) | 0.98 (0.87, 1.10) |
| Overweight/normal | 0.94 (0.34, 2.63) | 0.80 (0.43, 1.48) | 1 (0.78, 1.29) | 0.93 (0.76, 1.14) |
| Overweight/overweight | 1.21 (1.02, 1.42) | 1.03 (0.88, 1.22) | 1.09 (0.94, 1.26) | 0.95 (0.85, 1.05) |
| **Change in waist-height ratio[4,7]** | 1.27 (1.12, 1.45) | 1.23 (1.07, 1.41) | 1.11 (1.01, 1.21) | 1.01 (0.93, 1.10) |
| **Systolic BP z-score at BL[5]** | 1.04 (0.96, 1.13) | 0.97 (0.89, 1.06) | 1.00 (0.94, 1.07) | 1.01 (0.96, 1.05) |
| **Diastolic BP z-score at BL[5]** | 1.05 (0.96, 1.15) | 0.98 (0.89, 1.07) | 0.98 (0.92, 1.05) | 1.00 (0.96, 1.03) |
| **Systolic BP z-score change[6]** | 0.93 (0.86, 0.99) | 0.88 (0.8, 0.96) | 1.04 (0.99, 1.10) | 1.05 (1.01, 1.09) |
| **Diastolic BP z-score change[6]** | 1.07 (0.99, 1.15) | 1.02 (0.93, 1.12) | 1.09 (1.04, 1.14) | 1.08 (1.01, 1.15) |

[1]Adjusted for BMI z-score at baseline, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[2]Adjusted for Baseline A1C, BMI z-score at baseline, Change in BMI z-score, Duration since dx, Insurance status, Race/ethnicity, Site
[3]Adjusted for Baseline A1C, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[4] Change in BMI category represents overweight or obesity status at first and second retinal imaging. Adjusted for BMI z-score (waist-height) at baseline, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site; BMI category models don't include BMI baseline category
[5]Adjusted for Baseline A1C, A1C AUC, BMI z-score at baseline, Change in BMI z-score, Duration since dx, Race/ethnicity, Site
[6]Adjusted for Baseline A1C, A1C AUC, BMI z-score at baseline, BP z-score at baseline, Change in BMI z-score, Duration since dx, Site
[7]Risk ratio is for increase of 0.1
AUC=area under the curve; BMI-body mass index; SBP=systolic blood pressure; DBP=diastolic blood pressure; HS=high school; Assoc=Associate

**Supplementary Table 5**. Associations between modifiable risk factors and diabetic retinopathy, youth-onset type 2 diabetes – The SEARCH for Diabetes in Youth Study (2002-2019). Unweighted estimates.

