

Table S1 Univariate Cox regression results

lncRNA	P value	Hazard ratio (95% CI)
LINC01772	0.049	1.438 (1.002–2.065)
AC092422.1	0.004	0.366 (0.183–0.732)
AL031709.1	0.031	1.340 (1.026–1.749)
MMP25–AS1	0.012	1.394 (1.077–1.804)
AC012073.1	<0.001	2.096 (1.374–3.197)
AC103746.1	0.038	0.649 (0.431–0.977)
SH3BP5–AS1	0.035	1.282 (1.018–1.614)
RAP2C–AS1	0.003	0.416 (0.234–0.739)
OGFR–AS1	0.005	1.670 (1.165–2.394)
ZKSCAN7–AS1	<0.001	0.422 (0.262–0.680)
AC010536.1	0.028	2.565 (1.105–5.957)
AC145285.6	<0.001	2.627 (1.625–4.246)
AL117209.1	0.041	1.356 (1.012–1.817)
AL162311.3	0.022	0.131 (0.023–0.742)
AL355803.1	0.02	0.794 (0.654–0.965)
AC097639.1	<0.001	0.435 (0.290–0.650)
ZNF503–AS2	0.035	0.680 (0.475–0.974)
SMARCA5–AS1	<0.001	0.283 (0.176–0.454)
AC012615.6	<0.001	1.546 (1.193–2.003)
AC025171.2	0.045	1.348 (1.007–1.803)
AC008543.1	0.005	0.315 (0.139–0.712)
AL135999.1	0.001	2.863 (1.527–5.369)
AC115522.1	0.003	0.515 (0.332–0.799)
AC009486.1	0.004	0.498 (0.311–0.798)
AC018690.1	0.003	1.757 (1.211–2.551)
LINC00702	0.033	0.563 (0.332–0.954)
AC024909.1	0.006	0.398 (0.207–0.764)
AC092910.3	0.006	1.733 (1.173–2.563)
TRAM2–AS1	0.007	0.590 (0.402–0.866)
GAS6–DT	0.004	0.634 (0.463–0.867)
AC073254.1	0.015	0.528 (0.317–0.881)
AP006623.1	0.007	1.355 (1.087–1.688)
LINC01154	0.044	0.343 (0.121–0.972)
AC025165.1	0.004	2.185 (1.274–3.748)

Table S1 (continued)

Table S1 (continued)

lncRNA	P value	Hazard ratio (95% CI)
H1–10–AS1	0.002	1.638 (1.194–2.248)
AL162171.1	<0.001	0.580 (0.423–0.797)
SP2–AS1	0.045	0.654 (0.432–0.991)
AL078644.1	0.026	0.625 (0.414–0.945)
NARF–IT1	0.002	1.550 (1.181–2.035)
CYTOR	0.027	1.538 (1.051–2.251)
AC129510.1	<0.001	1.718 (1.288–2.292)
AC005670.3	0.005	0.617 (0.441–0.863)
AC095055.1	<0.001	0.401 (0.266–0.606)
PTOV1–AS2	<0.001	1.415 (1.152–1.739)
AC027601.2	0.003	0.596 (0.423–0.838)
Z97832.2	0.002	1.770 (1.236–2.535)
AL450326.1	0.011	0.692 (0.521–0.920)
AL645608.1	0.038	1.408 (1.020–1.945)
BX322557.2	0.03	0.391 (0.167–0.912)
AC104211.1	<0.001	0.679 (0.553–0.833)
USP27X–AS1	<0.001	0.527 (0.362–0.766)
C6orf223	0.042	0.884 (0.785–0.995)
AC021037.1	0.013	0.291 (0.110–0.772)
DHRS4–AS1	0.008	0.629 (0.445–0.888)
AL391684.1	0.023	1.462 (1.055–2.027)
AC103809.1	0.005	0.468 (0.276–0.795)
AP001922.6	0.019	0.589 (0.379–0.915)
AP003721.3	<0.001	0.524 (0.377–0.730)
AL022328.3	<0.001	1.770 (1.287–2.433)
AC005845.1	0.027	0.551 (0.325–0.934)
AL139287.1	0.043	1.217 (1.006–1.472)
AC006213.1	0.006	0.205 (0.066–0.635)
EMX2OS	<0.001	0.751 (0.666–0.848)
AP001542.3	<0.001	0.664 (0.549–0.803)
PKD1P6–NPIPP1	0.005	2.803 (1.370–5.737)
AC020907.4	<0.001	1.582 (1.299–1.928)
AP001267.3	<0.001	0.304 (0.165–0.561)
AP001107.3	0.005	1.900 (1.213–2.976)
AC125494.1	0.036	2.081 (1.047–4.134)

