**Table 1. Established loci for T2D susceptibility identified through candidate gene, genome-wide association, exome array or sequencing studies.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Locus** | **Lead SNP** | **Chr** | **Position (b37)** | **Alleles** | **RAF** | **OR (95% CI)** | **Functional annotation** | **Population or ethnic group** | **Reference** |
| **Risk** | **Other** |
| *MACF1* | rs2296172 | 1 | 39,835,812 | G | A | 0.23 | 1.10 (1.06-1.14) | *MACF1* p.Met1424Val | Danish | [62] |
| *FAF1* | rs17106184 | 1 | 50,909,985 | G | A | 0.90-0.94c | 1.10 (1.07-1.14) |  | Trans-ethnic | [34] |
| *NOTCH2* | rs10923931 | 1 | 120,517,959 | T | G | 0.11 | 1.13 (1.08-1.17) |  | European | [17] |
| *FAM63A* | rs140386498 | 1 | 150,972,959 | A | T | 0.99 | 1.21 (1.14-1.28) | *FAM63A* p.Tyr95Asn | Trans-ethnic | [\*\*55] |
| *ATP8B2* | rs67156297 | 1 | 154,336,716 | A | G | 0.09 | 1.14 (1.09-1.19) |  | Japanese | [28] |
| *PROX1* | rs340874 | 1 | 214,159,256 | C | T | 0.53c | 1.07 (1.05-1.09) |  | European | [18] |
| *TMEM18* | rs2867125 | 2 | 622,827 | C | T | 0.83 | 1.06 (1.04-1.08) |  | Trans-ethnic | [\*36] |
| *GCKR* | rs780094 | 2 | 27,741,237 | C | T | 0.60c | 1.06 (1.04-1.08) |  | European | [18] |
| *THADA* | rs7578597 | 2 | 43,732,823 | T | C | 0.90 | 1.15 (1.10-1.20) | *THADA* p.Thr1187Ala | European | [17] |
| *ASB3* | rs9309245 | 2 | 53,397,048 | G | C | 0.17 | 1.10 (1.07-1.14) |  | Japanese | [28] |
| *CCDC85A* | rs1116357 | 2 | 57,287,411 | G | A | 0.28 | 1.09 (1.06-1.12) |  | Japanese | [28] |
| *BCL11A* | rs243021 | 2 | 60,584,819 | A | G | 0.46 | 1.08 (1.06-1.10) |  | European | [19] |
| *CEP68* | rs7572857 | 2 | 65,296,798 | G | A | 0.85 | 1.05 (1.04-1.07) | *CEP68* p.Gly74Ser | Trans-ethnic | [\*\*55] |
| *BCL2L11* | rs11123406 | 2 | 111,950,541 | T | C | 0.36 | 1.04 (1.03-1.06) |  | Trans-ethnic | [\*36] |
| *TMEM163* | rs998451 | 2 | 135,429,288 | G | A | 0.86 | 1.56 (1.38-1.77) |  | Indian | [63] |
| *RBM43-RND3* | rs7560163 | 2 | 151,637,936 | C | G | 0.86 | 1.33 (1.19-1.49) |  | African American | [64] |
| *RBSM1* | rs7593730 | 2 | 161,171,454 | G | A | 0.77 | 1.11 (1.08-1.16) |  | European | [65] |
| *GRB14* | rs3923113 | 2 | 165,501,849 | A | C | 0.74 | 1.09 (1.06-1.13) |  | South Asian | [29] |
| *IRS1* | rs7568326 | 2 | 242,114,120 | A | G | 0.64 | 1.11 (1.08-1.13) |  | European | [19] |
| *PPARG* | rs1801282 | 3 | 12,393,125 | C | G | 0.88c | 1.14 (1.08-1.20) | *PPARG* p.Pro12Ala | European | [11] |
| *UBE2E2* | rs6780569 | 3 | 23,198,484 | G | A | 0.83 | 1.21 (1.14-1.30) |  | Japanese | [66] |