| | First retinal image | | Second retinal image | |
|---|---|---|---|---|
| | Crude RR (95% CI) | Adjusted RR (95% CI) | Crude RR (95% CI) | Adjusted RR (95% CI) |
| **Baseline A1C[1]** | 1.19 (1.14, 1.23) | 1.20 (1.15, 1.25) | 1.09 (1.07, 1.11) | 1.08 (1.04, 1.12) |
| **A1C AUC[2]** | 1.22 (1.19, 1.25) | 1.20 (1.10, 1.30) | 1.14 (1.11, 1.18) | 1.14 (1.09, 1.19) |
| **BMIz at baseline[3]** | 0.95 (0.75, 1.21) | 1.11 (0.91, 1.34) | 1.10 (0.87, 1.40) | 1.10 (0.89, 1.34) |
| **BMI category (ref: normal)[3]** | | | | |
| Overweight | 2.10 (0.99, 4.46) | 2.5 (1.25, 5.03) | 4.29 (1.18, 15.63) | 3.57 (1.05, 12.15) |
| Obese | 1.11 (0.54, 2.27) | 1.61 (0.82, 3.16) | 3.28 (0.92, 11.69) | 2.81 (0.84, 9.42) |
| **Waist-height ratio at baseline[3,7]** | 0.98 (0.86, 1.13) | 1.03 (0.93, 1.14) | 1.02 (0.89, 1.15) | 1.02 (0.91, 1.15) |
| **Change in BMI z-score[4]** | 0.73 (0.59, 0.90) | 0.74 (0.64, 0.85) | 0.72 (0.68, 0.77) | 0.75 (0.66, 0.86) |
| **Change in BMI category (ref: normal/normal)[4]** | | | | |
| Normal/overweight | 3.50 (1.06, 11.51) | 5.95 (2.14, 16.55) | 0.33 (0.03, 3.84) | 0.39 (0.03, 4.95) |
| Overweight/normal | 0 (0, Inf) | 0 (0, Inf) | 2.36 (0.46, 11.95) | 2.66 (0.46, 15.45) |
| Overweight/overweight | 1.60 (0.65, 3.91) | 1.92 (0.79, 4.68) | 1.64 (0.33, 8.17) | 1.90 (0.33, 10.89) |
| **Change in waist-height ratio[4,7]** | 0.85 (0.83, 0.87) | 0.87 (0.81, 0.93) | 0.90 (0.78, 1.03) | 0.81 (0.70, 0.93) |
| **Systolic BP z-score at BL[5]** | 0.98 (0.85, 1.13) | 0.92 (0.79, 1.06) | 1.13 (0.99, 1.28) | 1.07 (0.96, 1.19) |
| **Diastolic BP z-score at BL[5]** | 1.09 (0.93, 1.27) | 0.99 (0.85, 1.14) | 1.11 (0.97, 1.28) | 1.03 (0.93, 1.14) |
| **Systolic BP z-score change[6]** | 1.02 (0.91, 1.15) | 1.00 (0.87, 1.15) | 1.07 (0.99, 1.16) | 1.10 (1.00, 1.20) |
| **Diastolic BP z-score change[6]** | 1.06 (0.93, 1.21) | 1.09 (0.94, 1.27) | 1.09 (0.99, 1.2) | 1.15 (1.00, 1.33) |

[1]Adjusted for BMI z-score at baseline, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[2]Adjusted for Baseline A1C, BMI z-score at baseline, Change in BMI z-score, Duration since dx, Insurance status, Race/ethnicity, Site
[3]Adjusted for Baseline A1C, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[4] Change in BMI category represents overweight or obesity status at first and second retinal imaging. Adjusted for BMI z-score (waist-height, BMI category) at baseline, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[5]Adjusted for Baseline A1C, A1C AUC, BMI z-score at baseline, Change in BMI z-score, Duration since dx, Race/ethnicity, Site
[6]Adjusted for Baseline A1C, A1C AUC, BMI z-score at baseline, BP z-score at baseline, Change in BMI z-score, Duration since dx, Site
[7]Risk ratio is for an increase of 0.1 units in the modifiable exposure of interest
AUC=area under the curve; BMI-body mass index; SBP=systolic blood pressure; DBP=diastolic blood pressure; HS=high school; Assoc=Associate

**Supplementary Table 6**. Associations between modifiable risk factors and diabetic retinopathy progression, youth-onset type 1 diabetes – The SEARCH for Diabetes in Youth Study (2002-2019). Models standardized to sample of N=6200 eligible for both images using inverse probability of selection weighted model including age, sex, race, year of diagnosis, and clinic