Table S1 (continued)

Table S1 (continued)

lncRNA	P value	Hazard ratio (95% CI)
AC098484.4	0.014	1.543 (1.093–2.177)
AC120114.1	0.033	0.719 (0.530–0.974)
AP000759.1	0.003	0.643 (0.479–0.864)
AC018653.3	0.001	1.554 (1.194–2.023)
AC091057.1	<0.001	1.998 (1.336–2.986)
AC022167.2	0.024	1.748 (1.075–2.841)
AC011472.1	0.01	1.281 (1.060–1.549)
LINC00987	0.038	0.659 (0.444–0.976)
MBNL1–AS1	0.001	0.525 (0.353–0.779)
AC010327.6	0.045	1.735 (1.011–2.976)
AL161785.1	0.005	0.645 (0.477–0.874)
AC073896.2	<0.001	2.874 (1.703–4.852)
AC012360.3	<0.001	1.914 (1.352–2.710)
AL162377.1	<0.001	0.272 (0.161–0.457)
RUSC1–AS1	<0.001	1.596 (1.251–2.036)
THBS3–AS1	<0.001	2.045 (1.494–2.799)
AC015922.2	0.014	0.791 (0.656–0.953)
AC245052.4	0.005	2.005 (1.240–3.243)
FAM225B	0.004	4.105 (1.577–10.684)
AC006064.3	0.045	1.280 (1.005–1.629)
AC010642.2	0.002	2.402 (1.389–4.153)
ALDH1L1–AS2	<0.001	0.645 (0.502–0.830)
TCL6	0.025	0.648 (0.443–0.948)
AL022238.2	<0.001	1.582 (1.213–2.063)
MGC16275	0.043	0.556 (0.315–0.983)
AC004554.1	0.002	0.559 (0.385–0.810)
LINC00886	<0.001	0.562 (0.405–0.779)
AC245060.6	0.013	1.867 (1.142–3.052)
YEATS2–AS1	<0.001	2.063 (1.439–2.957)
AL078581.2	<0.001	0.534 (0.394–0.725)
ZNF503–AS1	<0.001	0.386 (0.253–0.590)
HID1–AS1	<0.001	0.613 (0.460–0.818)
AC026369.2	0.028	0.809 (0.669–0.978)
AC018521.6	<0.001	0.585 (0.431–0.795)
DOCK9–DT	<0.001	0.484 (0.332–0.706)

Table S1 (continued)

Table S1 (continued)

lncRNA	P value	Hazard ratio (95% CI)
AL590226.1	0.014	0.597 (0.396–0.902)
MRPL20–DT	<0.001	1.921 (1.428–2.583)
LINC01488	0.016	0.131 (0.025–0.685)
AL359853.1	0.012	0.611 (0.416–0.896)
AC011462.5	0.024	1.427 (1.048–1.943)
SBF2–AS1	0.013	0.618 (0.423–0.903)
AC060780.1	0.019	1.401 (1.056–1.858)
AL355075.2	0.029	1.282 (1.025–1.602)
ZNF32–AS2	0.005	1.485 (1.125–1.962)
AL031670.1	0.007	1.425 (1.100–1.847)
AL031123.5	0.01	0.699 (0.531–0.920)
PAXIP1–AS2	0.036	0.701 (0.504–0.976)
AL136295.7	0.02	1.465 (1.063–2.020)
AC008556.1	0.003	0.592 (0.417–0.840)
AL161782.1	<0.001	0.519 (0.379–0.712)
LINC02685	0.003	0.587 (0.412–0.837)
AC009962.1	0.01	0.307 (0.125–0.751)
LINC00342	<0.001	1.479 (1.198–1.826)
GATA2–AS1	<0.001	0.531 (0.386–0.731)
TPT1–AS1	0.027	1.516 (1.049–2.191)
AL161729.1	0.033	0.274 (0.083–0.900)
AL138995.1	0.026	0.516 (0.288–0.924)
AC012313.6	0.011	1.647 (1.121–2.421)
AC083964.1	0.049	0.763 (0.582–0.999)
UBE2Q1–AS1	0.002	1.599 (1.192–2.146)
AL122035.2	0.021	0.220 (0.060–0.799)
AL161756.3	0.023	2.213 (1.113–4.400)
INE1	0.002	1.469 (1.152–1.873)
AC005519.1	0.018	1.360 (1.054–1.754)
AC079140.6	0.016	0.621 (0.422–0.916)
AC018647.2	0.007	0.638 (0.458–0.887)
LINC01126	0.001	1.524 (1.180–1.967)
AC074117.1	<0.001	1.960 (1.373–2.799)
AF129075.3	<0.001	1.565 (1.219–2.010)
AL360181.2	<0.001	1.449 (1.184–1.772)

