|  |  |  |
| --- | --- | --- |
| Table S4. Gene sets enriched in the sorafenib-resistant organoids. |  |  |
| Gene set | Size | ES | NES | P value | FDR |
| MANALO\_HYPOXIA\_DN | 279 | 0.66 | 3.24 | <0.001 | <0.001 |
| WONG\_EMBRYONIC\_STEM\_CELL\_CORE | 317 | 0.55 | 2.71 | <0.001 | <0.001 |
| SCHUHMACHER\_MYC\_TARGETS\_UP | 76 | 0.65 | 2.66 | <0.001 | <0.001 |
| FUJII\_YBX1\_TARGETS\_DN | 181 | 0.56 | 2.61 | <0.001 | <0.001 |
| SOTIRIOU\_BREAST\_CANCER\_GRADE\_1\_VS\_3\_UP | 147 | 0.56 | 2.58 | <0.001 | <0.001 |
| KAUFFMANN\_MELANOMA\_RELAPSE\_UP | 59 | 0.66 | 2.52 | <0.001 | <0.001 |
| KOBAYASHI\_EGFR\_SIGNALING\_24HR\_DN | 238 | 0.53 | 2.52 | <0.001 | <0.001 |
| FOURNIER\_ACINAR\_DEVELOPMENT\_LATE\_2 | 269 | 0.52 | 2.51 | <0.001 | <0.001 |
| MUELLER\_PLURINET | 272 | 0.52 | 2.51 | <0.001 | <0.001 |
| DUTERTRE\_ESTRADIOL\_RESPONSE\_24HR\_UP | 291 | 0.51 | 2.49 | <0.001 | <0.001 |
| DUTERTRE\_ESTRADIOL\_RESPONSE\_6HR\_UP | 194 | 0.54 | 2.48 | <0.001 | <0.001 |
| WHITEFORD\_PEDIATRIC\_CANCER\_MARKERS | 110 | 0.56 | 2.47 | <0.001 | <0.001 |
| GARCIA\_TARGETS\_OF\_FLI1\_AND\_DAX1\_DN | 140 | 0.55 | 2.46 | <0.001 | <0.001 |
| REN\_BOUND\_BY\_E2F | 55 | 0.64 | 2.45 | <0.001 | <0.001 |
| VERNELL\_RETINOBLASTOMA\_PATHWAY\_UP | 68 | 0.62 | 2.44 | <0.001 | <0.001 |
| SARRIO\_EPITHELIAL\_MESENCHYMAL\_TRANSITION\_UP | 152 | 0.53 | 2.43 | <0.001 | <0.001 |
| DANG\_MYC\_TARGETS\_UP | 120 | 0.56 | 2.42 | <0.001 | <0.001 |
| ROSTY\_CERVICAL\_CANCER\_PROLIFERATION\_CLUSTER | 137 | 0.54 | 2.41 | <0.001 | <0.001 |
| ELVIDGE\_HIF1A\_TARGETS\_UP | 63 | 0.61 | 2.4 | <0.001 | <0.001 |
| GRAHAM\_NORMAL\_QUIESCENT\_VS\_NORMAL\_DIVIDING\_DN | 80 | 0.58 | 2.4 | <0.001 | <0.001 |
| ELVIDGE\_HIF1A\_AND\_HIF2A\_TARGETS\_UP | 37 | 0.69 | 2.4 | <0.001 | <0.001 |
| MEBARKI\_HCC\_PROGENITOR\_FZD8CRD\_UP | 420 | 0.47 | 2.38 | <0.001 | <0.001 |
| KARLSSON\_TGFB1\_TARGETS\_UP | 113 | 0.54 | 2.37 | <0.001 | <0.001 |
| SCHLOSSER\_MYC\_TARGETS\_REPRESSED\_BY\_SERUM | 145 | 0.52 | 2.37 | <0.001 | <0.001 |
| RUIZ\_TNC\_TARGETS\_DN | 127 | 0.55 | 2.36 | <0.001 | <0.001 |
| PUJANA\_BRCA2\_PCC\_NETWORK | 378 | 0.48 | 2.36 | <0.001 | <0.001 |