| | Crude RR (95% CI) | Adjusted RR (95% CI) |
|---|---|---|
| **Baseline A1C**[1] | 1.02 (0.97, 1.07) | 1.03 (0.98, 1.09) |
| **A1C AUC**[2] | 1.21 (1.03, 1.41) | 1.44 (1.26, 1.64) |
| **BMIz at baseline**[3] | 1.02 (0.94, 1.10) | 1.04 (0.96, 1.13) |
| **BMI category at baseline** | | |
| Normal | Referent | Referent |
| Overweight | 0.89 (0.71, 1.11) | 0.97 (0.78, 1.20) |
| Obese | 0.97 (0.77, 1.24) | 1.03 (0.81, 1.30) |
| **Waist-height ratio at baseline**[3,7] | 1.01 (0.87, 1.18) | 1.03 (0.89, 1.19) |
| **Change in BMI z-score**[4] | 0.94 (0.83, 1.06) | 1.00 (0.89, 1.13) |
| **Change in BMI category** | | |
| Normal | Referent | Referent |
| Normal/overweight | 1.11 (0.89, 1.38) | 1.05 (0.85, 1.30) |
| Overweight/normal | 1.10 (0.77, 1.55) | 0.91 (0.62, 1.33) |
| Overweight/overweight | 0.93 (0.78, 1.12) | 0.87 (0.71, 1.06) |
| **Change in waist-height ratio**[4,7] | 1.01 (0.85, 1.21) | 1.00 (0.85, 1.19) |
| **Systolic BP z-score at baseline**[5] | 1.02 (0.94, 1.11) | 1.05 (0.97, 1.14) |
| **Diastolic BP z-score at baseline**[5] | 1.06 (0.96, 1.16) | 1.06 (0.97, 1.15) |
| **Systolic BP z-score change**[6] | 1.04 (0.97, 1.11) | 1.02 (0.94, 1.1) |
| **Diastolic BP z-score change**[6] | 1.04 (0.97, 1.12) | 1.07 (0.98, 1.16) |

[1]Adjusted for BMI z-score at baseline, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[2]Adjusted for Baseline A1C, BMI z-score at baseline, Change in BMI z-score, Duration since dx, Insurance status, Race/ethnicity, Site
[3]Adjusted for Baseline A1C, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[4] Change in BMI category represents overweight or obesity status at first and second retinal imaging. Adjusted for BMI z-score (waist-height, BMI category) at baseline, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[5]Adjusted for Baseline A1C, A1C AUC, BMI z-score at baseline, Change in BMI z-score, Duration since dx, Race/ethnicity, Site
[6]Adjusted for Baseline A1C, A1C AUC, BMI z-score at baseline, BP z-score at baseline, Change in BMI z-score, Duration since dx, Site
[7]Risk ratio is for an increase of 0.1 units in the modifiable exposure of interest
AUC=area under the curve; BMI-body mass index; SBP=systolic blood pressure; DBP=diastolic blood pressure; HS=high school; Assoc=Associate

**Supplementary Table 7**. Associations between modifiable risk factors and diabetic retinopathy progression, youth-onset type 2 diabetes – The SEARCH for Diabetes in Youth Study (2002-2019). Models standardized to sample of N=1589 eligible for both images using inverse probability of selection weighted model including age, sex, race, year of diagnosis, and clinic

| | Crude[1] RR (95% CI) | Adjusted[1] RR (95% CI) |
|---|---|---|
| **Baseline A1C[1]** | 1.04 (0.96, 1.12) | 1.06 (0.99, 1.14) |
| **A1C AUC[2]** | 1.58 (1.26, 1.98) | 2.14 (1.53, 2.97) |
| **BMIz at baseline[3]** | 1.27 (0.89, 1.80) | 1.32 (0.93, 1.90) |
| **BMI category at baseline** | | |
| Normal | Referent | Referent |
| Overweight | 2.21 (0.40, 12.10) | 0.72 (0.14, 3.78) |
| Obese | 3.43 (0.72, 16.34) | 2.35 (0.66, 8.36) |
| **Waist-height ratio at baseline[3,7]** | 1.04 (0.86, 1.26) | 1.03 (0.85, 1.25) |
| **Change in BMI z-score[4]** | 0.83 (0.55, 1.25) | 0.95 (0.59, 1.53) |
| **Change in BMI category** | | |
| Normal/normal | Referent | Referent |
| Normal/overweight | 0.41 (0.11, 1.58) | 0.51 (0.14, 1.92) |
| Overweight/normal | 0.72 (0.28, 1.86) | 0.82 (0.38, 1.80) |
| Overweight/overweight | 0.59 (0.33, 1.05) | 0.51 (0.32, 0.79) |
| **Change in waist-height ratio[4,7]** | 0.98 (0.77, 1.26) | 0.96 (0.69, 1.32) |
| **Systolic BP z-score at baseline[5]** | 1.19 (0.98, 1.43) | 1.16 (0.97, 1.38) |
| **Diastolic BP z-score at baseline[5]** | 1.06 (0.86, 1.29) | 1.02 (0.87, 1.21) |
| **Systolic BP z-score change[6]** | 0.97 (0.85, 1.11) | 0.99 (0.88, 1.11) |
| **Diastolic BP z-score change[6]** | 1.05 (0.90, 1.23) | 0.96 (0.81, 1.14) |