| *KIF9* | rs2276853 | 3 | 47,282,303 | A | G | 0.59 | 1.02 (1.01-1.04) | *KIF9* p.Arg638Trp | Trans-ethnic | [\*\*55] |
| *PSMD6* | rs831571 | 3 | 64,048,297 | C | T | 0.63c | 1.09 (1.06-1.12) |  | East Asian | [27] |
| *ADAMTS9* | rs4607103 | 3 | 64,711,904 | C | T | 0.76 | 1.09 (1.06-1.12) |  | European | [17] |
| *ADCY5* | rs11708067 | 3 | 123,065,778 | A | G | 0.83c | 1.12 (1.09-1.15) |  | European | [18] |
| *MRAS* | rs2306374 | 3 | 138,119,952 | C | T | 0.14 | 1.04 (1.02-1.06) |  | Trans-ethnic | [\*\*55] |
| *IGF2BP2* | rs4402960 | 3 | 185,511,687 | T | C | 0.30c | 1.12 (1.07-1.17) |  | European | [11] |
| *ST6GAL1* | rs16861329 | 3 | 186,666,461 | G | A | 0.75 | 1.09 (1.06-1.12) |  | South Asian | [29] |
| *LPP* | rs6808574 | 3 | 187,740,523 | C | T | 0.61-0.99c | 1.07 (1.04-1.09) |  | Trans-ethnic | [34] |
| *MAEA* | rs6815464 | 4 | 1,309,901 | C | G | 0.58c | 1.13 (1.10-1.16) |  | East Asian | [27] |
| *WFS1* | rs4458523 | 4 | 6,289,986 | G | T | 0.57 | 1.10 (1.07-1.12) |  | European | [24] |
| *FAM13A* | rs13133548 | 4 | 89,740,128 | A | G | 0.49 | 1.03 (1.02-1.04) |  | Trans-ethnic | [\*\*55] |
| *CISD2* | rs7674212 | 4 | 103,988,899 | G | T | 0.58 | 1.07 (1.04-1.09) |  | Trans-ethnic | [\*36] |
| *TMEM155* | rs2706785 | 4 | 122,660,250 | G | A | 0.05 | 1.13 (1.08-1.17) |  | Trans-ethnic | [\*36] |
| *TMEM154* | rs6813195 | 4 | 153,520,475 | C | T | 0.53-0.71c | 1.08 (1.06-1.10) |  | Trans-ethnic | [34] |
| *ACSL1* | rs60780116 | 4 | 185,708,807 | T | C | 0.84 | 1.09 (1.06-1.13) |  | European | [\*25] |
| *ANKH* | rs146886108 | 5 | 14,751,305 | C | T | 1.00 | 1.29 (1.16-1.45) | *ANKH* p.Arg187Gln | Trans-ethnic | [\*\*55] |
| *ARL15* | rs702634 | 5 | 53,271,420 | A | G | 0.69-0.83c | 1.06 (1.04-1.09) |  | Trans-ethnic | [34] |
| *ANKRD55* | rs459193 | 5 | 55,806,751 | G | A | 0.70 | 1.08 (1.05-1.11) |  | European | [24] |
| *POC5* | rs2307111 | 5 | 75,003,678 | T | C | 0.56 | 1.05 (1.04-1.07) | *POC5* p.His36Arg | Trans-ethnic | [\*\*55] |
| *ZBED3* | rs4457053 | 5 | 76,424,949 | G | A | 0.26 | 1.08 (1.06-1.11) |  | European | [19] |
| *PAM* | rs35658696 | 5 | 102,338,811 | G | A | 0.05 | 1.23 | *PAM* p.Asp336Gly | Icelandic | [67] |
| *PHFI5* | rs329122 | 5 | 133,864,599 | A | G | 0.43 | 1.04 (1.03-1.06) |  | Trans-ethnic | [\*36] |
| *SSR1-RREB1* | rs9505118 | 6 | 7,290,437 | A | G | 0.55-0.71c | 1.06 (1.04-1.08) |  | Trans-ethnic | [34] |
| *CDKAL1* | rs10946398 | 6 | 20,661,034 | C | A | 0.32c | 1.12 (1.08-1.16) |  | European | [11] |