| RHODES\_UNDIFFERENTIATED\_CANCER | 62 | 0.61 | 2.35 | <0.001 | <0.001 |
| MOREAUX\_B\_LYMPHOCYTE\_MATURATION\_BY\_TACI\_DN | 74 | 0.57 | 2.35 | <0.001 | <0.001 |
| NAKAMURA\_CANCER\_MICROENVIRONMENT\_DN | 38 | 0.65 | 2.34 | <0.001 | <0.001 |
| BENPORATH\_PROLIFERATION | 136 | 0.52 | 2.33 | <0.001 | <0.001 |
| SONG\_TARGETS\_OF\_IE86\_CMV\_PROTEIN | 52 | 0.61 | 2.32 | <0.001 | <0.001 |
| FRASOR\_RESPONSE\_TO\_SERM\_OR\_FULVESTRANT\_DN | 47 | 0.64 | 2.31 | <0.001 | <0.001 |
| PUJANA\_BRCA\_CENTERED\_NETWORK | 117 | 0.54 | 2.3 | <0.001 | <0.001 |
| SCHLOSSER\_MYC\_TARGETS\_AND\_SERUM\_RESPONSE\_UP | 46 | 0.62 | 2.27 | <0.001 | 3.41E-05 |
| ZHOU\_CELL\_CYCLE\_GENES\_IN\_IR\_RESPONSE\_6HR | 81 | 0.56 | 2.27 | <0.001 | 3.31E-05 |
| MISSIAGLIA\_REGULATED\_BY\_METHYLATION\_DN | 113 | 0.51 | 2.26 | <0.001 | 3.22E-05 |
| WAKASUGI\_HAVE\_ZNF143\_BINDING\_SITES | 54 | 0.61 | 2.26 | <0.001 | 3.13E-05 |
| MOREAUX\_MULTIPLE\_MYELOMA\_BY\_TACI\_DN | 170 | 0.48 | 2.26 | <0.001 | 3.05E-05 |
| FERREIRA\_EWINGS\_SARCOMA\_UNSTABLE\_VS\_STABLE\_UP | 144 | 0.51 | 2.24 | <0.001 | 2.97E-05 |
| WINNEPENNINCKX\_MELANOMA\_METASTASIS\_UP | 152 | 0.5 | 2.24 | <0.001 | 2.90E-05 |
| WANG\_RESPONSE\_TO\_GSK3\_INHIBITOR\_SB216763\_DN | 309 | 0.45 | 2.24 | <0.001 | 2.83E-05 |
| KONG\_E2F3\_TARGETS | 86 | 0.53 | 2.23 | <0.001 | 5.59E-05 |
| GRADE\_COLON\_AND\_RECTAL\_CANCER\_UP | 266 | 0.45 | 2.23 | <0.001 | 5.46E-05 |
| SANSOM\_APC\_TARGETS\_REQUIRE\_MYC | 195 | 0.48 | 2.23 | <0.001 | 5.34E-05 |
| BILANGES\_SERUM\_AND\_RAPAMYCIN\_SENSITIVE\_GENES | 66 | 0.56 | 2.23 | <0.001 | 5.22E-05 |
| ELVIDGE\_HYPOXIA\_DN | 139 | 0.51 | 2.22 | <0.001 | 5.11E-05 |
| GARY\_CD5\_TARGETS\_DN | 402 | 0.44 | 2.22 | <0.001 | 5.00E-05 |
| PUJANA\_BREAST\_CANCER\_WITH\_BRCA1\_MUTATED\_UP | 54 | 0.59 | 2.2 | <0.001 | 9.73E-05 |
| PUJANA\_XPRSS\_INT\_NETWORK | 164 | 0.49 | 2.19 | <0.001 | 1.44E-04 |
| KAMMINGA\_EZH2\_TARGETS | 39 | 0.62 | 2.18 | <0.001 | 1.65E-04 |
| YAO\_TEMPORAL\_RESPONSE\_TO\_PROGESTERONE\_CLUSTER\_11 | 84 | 0.53 | 2.17 | <0.001 | 2.10E-04 |
| BURTON\_ADIPOGENESIS\_PEAK\_AT\_16HR | 38 | 0.61 | 2.16 | <0.001 | 2.06E-04 |