Table S1 (continued)

Table S1 (continued)

lncRNA	P value	Hazard ratio (95% CI)
LINC01747	0.022	0.104 (0.015–0.721)
AC007406.3	0.004	0.767 (0.640–0.918)
AL928654.2	0.005	1.284 (1.076–1.531)
RAD51–AS1	0.006	1.364 (1.092–1.704)
AL358472.4	0.007	1.755 (1.168–2.636)
AL132800.1	<0.001	0.498 (0.355–0.699)
CD27–AS1	<0.001	1.891 (1.333–2.681)
AL021707.2	0.007	2.141 (1.231–3.725)
U91328.1	0.01	0.668 (0.491–0.909)
LINC01415	0.012	0.464 (0.255–0.843)
AF186192.1	0.023	0.713 (0.533–0.955)
AC108156.1	0.009	0.215 (0.067–0.685)
AL596244.1	0.014	0.603 (0.402–0.904)
AL109659.2	0.034	1.622 (1.037–2.536)
AC009283.1	0.006	1.468 (1.119–1.926)
C3orf36	<0.001	0.641 (0.522–0.788)
AC020558.2	<0.001	1.609 (1.255–2.063)
AL021707.3	0.032	1.480 (1.035–2.118)
AL158206.1	<0.001	0.605 (0.460–0.794)
AC084018.2	0.027	3.828 (1.161–12.624)
AC084198.2	0.037	1.404 (1.020–1.931)
LINC01671	0.003	0.829 (0.733–0.937)
AC007861.1	0.001	0.082 (0.018–0.367)
AC020558.6	0.007	2.061 (1.214–3.499)
AC027601.5	<0.001	3.157 (1.776–5.609)
AC008735.1	0.019	1.427 (1.062–1.918)
NOP53–AS1	0.007	0.533 (0.337–0.841)
AL353796.1	0.032	1.818 (1.053–3.138)
AC015813.1	0.003	1.344 (1.103–1.638)
AC004112.1	0.046	0.693 (0.483–0.994)
AL136084.2	0.008	0.545 (0.347–0.855)
AC096921.2	0.01	0.660 (0.482–0.904)
AL049871.1	0.033	0.599 (0.374–0.959)
CTBP1–DT	0.025	0.666 (0.466–0.951)
LINC01852	0.036	0.668 (0.458–0.973)

Table S1 (continued)

Table S1 (continued)