[1]Adjusted for BMI z-score at baseline, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[2]Adjusted for Baseline A1C, BMI z-score at baseline, Change in BMI z-score, Duration since dx, Insurance status, Race/ethnicity, Site
[3]Adjusted for Baseline A1C, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[4] Change in BMI category represents overweight or obesity status at first and second retinal imaging. Adjusted for BMI z-score (waist-height, BMI category) at baseline, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[5]Adjusted for Baseline A1C, A1C AUC, BMI z-score at baseline, Change in BMI z-score, Duration since dx, Race/ethnicity, Site
[6]Adjusted for Baseline A1C, A1C AUC, BMI z-score at baseline, BP z-score at baseline, Change in BMI z-score, Duration since dx, Site
[7]Risk ratio is for an increase of 0.1 units in the modifiable exposure of interest
AUC=area under the curve; BMI-body mass index; SBP=systolic blood pressure; DBP=diastolic blood pressure; HS=high school; Assoc=Associate

**Supplementary Table 8**. Associations between modifiable risk factors and diabetic retinoapthy progression, youth-onset type 1 diabetes – The SEARCH for Diabetes in Youth Study (2002-2019)

| | Crude RR (95% CI) | Adjusted RR (95% CI) |
|---|---|---|
| **Baseline A1C[1]** | 1.03 (0.98, 1.09) | 1.04 (0.98, 1.09) |
| **A1C AUC[2]** | 1.16 (0.99, 1.36) | 1.34 (1.15, 1.55) |
| **BMIz at baseline[3]** | 1.02 (0.94, 1.10) | 1.05 (0.96, 1.14) |
| **BMI category at baseline** | | |
| Normal | Referent | Referent |
| Overweight | 0.91 (0.73, 1.13) | 0.99 (0.80, 1.24) |
| Obese | 1.01 (0.80, 1.27) | 1.07 (0.85, 1.35) |
| **Waist-height ratio at baseline[3,7]** | 0.99 (0.85, 1.15) | 1.01 (0.87, 1.17) |
| **Change in BMI z-score[4]** | 0.89 (0.79, 1.00) | 0.94 (0.84, 1.06) |
| **Change in BMI category** | | |
| Normal/normal | Referent | Referent |
| Normal/overweight | 1.10 (0.87, 1.38) | 1.00 (0.79, 1.27) |
| Overweight/normal | 1.20 (0.86, 1.67) | 1.02 (0.72, 1.45) |
| Overweight/overweight | 1.07 (0.89, 1.29) | 1.00 (0.82, 1.22) |
| **Change in waist-height ratio[4,7]** | 1.04 (0.87, 1.24) | 0.98 (0.82, 1.16) |
| **Systolic BP z-score at baseline[5]** | 1.00 (0.92, 1.09) | 1.02 (0.94, 1.11) |
| **Diastolic BP z-score at BL[5]** | 1.01 (0.92, 1.11) | 1.01 (0.93, 1.11) |
| **Systolic BP z-score change[6]** | 1.06 (0.99, 1.13) | 1.05 (0.97, 1.14) |
| **Diastolic BP z-score change[6]** | 1.02 (0.94, 1.10) | 1.04 (0.96, 1.14) |