| SCHLOSSER\_MYC\_TARGETS\_AND\_SERUM\_RESPONSE\_DN | 48 | 0.59 | 2.16 | <0.001 | 2.02E-04 |
| ABRAMSON\_INTERACT\_WITH\_AIRE | 41 | 0.61 | 2.16 | <0.001 | 1.98E-04 |
| ZHOU\_CELL\_CYCLE\_GENES\_IN\_IR\_RESPONSE\_24HR | 115 | 0.5 | 2.15 | <0.001 | 2.82E-04 |
| VECCHI\_GASTRIC\_CANCER\_EARLY\_UP | 378 | 0.43 | 2.15 | <0.001 | 2.77E-04 |
| KAUFFMANN\_DNA\_REPLICATION\_GENES | 130 | 0.48 | 2.13 | <0.001 | 3.69E-04 |
| WHITFIELD\_CELL\_CYCLE\_G1\_S | 121 | 0.49 | 2.13 | <0.001 | 4.02E-04 |
| BASAKI\_YBX1\_TARGETS\_UP | 250 | 0.45 | 2.12 | <0.001 | 5.36E-04 |
| FEVR\_CTNNB1\_TARGETS\_DN | 500 | 0.41 | 2.11 | <0.001 | 6.06E-04 |
| LEE\_LIVER\_CANCER\_SURVIVAL\_DN | 166 | 0.45 | 2.11 | <0.001 | 6.16E-04 |
| SCHLOSSER\_MYC\_AND\_SERUM\_RESPONSE\_SYNERGY | 31 | 0.62 | 2.11 | <0.001 | 6.26E-04 |
| YAO\_TEMPORAL\_RESPONSE\_TO\_PROGESTERONE\_CLUSTER\_14 | 131 | 0.46 | 2.11 | <0.001 | 6.52E-04 |
| KAUFFMANN\_DNA\_REPAIR\_GENES | 212 | 0.44 | 2.1 | <0.001 | 7.71E-04 |
| STEIN\_ESRRA\_TARGETS\_RESPONSIVE\_TO\_ESTROGEN\_DN | 39 | 0.6 | 2.09 | <0.001 | 7.95E-04 |
| ZHANG\_RESPONSE\_TO\_CANTHARIDIN\_DN | 65 | 0.54 | 2.09 | <0.001 | 8.71E-04 |
| KIM\_MYC\_AMPLIFICATION\_TARGETS\_UP | 164 | 0.46 | 2.09 | <0.001 | 8.58E-04 |
| BHATTACHARYA\_EMBRYONIC\_STEM\_CELL | 61 | 0.54 | 2.08 | <0.001 | 9.30E-04 |
| LY\_AGING\_OLD\_DN | 49 | 0.55 | 2.07 | <0.001 | 1.03E-03 |
| ZHAN\_MULTIPLE\_MYELOMA\_PR\_UP | 43 | 0.58 | 2.05 | <0.001 | 1.35E-03 |
| TARTE\_PLASMA\_CELL\_VS\_PLASMABLAST\_DN | 277 | 0.41 | 2.04 | <0.001 | 1.63E-03 |
| ISHIDA\_E2F\_TARGETS | 50 | 0.55 | 2.03 | <0.001 | 1.77E-03 |
| MOLENAAR\_TARGETS\_OF\_CCND1\_AND\_CDK4\_DN | 57 | 0.54 | 2.03 | <0.001 | 2.09E-03 |
| MORI\_EMU\_MYC\_LYMPHOMA\_BY\_ONSET\_TIME\_UP | 106 | 0.48 | 2.02 | <0.001 | 2.28E-03 |
| BERENJENO\_TRANSFORMED\_BY\_RHOA\_UP | 490 | 0.39 | 2 | <0.001 | 2.69E-03 |
| CROONQUIST\_IL6\_DEPRIVATION\_DN | 90 | 0.46 | 1.98 | <0.001 | 3.43E-03 |
| TOYOTA\_TARGETS\_OF\_MIR34B\_AND\_MIR34C | 416 | 0.39 | 1.98 | <0.001 | 3.40E-03 |
| BILANGES\_RAPAMYCIN\_SENSITIVE\_VIA\_TSC1\_AND\_TSC2 | 65 | 0.51 | 1.98 | <0.001 | 3.58E-03 |