| *POU5F1-TCF19* | rs3130501 | 6 | 31,136,453 | G | A | 0.68-0.87c | 1.07 (1.04-1.09) |  | Trans-ethnic | [34] |
| *HLA-B* | rs2244020 | 6 | 31,347,451 | G | A | 0.69 | 1.09 (1.06-1.13) |  | African American | [32] |
| *HLA-DQA1* | rs9271774 | 6 | 32,594,309 | C | A | 0.74 | 1.10 (1.06-1.14) |  | European | [\*25] |
| *ZFAND3* | rs9470794 | 6 | 38,106,844 | C | T | 0.29c | 1.12 (1.08-1.16) |  | East Asian | [27] |
| *KCNK16* | rs1535500 | 6 | 39,284,050 | T | G | 0.47c | 1.06 (1.05-1.11) | *KCNK16* p.Ala277Glu | East Asian | [27] |
| *VEGFA* | rs6905288 | 6 | 43,758,873 | A | G | 0.60 | 1.03 (1.02-1.05) |  | Trans-ethnic | [\*\*55] |
| *TFAP2B* | rs2206277 | 6 | 50,798,526 | T | C | 0.20 | 1.05 (1.03-1.07) |  | Trans-ethnic | [\*\*55] |
| *CENPW* | rs11759026 | 6 | 126,792,095 | G | A | 0.25c | Not reported |  | European | [\*\*40] |
| *SLC35D3* | rs6918311 | 6 | 137,287,702 | A | G | 0.53 | 1.07 (1.04-1.10) |  | European | [\*25] |
| *SLC22A3* | rs622217 | 6 | 160,766,770 | T | C | 0.52 | 1.05 (1.03-1.07) |  | Trans-ethnic | [\*36] |
| *DGKB* | rs2191349 | 7 | 15,064,309 | T | G | 0.50c | 1.06 (1.04-1.08) |  | European | [18] |
| *JAZF1* | rs864745 | 7 | 28,180,556 | T | C | 0.50 | 1.10 (1.07-1.13) |  | European | [17] |
| *GCK* | rs4607517 | 7 | 44,235,668 | A | G | 0.18c | 1.07 (1.05-1.10) |  | European | [18] |
| *GCC1-PAX4* | rs6467136 | 7 | 127,164,958 | G | A | 0.79c | 1.11 (1.07-1.14) |  | East Asian | [27] |
| *LEP* | rs791595 | 7 | 127,862,802 | A | G | 0.08 | 1.19 (1.11-1.28) |  | East Asian | [68] |
| *KLF14* | rs972283 | 7 | 130,466,854 | G | A | 0.55 | 1.07 (1.05-1.10) |  | European | [19] |
| *BRAF* | rs9648716 | 7 | 140,612,163 | T | A | 0.15 | 1.06 (1.04-1.09) |  | Trans-ethnic | [\*36] |
| *MNX1* | rs1182436 | 7 | 157,027,753 | C | T | 0.80 | 1.08 (1.05-1.12) |  | European | [\*25] |
| *LPL* | rs328 | 8 | 19,819,724 | C | G | 0.90 | 1.05 (1.03-1.08) | *LPL* p.Ser474\* | Trans-ethnic | [\*\*55] |
| *KCNU1* | rs12681990 | 8 | 36,859,186 | C | T | 0.15 | 1.05 (1.04-1.07) |  | Trans-ethnic | [\*36] |
| *ANK1* | rs516946 | 8 | 41,519,248 | C | T | 0.76 | 1.09 (1.06-1.12) |  | European | [24] |
| *TP53INP1* | rs896854 | 8 | 95,960,511 | T | C | 0.48 | 1.06 (1.04-1.09) |  | European | [19] |
| *SLC30A8* | rs13266634 | 8 | 118,184,783 | C | T | 0.72c | 1.12 (1.07-1.16) | *SLC30A8* p.Arg276Trp | European | [11] |
| *GLIS3* | rs7041847 | 9 | 4,287,466 | A | G | 0.50c | 1.10 (1.07-1.13) |  | East Asian | [27] |
| *PTPRD* | rs17584499 | 9 | 8,879,118 | T | C | 0.07 | 1.57 (1.36-1.82) |  | Chinese | [69] |