lncRNA	P value	Hazard ratio (95% CI)
AP001922.5	<0.001	0.493 (0.328–0.739)
AP001372.2	<0.001	0.487 (0.335–0.707)
WDFY3–AS2	0.005	0.685 (0.526–0.892)
AC132872.1	0.002	1.503 (1.166–1.936)
PCAT19	0.009	0.664 (0.489–0.903)
ZNF582–AS1	<0.001	0.504 (0.336–0.754)
AC104564.3	<0.001	1.537 (1.225–1.929)
WWC2–AS2	0.006	0.652 (0.481–0.884)
AC121338.2	<0.001	0.422 (0.304–0.587)
AC005034.5	0.005	0.616 (0.440–0.862)
EPB41L4A–DT	<0.001	0.500 (0.369–0.676)
GAS5–AS1	0.006	0.551 (0.359–0.845)
LINC02521	0.024	0.533 (0.309–0.919)
USP46–DT	0.05	0.722 (0.522–0.999)
AC018752.1	<0.001	0.699 (0.574–0.851)
AL049795.1	<0.001	3.982 (1.925–8.237)
AL162586.1	<0.001	1.497 (1.188–1.887)
AL109741.1	<0.001	0.584 (0.467–0.732)
AC090589.3	0.008	1.420 (1.098–1.835)
AC002070.1	<0.001	0.485 (0.365–0.644)
AL133406.2	0.002	1.791 (1.230–2.608)
FGD5–AS1	0.033	0.692 (0.493–0.971)
MIR34AHG	0.005	1.399 (1.108–1.766)
EDRF1–DT	0.023	0.336 (0.131–0.861)
AC017099.2	0.003	0.550 (0.373–0.813)
AC109460.3	<0.001	6.397 (2.301–17.783)
LIFR–AS1	0.033	0.622 (0.403–0.961)
AC018809.2	0.014	0.507 (0.294–0.874)
AC092295.2	0.02	0.584 (0.371–0.918)
AC109460.2	0.022	1.358 (1.046–1.764)
AC004918.3	0.035	0.765 (0.597–0.981)
NNT–AS1	<0.001	0.559 (0.407–0.769)
AL022322.1	0.002	1.323 (1.104–1.586)
OVCH1–AS1	<0.001	0.239 (0.114–0.501)
VASH1–AS1	0.02	2.578 (1.159–5.734)

Table S1 (continued)

Table S1 (continued)

lncRNA	P value	Hazard ratio (95% CI)
AC046143.1	0.033	1.519 (1.034–2.232)
CARD8–AS1	0.021	0.687 (0.500–0.946)
AC005104.1	<0.001	1.531 (1.234–1.899)
GNG12–AS1	0.001	0.413 (0.244–0.701)
LENG8–AS1	<0.001	1.521 (1.216–1.904)
MIR1915HG	0.012	0.733 (0.574–0.935)
FOXD2–AS1	<0.001	1.839 (1.344–2.516)
AC019205.1	0.005	2.341 (1.291–4.243)
AC064807.1	0.005	0.594 (0.414–0.852)
LINC01197	0.017	0.543 (0.330–0.896)
SGMS1–AS1	0.009	0.533 (0.332–0.855)
AC108053.1	<0.001	0.400 (0.252–0.634)
AL109811.2	0.014	1.439 (1.076–1.923)
LINC01704	0.008	0.375 (0.183–0.770)
AC091563.1	0.001	0.664 (0.515–0.855)
AL355835.1	<0.001	0.298 (0.169–0.528)
FAM160A1–DT	0.005	0.645 (0.475–0.876)
AC109460.1	0.023	1.548 (1.063–2.256)
AC012313.5	0.002	0.586 (0.417–0.823)
AC104088.3	<0.001	0.237 (0.114–0.496)
OTUD6B–AS1	0.01	0.638 (0.454–0.898)
AC003086.1	0.027	0.653 (0.448–0.952)
FGF12–AS2	0.02	0.465 (0.244–0.886)
LINC01963	0.004	0.657 (0.493–0.878)
AC000050.2	<0.001	0.685 (0.547–0.858)
ZNF667–AS1	0.009	0.644 (0.463–0.898)
AC007743.1	0.002	0.647 (0.489–0.856)
AL161935.1	0.003	2.275 (1.318–3.927)
CDC42–AS1	0.013	1.994 (1.157–3.438)
AC005253.1	0.005	1.652 (1.165–2.344)
LINC01624	<0.001	0.072 (0.016–0.323)
AL121832.3	0.013	1.993 (1.159–3.427)
AC112220.2	0.003	0.520 (0.338–0.801)
PXN–AS1	<0.001	2.483 (1.578–3.906)
AC004148.1	0.001	1.437 (1.155–1.788)

Table S1 (continued)

Table S1 (continued)