| BLANCO\_MELO\_BRONCHIAL\_EPITHELIAL\_CELLS | 162 | 0.43 | 1.97 | <0.001 | 3.59E-03 |
| \_INFLUENZA\_A\_DEL\_NS1\_INFECTION\_DN |  |  |  |  |
| BOYAULT\_LIVER\_CANCER\_SUBCLASS\_G123\_UP | 44 | 0.54 | 1.97 | <0.001 | 3.57E-03 |
| IRITANI\_MAD1\_TARGETS\_DN | 40 | 0.57 | 1.97 | <0.001 | 3.56E-03 |
| ODONNELL\_TARGETS\_OF\_MYC\_AND\_TFRC\_DN | 43 | 0.55 | 1.97 | <0.001 | 3.59E-03 |
| COLDREN\_GEFITINIB\_RESISTANCE\_UP | 80 | 0.48 | 1.97 | <0.001 | 3.59E-03 |
| ZHANG\_BREAST\_CANCER\_PROGENITORS\_UP | 399 | 0.38 | 1.97 | <0.001 | 3.63E-03 |
| SENGUPTA\_NASOPHARYNGEAL\_CARCINOMA\_UP | 241 | 0.4 | 1.96 | <0.001 | 3.90E-03 |
| MULLIGAN\_NTF3\_SIGNALING\_VIA\_INSR\_AND\_IGF1R\_UP | 18 | 0.68 | 1.96 | <0.001 | 3.87E-03 |
| EPPERT\_PROGENITOR | 122 | 0.44 | 1.95 | <0.001 | 4.06E-03 |
| BENPORATH\_ES\_1 | 306 | 0.4 | 1.95 | <0.001 | 4.10E-03 |
| PUJANA\_BREAST\_CANCER\_LIT\_INT\_NETWORK | 98 | 0.46 | 1.95 | <0.001 | 4.09E-03 |
| KANG\_DOXORUBICIN\_RESISTANCE\_UP | 54 | 0.51 | 1.91 | <0.001 | 5.96E-03 |
| ONDER\_CDH1\_TARGETS\_1\_DN | 129 | 0.43 | 1.91 | <0.001 | 5.98E-03 |
| GRAHAM\_CML\_DIVIDING\_VS\_NORMAL\_QUIESCENT\_UP | 152 | 0.43 | 1.91 | <0.001 | 6.17E-03 |
| BURTON\_ADIPOGENESIS\_3 | 92 | 0.45 | 1.89 | <0.001 | 7.17E-03 |
| FISCHER\_G1\_S\_CELL\_CYCLE | 165 | 0.41 | 1.89 | <0.001 | 7.28E-03 |
| BILD\_MYC\_ONCOGENIC\_SIGNATURE | 175 | 0.4 | 1.88 | <0.001 | 8.01E-03 |
| FINETTI\_BREAST\_CANCER\_KINOME\_RED | 16 | 0.67 | 1.88 | <0.001 | 8.20E-03 |
| LI\_WILMS\_TUMOR\_VS\_FETAL\_KIDNEY\_1\_DN | 139 | 0.42 | 1.88 | <0.001 | 8.30E-03 |
| YU\_BAP1\_TARGETS | 26 | 0.58 | 1.88 | 3.07E-03 | 8.24E-03 |
| ELVIDGE\_HYPOXIA\_BY\_DMOG\_DN | 52 | 0.51 | 1.88 | <0.001 | 8.30E-03 |
| CROONQUIST\_NRAS\_SIGNALING\_DN | 68 | 0.47 | 1.88 | <0.001 | 8.27E-03 |
| DAIRKEE\_CANCER\_PRONE\_RESPONSE\_BPA | 44 | 0.52 | 1.87 | <0.001 | 8.41E-03 |
| CHEMNITZ\_RESPONSE\_TO\_PROSTAGLANDIN\_E2\_UP | 128 | 0.42 | 1.86 | <0.001 | 9.19E-03 |
| BOYAULT\_LIVER\_CANCER\_SUBCLASS\_G3\_DN | 35 | -0.63 | -1.83 | 1.43E-03 | 9.97E-03 |
| SANSOM\_APC\_TARGETS\_DN | 212 | -0.49 | -1.83 | <0.001 | 9.67E-03 |