| *CDKN2A-CDKN2B* | rs10811661 | 9 | 22,134,094 | T | C | 0.83c | 1.20 (1.14-1.25) |  | European | [11] |
| *DMRTA1* | rs1575972 | 9 | 22,301,092 | T | A | 0.94 | 1.19 (1.13-1.26) |  | Japanese | [28] |
| *TLE4* | rs13292136 | 9 | 81,952,128 | C | T | 0.93 | 1.11 (1.07-1.15) |  | European | [19] |
| *TLE1* | rs2796441 | 9 | 84,308,948 | G | A | 0.57 | 1.07 (1.05-1.10) |  | European | [24] |
| *ABO* | rs635634 | 9 | 136,155,000 | T | C | 0.18 | 1.08 (1.05-1.12) |  | European | [\*25] |
| *GPSM1* | rs11787792 | 9 | 139,252,148 | A | G | 0.87 | 1.17 (1.09-1.25) |  | East Asian | [68] |
| *CDC123-CAMK1D* | rs12779790 | 10 | 12,328,010 | G | A | 0.18 | 1.11 (1.07-1.14) |  | European | [17] |
| *VPS26A* | rs1802295 | 10 | 70,931,474 | A | G | 0.26 | 1.08 (1.05-1.12) |  | South Asian | [29] |
| *ZMIZ1* | rs12571751 | 10 | 80,942,631 | A | G | 0.52 | 1.08 (1.05-1.10) |  | European | [24] |
| *HHEX-IDE* | rs1111875 | 10 | 94,462,882 | G | A | 0.53 | 1.13 (1.08-1.17) |  | European | [10] |
| *TCF7L2* | rs7903146 | 10 | 114,758,349 | C | T | 0.68c | 1.37 (1.28-1.47) |  | European | [17] |
| *GRK5* | rs10886471 | 10 | 121,149,403 | C | T | 0.78c | 1.12 (1.08-1.16) |  | East Asian | [70] |
| *PLEKHA1* | rs2292626 | 10 | 124,186,714 | C | T | 0.50 | 1.09 (1.06-1.11) |  | European | [\*25] |
| *DUSP8* | rs2334499 | 11 | 1,696,849 | T | C | N/A | 1.35a |  | Icelandic | [71] |
| *INS-IGF2* | rs3842770 | 11 | 2,178,670 | A | G | 0.23 | 1.14 (1.09-1.19) |  | African American | [32] |
| *KCNQ1* | rs231362 | 11 | 2,691,471 | G | A | 0.52 | 1.08 (1.06-1.10) |  | European | [19] |
| *KCNJ11-ABCC8* | rs5215 | 11 | 17,408,630 | C | T | 0.35c | 1.14 (1.10-1.19) | *KCNJ11* p.Val250Ile | European | [11] |
| *HSD17B12* | rs1061810 | 11 | 43,877,934 | A | C | 0.28 | 1.08 (1.05-1.11) |  | European | [\*25] |
| *TMEM258* | rs102275 | 11 | 61,557,803 | T | C | 0.64 | 1.03 (1.02-1.04) |  | Trans-ethnic | [\*\*55] |
| *PLCB3* | rs35169799 | 11 | 64,031,241 | T | C | 0.07 | 1.05 (1.02-1.08) | *PLCB3* p.Ser778Leu | Trans-ethnic | [\*\*55] |
| *MAP3K11* | rs111669836 | 11 | 65,364,385 | A | T | 0.25 | 1.07 (1.04-1.10) |  | European | [\*25] |
| *TPCN2* | rs72928978 | 11 | 68,831,364 | G | A | 0.89 | 1.05 (1.02-1.07) | *TPCN2* p.Val219Ile | Trans-ethnic | [\*\*55] |
| *CENTD2* | rs1552224 | 11 | 72,433,098 | A | C | 0.88 | 1.14 (1.11-1.18) |  | European | [19] |
| *MTNR1B* | rs10830963 | 11 | 92,708,710 | G | C | 0.29c | 1.09 (1.06-1.12) |  | European | [18] |
| *CCND2* | rs11063069 | 12 | 4,374,373 | G | A | 0.21 | 1.08 (1.05-1.11) |  | European | [24] |