lncRNA	P value	Hazard ratio (95% CI)
AC084018.1	0.006	1.284 (1.073–1.536)
NR2F1–AS1	0.013	0.508 (0.299–0.864)
AC040162.3	0.003	2.596 (1.374–4.905)
AC093827.4	0.046	0.667 (0.448–0.992)
AC100793.3	0.001	2.103 (1.333–3.318)
LINC02289	<0.001	0.536 (0.372–0.773)
ALOX12–AS1	0.021	1.672 (1.080–2.589)
AC016026.1	0.026	1.726 (1.066–2.796)
AC004263.2	0.014	1.270 (1.050–1.537)
AC114730.3	0.007	1.485 (1.116–1.975)
CCDC18–AS1	<0.001	1.466 (1.178–1.825)
AL139398.1	0.006	0.360 (0.174–0.743)
AC104532.2	0.031	1.310 (1.024–1.675)
AC107027.3	0.043	0.682 (0.472–0.988)
LINC01843	0.023	0.822 (0.694–0.973)
AC005332.5	0.017	1.612 (1.088–2.387)
AC022387.2	0.033	0.492 (0.256–0.945)
PSMG3–AS1	0.004	0.549 (0.364–0.829)
LINC00174	0.002	1.549 (1.179–2.034)
AC008735.2	0.001	1.329 (1.119–1.580)
AC110611.2	0.006	0.661 (0.491–0.890)
AC034102.6	0.014	2.095 (1.164–3.771)
SEPTIN7–DT	0.028	0.643 (0.434–0.954)

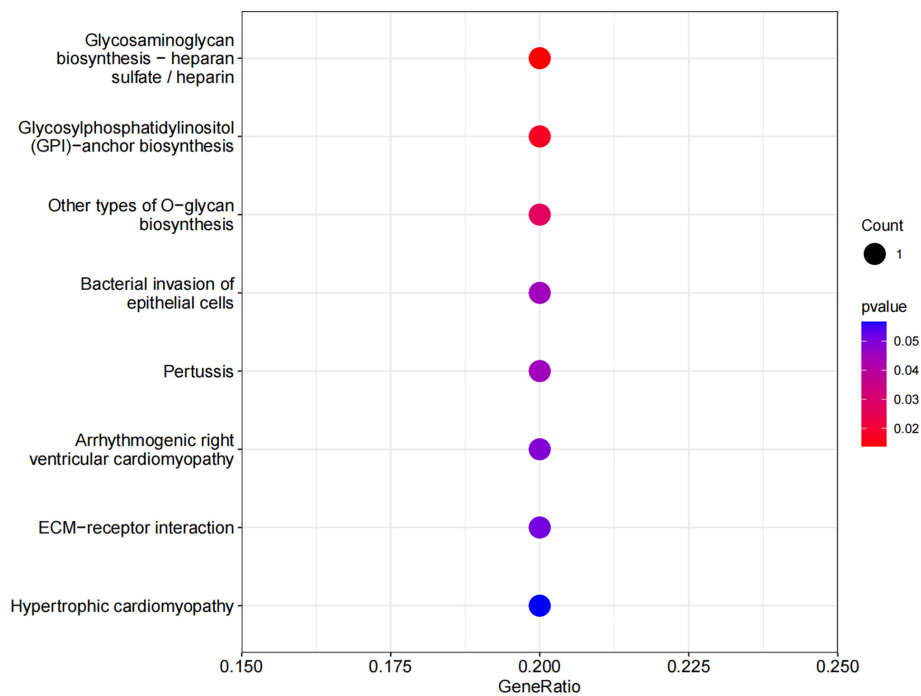


Figure S1 KEGG enrichment analysis of 13 lncRNAs-associated pathways. KEGG, Kyoto Encyclopedia of Genes and Genomes; lncRNAs, long non-coding RNAs.

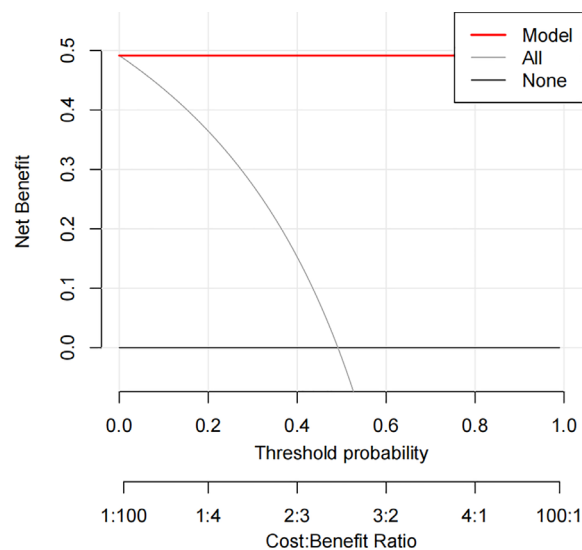


Figure S2 Decision curve analysis demonstrates the comparison of net benefits among the three strategies. “Model” (red line): Maintains a consistent net benefit of approximately 0.5 across all threshold probabilities. “All” (gray line): Starts with high benefit at low thresholds but decreases as the threshold increases. “None” (black line): Remains at zero net benefit across all thresholds.