| ZHU\_SKIL\_TARGETS\_UP | 18 | -0.74 | -1.83 | <0.001 | 9.68E-03 |
| SCHUETZ\_BREAST\_CANCER\_DUCTAL\_INVASIVE\_UP | 161 | -0.51 | -1.84 | <0.001 | 9.43E-03 |
| ZIRN\_TRETINOIN\_RESPONSE\_WT1\_UP | 17 | -0.74 | -1.84 | 1.56E-03 | 9.50E-03 |
| GROSS\_ELK3\_TARGETS\_DN | 24 | -0.69 | -1.84 | <0.001 | 9.26E-03 |
| CERVERA\_SDHB\_TARGETS\_2 | 79 | -0.55 | -1.84 | <0.001 | 8.72E-03 |
| KIM\_BIPOLAR\_DISORDER\_OLIGODENDROCYTE | 31 | -0.64 | -1.85 | <0.001 | 8.67E-03 |
| \_DENSITY\_CORR\_DN |  |  |  |  |  |
| LI\_CISPLATIN\_RESISTANCE\_UP | 16 | -0.74 | -1.85 | 1.54E-03 | 8.55E-03 |
| GRAESSMANN\_APOPTOSIS\_BY\_SERUM\_DEPRIVATION\_DN | 180 | -0.5 | -1.85 | <0.001 | 8.64E-03 |
| BUFFA\_HYPOXIA\_METAGENE | 48 | -0.6 | -1.85 | <0.001 | 8.23E-03 |
| IZADPANAH\_STEM\_CELL\_ADIPOSE\_VS\_BONE\_DN | 72 | -0.56 | -1.86 | <0.001 | 7.06E-03 |
| ISSAEVA\_MLL2\_TARGETS | 36 | -0.64 | -1.86 | <0.001 | 6.97E-03 |
| TURASHVILI\_BREAST\_DUCTAL\_CARCINOMA | 34 | -0.63 | -1.86 | <0.001 | 6.90E-03 |
| \_VS\_LOBULAR\_NORMAL\_DN |  |  |  |  |  |
| SWEET\_KRAS\_TARGETS\_UP | 59 | -0.58 | -1.87 | <0.001 | 6.63E-03 |
| CORRE\_MULTIPLE\_MYELOMA\_DN | 31 | -0.65 | -1.87 | <0.001 | 6.65E-03 |
| SARRIO\_EPITHELIAL\_MESENCHYMAL\_TRANSITION\_DN | 103 | -0.54 | -1.87 | <0.001 | 6.62E-03 |
| SERVITJA\_ISLET\_HNF1A\_TARGETS\_DN | 68 | -0.58 | -1.87 | <0.001 | 6.46E-03 |
| SU\_LIVER | 27 | -0.68 | -1.87 | 1.50E-03 | 6.48E-03 |
| HOOI\_ST7\_TARGETS\_DN | 88 | -0.56 | -1.87 | <0.001 | 6.39E-03 |
| SATO\_SILENCED\_BY\_METHYLATION\_IN\_PANCREATIC\_CANCER\_1 | 220 | -0.5 | -1.87 | <0.001 | 6.27E-03 |
| VANHARANTA\_UTERINE\_FIBROID\_DN | 52 | -0.6 | -1.87 | <0.001 | 6.33E-03 |
| SWEET\_LUNG\_CANCER\_KRAS\_DN | 223 | -0.5 | -1.88 | <0.001 | 6.20E-03 |
| BLANCO\_MELO\_RESPIRATORY\_SYNCYTIAL\_VIRUS | 170 | -0.51 | -1.88 | <0.001 | 5.96E-03 |
| \_INFECTION\_A594\_CELLS\_UP |  |  |  |  |  |
| SENESE\_HDAC1\_AND\_HDAC2\_TARGETS\_DN | 141 | -0.52 | -1.88 | <0.001 | 5.85E-03 |
| VECCHI\_GASTRIC\_CANCER\_ADVANCED\_VS\_EARLY\_DN | 105 | -0.54 | -1.88 | <0.001 | 5.77E-03 |
| KHETCHOUMIAN\_TRIM24\_TARGETS\_UP | 30 | -0.67 | -1.88 | <0.001 | 5.85E-03 |