| *KLHDC5* | rs10842994 | 12 | 27,965,150 | C | T | 0.80 | 1.10 (1.06-1.13) |  | European | [24] |
| *FAM60A* | rs147538848 | 12 | 31,466,613 | A | G | 0.19 | 1.11 (1.07-1.15) |  | Japanese | [28] |
| *HMGA2* | rs1531343 | 12 | 66,174,894 | C | G | 0.10 | 1.10 (1.07-1.14) |  | European | [19] |
| *TSPAN8* | rs7961581 | 12 | 71,663,102 | C | T | 0.27 | 1.09 (1.06-1.12) |  | European | [17] |
| *WSCD2* | rs3764002 | 12 | 108,618,630 | C | T | 0.72 | 1.03 (1.02-1.05) | *WSCD2* p.Thr113Ile | Trans-ethnic | [\*\*55] |
| *HNF1A* | rs7957197 | 12 | 121,460,686 | T | A | 0.85 | 1.07 (1.05-1.10) |  | European | [19] |
| *MPHOSPH9* | rs4275659 | 12 | 123,447,928 | C | T | 0.09-0.69c | 1.06 (1.04-1.08) |  | Trans-ethnic | [34] |
| *SGCG* | rs9552911 | 13 | 23,864,657 | G | A | 0.92 | 1.49 (1.30-1.72) |  | Indian | [72] |
| *RNF6* | rs10507349 | 13 | 26,781,528 | G | A | 0.78 | 1.05 (1.04-1.07) |  | Trans-ethnic | [\*36] |
| *KL* | rs576674 | 13 | 33,554,302 | G | A | 0.16 | 1.07 (1.05-1.10) |  | Trans-ethnic | [\*36] |
| *TBC1D4* | rs61736969 | 13 | 75,898,521 | G | C | 0.17 | 10.3b | *TBC1D4* p.Arg684Ter | Greenlanders | [37] |
| *SPRY2* | rs1359790 | 13 | 80,717,156 | G | A | 0.71 | 1.15 (1.10-1.20) |  | East Asian | [73] |
| *MIR17HG* | rs7985179 | 13 | 91,940,169 | T | A | 0.72 | 1.07 (1.05-1.10) |  | Trans-ethnic | [\*36] |
| *NRXN3* | rs10146997 | 14 | 79,945,162 | G | A | 0.21 | 1.07 (1.04-1.10) |  | European | [\*25] |
| *RASGRP1* | rs7403531 | 15 | 38,822,905 | T | C | 0.35c | 1.10 (1.06-1.13) |  | East Asian | [70] |
| *INFAM2* | rs67839313 | 15 | 40,619,724 | C | T | 0.26 | 1.09 (1.06-1.12) |  | Japanese | [28] |
| *C2CD4A-C2CD4B* | rs7172432 | 15 | 62,396,389 | A | G | 0.56 | 1.14 (1.09-1.20) |  | Japanese | [66] |
| *PTPN9* | rs4886707 | 15 | 75,755,467 | C | T | 0.72 | 1.04 (1.02-1.05) |  | Trans-ethnic | [\*\*55] |
| *HMG20A* | rs7178572 | 15 | 77,747,190 | G | A | 0.52 | 1.09 (1.06-1.12) |  | South Asian | [29] |
| *ZFAND6* | rs11634397 | 15 | 80,432,222 | G | A | 0.60 | 1.06 (1.04-1.08) |  | European | [19] |
| *AP3S2* | rs2028299 | 15 | 90,374,257 | C | A | 0.31 | 1.10 (1.07-1.13) |  | South Asian | [29] |
| *PRC1* | rs8042680 | 15 | 91,521,337 | A | C | 0.22 | 1.07 (1.05-1.09) |  | European | [19] |
| *ITFG3* | rs9940149 | 16 | 300,641 | G | A | 0.83 | 1.05 (1.04-1.07) |  | Trans-ethnic | [\*36] |
| *FTO* | rs8050136 | 16 | 53,816,275 | A | C | 0.41c | 1.17 (1.12-1.22) |  | European | [11] |
| *NFAT5* | rs1364063 | 16 | 69,588,572 | T | C | 0.62 | 1.03 (1.01-1.04) |  | Trans-ethnic | [\*\*55] |