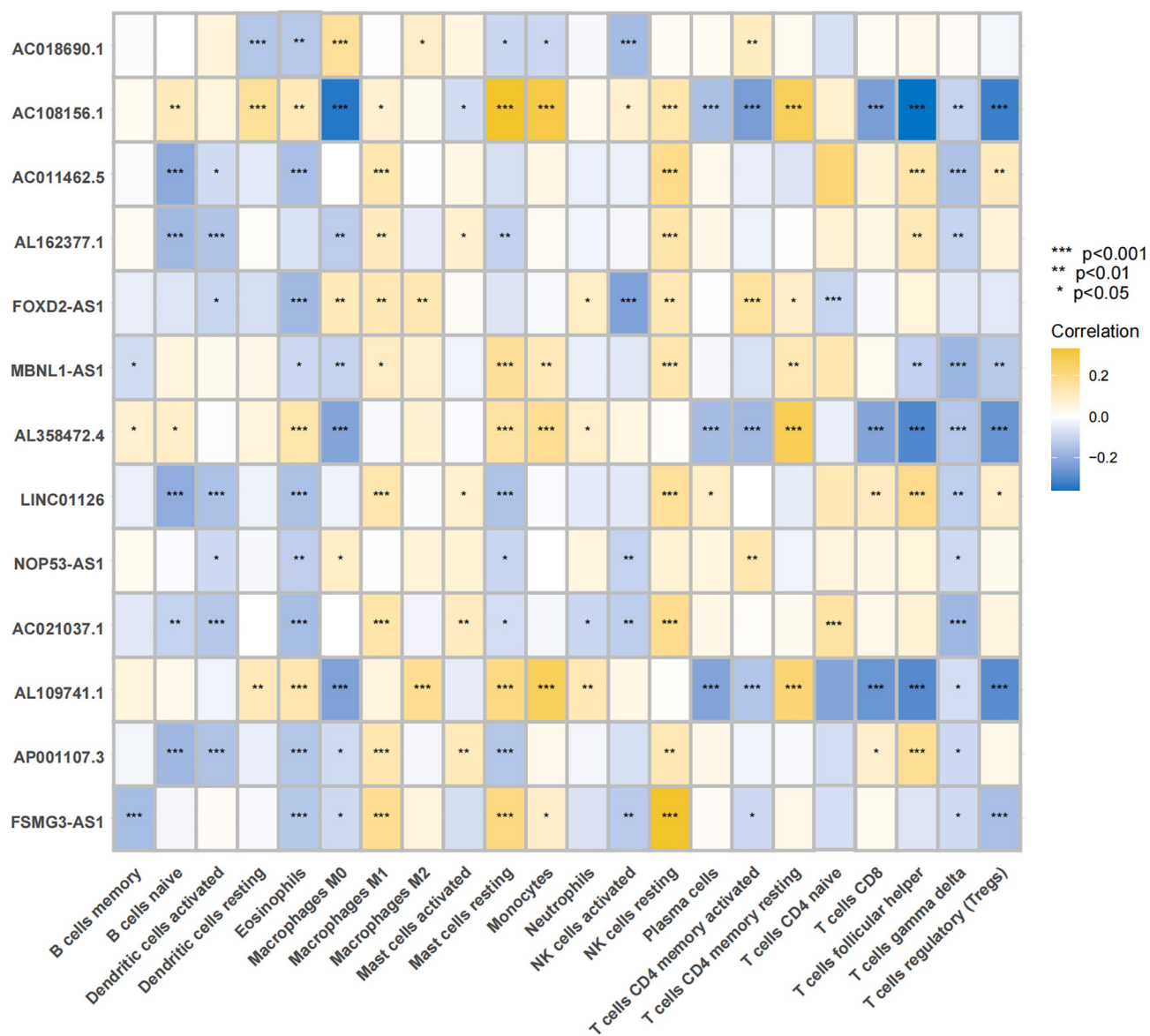


Figure S3 Heatmap showing correlation analysis between 13 lncRNAs and 22 immune cell types. lncRNAs, long non-coding RNAs; NK, natural killer.