| MINGUEZ\_LIVER\_CANCER\_VASCULAR\_INVASION\_DN | 16 | -0.76 | -1.88 | <0.001 | 5.92E-03 |
| BASAKI\_YBX1\_TARGETS\_DN | 344 | -0.49 | -1.89 | <0.001 | 5.85E-03 |
| GESERICK\_TERT\_TARGETS\_DN | 19 | -0.74 | -1.89 | <0.001 | 5.86E-03 |
| KIM\_GLIS2\_TARGETS\_UP | 44 | -0.62 | -1.89 | <0.001 | 5.75E-03 |
| WATANABE\_COLON\_CANCER\_MSI\_VS\_MSS\_DN | 30 | -0.67 | -1.89 | <0.001 | 5.66E-03 |
| MOHANKUMAR\_HOXA1\_TARGETS\_DN | 98 | -0.56 | -1.89 | <0.001 | 5.73E-03 |
| IIZUKA\_LIVER\_CANCER\_PROGRESSION\_G2\_G3\_UP | 24 | -0.71 | -1.89 | <0.001 | 5.78E-03 |
| BLANCO\_MELO\_COVID19\_BRONCHIAL\_EPITHELIAL\_CELLS | 33 | -0.66 | -1.89 | 1.43E-03 | 5.73E-03 |
| \_SARS\_COV\_2\_INFECTION\_DN |  |  |  |  |  |
| CASORELLI\_ACUTE\_PROMYELOCYTIC\_LEUKEMIA\_UP | 121 | -0.54 | -1.9 | <0.001 | 5.69E-03 |
| MIKKELSEN\_MEF\_ICP\_WITH\_H3K27ME3 | 56 | -0.61 | -1.9 | <0.001 | 5.71E-03 |
| CAIRO\_HEPATOBLASTOMA\_CLASSES\_DN | 141 | -0.53 | -1.9 | <0.001 | 5.16E-03 |
| SHETH\_LIVER\_CANCER\_VS\_TXNIP\_LOSS\_PAM3 | 55 | -0.6 | -1.9 | 1.32E-03 | 5.02E-03 |
| BLANCO\_MELO\_MERS\_COV\_INFECTION\_MCR5\_CELLS\_UP | 161 | -0.52 | -1.91 | <0.001 | 4.54E-03 |
| YAO\_TEMPORAL\_RESPONSE\_TO\_PROGESTERONE\_CLUSTER\_5 | 21 | -0.71 | -1.91 | <0.001 | 4.59E-03 |
| WINTER\_HYPOXIA\_UP | 86 | -0.57 | -1.91 | <0.001 | 4.57E-03 |
| GOZGIT\_ESR1\_TARGETS\_UP | 98 | -0.56 | -1.92 | <0.001 | 4.00E-03 |
| VECCHI\_GASTRIC\_CANCER\_EARLY\_DN | 147 | -0.53 | -1.92 | <0.001 | 4.04E-03 |
| ODONNELL\_TFRC\_TARGETS\_UP | 215 | -0.52 | -1.92 | <0.001 | 3.85E-03 |
| KINSEY\_TARGETS\_OF\_EWSR1\_FLII\_FUSION\_DN | 258 | -0.51 | -1.93 | <0.001 | 3.72E-03 |
| SCHAEFFER\_PROSTATE\_DEVELOPMENT\_12HR\_UP | 69 | -0.6 | -1.93 | <0.001 | 3.75E-03 |
| BAELDE\_DIABETIC\_NEPHROPATHY\_UP | 54 | -0.61 | -1.93 | <0.001 | 3.74E-03 |
| MIKKELSEN\_IPS\_LCP\_WITH\_H3K4ME3 | 82 | -0.57 | -1.93 | <0.001 | 3.80E-03 |
| TSAI\_RESPONSE\_TO\_RADIATION\_THERAPY | 20 | -0.75 | -1.93 | 1.50E-03 | 3.68E-03 |
| CHIANG\_LIVER\_CANCER\_SUBCLASS\_PROLIFERATION\_DN | 113 | -0.55 | -1.94 | <0.001 | 3.68E-03 |