| *BCAR1* | rs7202877 | 16 | 75,247,245 | T | G | 0.89 | 1.12 (1.07-1.16) |  | European | [24] |
| *CMIP* | rs2925979 | 16 | 81,534,790 | T | C | 0.30 | 1.08 (1.05-1.10) |  | European | [\*25] |
| *ZZEF1* | rs7224685 | 17 | 4,014,384 | T | G | 0.30 | 1.07 (1.04-1.10) |  | European | [\*25] |
| *SLC16A11-SLC16A13* | rs312457 | 17 | 6,940,393 | G | A | 0.08 | 1.19 (1.10-1.29) |  | East Asian | [68] |
| *GLP2R* | rs78761021 | 17 | 9,780,387 | G | A | 0.34 | 1.07 (1.05-1.10) |  | European | [\*25] |
| *HNF1B* | rs11651052 | 17 | 36,102,381 | A | G | 0.44 | 1.10 (1.07-1.14) |  | European | [24] |
| *MLX* | rs665268 | 17 | 40,722,029 | G | A | 0.29 | 1.04 (1.02-1.05) | *MLX* p.Gln139Arg | Trans-ethnic | [\*\*55] |
| *GIP*  | rs79349575 | 17 | 46,967,038 | A | T | 0.51 | 1.07 (1.04-1.09) |  | European | [\*25] |
| *BPTF* | rs12602912 | 17 | 65,870,073 | T | C | 0.24 | 1.04 (1.03-1.06) |  | Trans-ethnic | [\*\*55] |
| *LAMA1* | rs8090011 | 18 | 7,068,462 | G | C | 0.38c | 1.13 (1.09-1.18) |  | European | [74] |
| *MC4R* | rs12970134 | 18 | 57,884,750 | A | G | 0.27 | 1.08 (1.05-1.11) |  | European | [24] |
| *CILP2* | rs10401969 | 19 | 19,407,718 | C | T | 0.08 | 1.13 (1.09-1.18) |  | European | [24] |
| *PEPD* | rs3786897 | 19 | 33,893,008 | A | G | 0.59c | 1.10 (1.07-1.14) |  | East Asian | [27] |
| *TOMM40-APOE* | rs157582 | 19 | 45,396,219 | C | T | 0.77 | 1.13 (1.08-1.17) |  | Trans-ethnic | [75] |
| *GIPR* | rs8108269 | 19 | 46,158,513 | G | T | 0.31 | 1.07 (1.04-1.10) |  | European | [24] |
| *ZHX3* | rs17265513 | 20 | 39,832,628 | C | T | 0.21 | 1.05 (1.03-1.07) | *ZHX3* p.Asn310Ser | Trans-ethnic | [\*\*55] |
| *HNF4A* | rs4812829 | 20 | 42,989,267 | A | G | 0.29 | 1.09 (1.06-1.12) |  | South Asian | [29] |
| *MTMR3* | rs41278853 | 22 | 30,416,527 | A | G | 0.93-1.00 | 1.14 (1.09-1.19) | *MTMR3* p.Asn960Ser | Trans-ethnic | [\*\*40] |
| *PNPLA3* | rs738409 | 22 | 44,324,727 | G | C | 0.24 | 1.04 (1.03-1.05) | *PNPLA3* p.Ile148Met | Trans-ethnic | [\*\*55] |
| *PIM3* | rs4077129 | 22 | 50,356,693 | C | C | 0.28 | 1.04 (1.02-1.05) | *PIM3* p.Val300Ala | Trans-ethnic | [\*\*55] |
| *DUSP9* | rs5945326 | X | 152,899,922 | A | G | 0.79 | 1.27 (1.18-1.37) |  | European | [19] |

Chr: chromosome. RAF: risk allele frequency. OR: odds-ratio. CI: confidence interval.

aParent of origin effect: paternal allele.

bRecessive model.

cRAF not reported, so estimated from relevant ethnic group(s) from the 1000 Genomes Project [22].

dLead SNP as reported, but not necessarily the causal variant at the locus.