[1]Adjusted for BMI z-score at baseline, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[2]Adjusted for Baseline A1C, BMI z-score at baseline, Change in BMI z-score, Duration since dx, Insurance status, Race/ethnicity, Site
[3]Adjusted for Baseline A1C, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[4] Change in BMI category represents overweight or obesity status at first and second retinal imaging. Adjusted for BMI z-score (waist-height, BMI category) at baseline, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[5]Adjusted for Baseline A1C, A1C AUC, BMI z-score at baseline, Change in BMI z-score, Duration since dx, Race/ethnicity, Site
[6]Adjusted for Baseline A1C, A1C AUC, BMI z-score at baseline, BP z-score at baseline, Change in BMI z-score, Duration since dx, Site
[7]Risk ratio is for an increase of 0.1 units in the modifiable exposure of interest
AUC=area under the curve; BMI-body mass index; SBP=systolic blood pressure; DBP=diastolic blood pressure; HS=high school; Assoc=Associate

**Supplementary Table 9**. Associations between modifiable risk factors and diabetic retinopathy progression, youth-onset type 2 diabetes – The SEARCH for Diabetes in Youth Study (2002-2019).

| | Crude RR (95% CI) | Adjusted RR (95% CI) |
|---|---|---|
| **Baseline A1C**[1] | 1.05 (0.97, 1.13) | 1.05 (0.98, 1.13) |
| **A1C AUC**[2] | 1.57 (1.27, 1.95) | 2.09 (1.58, 2.77) |
| **BMIz at baseline**[3] | 1.42 (0.98, 2.05) | 1.40 (0.96, 2.05) |
| **BMI category at baseline** | | |
| Normal | Referent | Referent |
| Overweight | 2.86 (0.38, 21.67) | 1.35 (0.18, 10.19) |
| Obese | 4.77 (0.72, 31.44) | 3.42 (0.61, 19.32) |
| **Waist-height ratio at baseline**[3,7] | 1.10 (0.91, 1.32) | 1.11 (0.91, 1.35) |
| **Change in BMI z-score**[4] | 0.84 (0.55, 1.27) | 0.95 (0.59, 1.54) |
| **Change in BMI category** | | |
| Normal/normal | Referent | Referent |
| Normal/overweight | 0.4 (0.10, 1.55) | 0.52 (0.15, 1.79) |
| Overweight/normal | 0.67 (0.23, 1.96) | 0.62 (0.24, 1.58) |
| Overweight/overweight | 0.66 (0.36, 1.22) | 0.48 (0.31, 0.75) |
| **Change in waist-height ratio**[4,7] | 0.97 (0.77, 1.21) | 0.91 (0.69, 1.20) |
| **Systolic BP z-score at baseline**[5] | 1.13 (0.94, 1.36) | 1.08 (0.90, 1.30) |
| **Diastolic BP z-score at baseline**[5] | 1.07 (0.88, 1.31) | 1.00 (0.85, 1.18) |
| **Systolic BP z-score change**[6] | 1.00 (0.88, 1.15) | 1.03 (0.92, 1.16) |
| **Diastolic BP z-score change**[6] | 1.04 (0.88, 1.22) | 1.01 (0.86, 1.20) |

[1]Adjusted for BMI z-score at baseline, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[2]Adjusted for Baseline A1C, BMI z-score at baseline, Change in BMI z-score, Duration since dx, Insurance status, Race/ethnicity, Site
[3]Adjusted for Baseline A1C, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[4] Change in BMI category represents overweight or obesity status at first and second retinal imaging. Adjusted for BMI z-score (waist-height, BMI category) at baseline, Duration since dx, Insurance status, Parent education, Race/ethnicity, Site
[5]Adjusted for Baseline A1C, A1C AUC, BMI z-score at baseline, Change in BMI z-score, Duration since dx, Race/ethnicity, Site
[6]Adjusted for Baseline A1C, A1C AUC, BMI z-score at baseline, BP z-score at baseline, Change in BMI z-score, Duration since dx, Site
[7]Risk ratio is for an increase of 0.1 units in the modifiable exposure of interest
AUC=area under the curve; BMI-body mass index; SBP=systolic blood pressure; DBP=diastolic blood pressure; HS=high school; Assoc=Associate