| BERTUCCI\_INVASIVE\_CARCINOMA\_DUCTAL\_VS\_LOBULAR\_DN | 21 | -0.76 | -1.94 | <0.001 | 3.33E-03 |
| NAKAYAMA\_SOFT\_TISSUE\_TUMORS\_PCA2\_DN | 42 | -0.65 | -1.94 | 1.38E-03 | 3.30E-03 |
| DUNNE\_TARGETS\_OF\_AML1\_MTG8\_FUSION\_UP | 24 | -0.73 | -1.94 | <0.001 | 3.36E-03 |
| LEE\_AGING\_CEREBELLUM\_UP | 52 | -0.62 | -1.95 | <0.001 | 3.32E-03 |
| MIKKELSEN\_MEF\_LCP\_WITH\_H3K4ME3 | 73 | -0.59 | -1.95 | <0.001 | 3.38E-03 |
| PRAMOONJAGO\_SOX4\_TARGETS\_UP | 47 | -0.64 | -1.95 | 1.39E-03 | 3.36E-03 |
| COATES\_MACROPHAGE\_M1\_VS\_M2\_DN | 58 | -0.61 | -1.95 | <0.001 | 3.10E-03 |
| GROSS\_HYPOXIA\_VIA\_ELK3\_AND\_HIF1A\_UP | 126 | -0.55 | -1.96 | <0.001 | 2.97E-03 |
| GROSS\_HYPOXIA\_VIA\_HIF1A\_DN | 90 | -0.59 | -1.96 | <0.001 | 2.84E-03 |
| MCDOWELL\_ACUTE\_LUNG\_INJURY\_UP | 30 | -0.7 | -1.96 | <0.001 | 2.88E-03 |
| MIKKELSEN\_ES\_LCP\_WITH\_H3K4ME3 | 63 | -0.61 | -1.96 | <0.001 | 2.95E-03 |
| MIKKELSEN\_IPS\_ICP\_WITH\_H3K4ME3\_AND\_H327ME3 | 38 | -0.67 | -1.97 | <0.001 | 2.59E-03 |
| KORKOLA\_YOLK\_SAC\_TUMOR | 33 | -0.67 | -1.98 | <0.001 | 2.40E-03 |
| CERVERA\_SDHB\_TARGETS\_1\_DN | 21 | -0.76 | -1.98 | <0.001 | 2.20E-03 |
| STEARMAN\_LUNG\_CANCER\_EARLY\_VS\_LATE\_DN | 42 | -0.66 | -1.99 | <0.001 | 2.23E-03 |
| CHEN\_LVAD\_SUPPORT\_OF\_FAILING\_HEART\_UP | 74 | -0.61 | -2 | <0.001 | 1.62E-03 |
| YAO\_HOXA10\_TARGETS\_VIA\_PROGESTERONE\_UP | 44 | -0.66 | -2 | <0.001 | 1.54E-03 |
| RIGGINS\_TAMOXIFEN\_RESISTANCE\_UP | 46 | -0.65 | -2 | <0.001 | 1.53E-03 |
| KIM\_HYPOXIA | 16 | -0.83 | -2.01 | <0.001 | 1.41E-03 |
| DEMAGALHAES\_AGING\_UP | 35 | -0.69 | -2.01 | <0.001 | 1.45E-03 |
| BOQUEST\_STEM\_CELL\_UP | 138 | -0.56 | -2.02 | <0.001 | 1.35E-03 |
| DUTERTRE\_ESTRADIOL\_RESPONSE\_6HR\_DN | 76 | -0.6 | -2.02 | <0.001 | 1.33E-03 |
| VANDESLUIS\_COMMD1\_TARGETS\_GROUP\_3\_UP | 65 | -0.63 | -2.02 | <0.001 | 1.22E-03 |
| BHAT\_ESR1\_TARGETS\_VIA\_AKT1\_DN | 64 | -0.63 | -2.03 | <0.001 | 1.07E-03 |
| HARRIS\_HYPOXIA | 61 | -0.64 | -2.03 | <0.001 | 9.47E-04 |
| KIM\_LIVER\_CANCER\_POOR\_SURVIVAL\_DN | 32 | -0.73 | -2.04 | <0.001 | 8.79E-04 |
| LEE\_LIVER\_CANCER\_SURVIVAL\_UP | 124 | -0.58 | -2.06 | <0.001 | 7.01E-04 |
| RUIZ\_TNC\_TARGETS\_UP | 121 | -0.59 | -2.08 | <0.001 | 3.64E-04 |
| BLANCO\_MELO\_HUMAN\_PARAINFLUENZA\_VIRUS\_3 | 83 | -0.62 | -2.08 | <0.001 | 3.78E-04 |
| \_INFECTION\_A594\_CELLS\_DN |  |  |  |  |  |
| MARTENS\_TRETINOIN\_RESPONSE\_UP | 252 | -0.56 | -2.12 | <0.001 | 1.97E-04 |
| BLANCO\_MELO\_COVID19\_SARS\_COV\_2\_INFECTION\_CALU3\_CELLS\_UP | 166 | -0.59 | -2.13 | <0.001 | 2.06E-04 |
| HOSHIDA\_LIVER\_CANCER\_SUBCLASS\_S3 | 212 | -0.57 | -2.14 | <0.001 | 1.30E-04 |
| STEARMAN\_TUMOR\_FIELD\_EFFECT\_UP | 25 | -0.81 | -2.17 | <0.001 | 9.04E-05 |
| ANDERSEN\_LIVER\_CANCER\_KRT19\_DN | 56 | -0.69 | -2.18 | <0.001 | 4.75E-05 |
| SEMENZA\_HIF1\_TARGETS | 30 | -0.77 | -2.18 | <0.001 | 5.00E-05 |
| QI\_HYPOXIA | 114 | -0.62 | -2.2 | <0.001 | <0.001 |
| KOBAYASHI\_EGFR\_SIGNALING\_24HR\_UP | 79 | -0.67 | -2.21 | <0.001 | <0.001 |
| OHGUCHI\_LIVER\_HNF4A\_TARGETS\_DN | 97 | -0.65 | -2.22 | <0.001 | <0.001 |
| SABATES\_COLORECTAL\_ADENOMA\_DN | 99 | -0.65 | -2.22 | <0.001 | <0.001 |
| CADWELL\_ATG16L1\_TARGETS\_UP | 55 | -0.7 | -2.23 | <0.001 | <0.001 |
| YAO\_TEMPORAL\_RESPONSE\_TO\_PROGESTERONE\_CLUSTER\_0 | 61 | -0.7 | -2.23 | <0.001 | <0.001 |
| WINTER\_HYPOXIA\_METAGENE | 193 | -0.61 | -2.25 | <0.001 | <0.001 |
| CAIRO\_LIVER\_DEVELOPMENT\_DN | 153 | -0.62 | -2.25 | <0.001 | <0.001 |
| MEBARKI\_HCC\_PROGENITOR\_FZD8CRD\_DN | 294 | -0.61 | -2.32 | <0.001 | <0.001 |
| FARDIN\_HYPOXIA\_11 | 31 | -0.82 | -2.35 | <0.001 | <0.001 |
| LEONARD\_HYPOXIA | 36 | -0.81 | -2.38 | <0.001 | <0.001 |
| MANALO\_HYPOXIA\_UP | 150 | -0.67 | -2.38 | <0.001 | <0.001 |
| MENSE\_HYPOXIA\_UP | 94 | -0.7 | -2.4 | <0.001 | <0.001 |
| HSIAO\_LIVER\_SPECIFIC\_GENES | 177 | -0.67 | -2.47 | <0.001 | <0.001 |
| ELVIDGE\_HIF1A\_TARGETS\_DN | 74 | -0.82 | -2.68 | <0.001 | <0.001 |
| ELVIDGE\_HIF1A\_AND\_HIF2A\_TARGETS\_DN | 88 | -0.8 | -2.7 | <0.001 | <0.001 |
| ELVIDGE\_HYPOXIA\_BY\_DMOG\_UP | 113 | -0.77 | -2.72 | <0.001 | <0.001 |
| ELVIDGE\_HYPOXIA\_UP | 143 | -0.77 | -2.75 | <0.001 | <0.001 |
| Abbreviation: ES, enrichment score; NES, normalized ES; FDR, false discovery rate. |  |