Supplementary Material: Identification of Cancer Hub Gene Signatures Associated with Immune-Suppressive Tumor Microenvironment and Ovatodiolide as a Potential Cancer Immunotherapeutic Agent

Jia-Hong Chen, Alexander T. H. Wu, Bashir Lawal, David T. W. Tzeng, Jih-Chin Lee, Ching-Liang Ho and Tsu-Yi Chao

Table S1. Mutation frequency of the hub genes in the hub cancers.

Cancer type	Symbol	EffectiveMut	NonEffectiveMut	Sample_Size	Percentage	Entrez
BRCA	IRAK3	5	3	1026	0.487329	11213
COAD	IRAK3	9	3	407	2.211302	11213
LIHC	IRAK3	4	1	365	1.09589	11213
LUAD	IRAK3	4	6	567	0.705467	11213
PRAD	IRAK3	5	1	498	1.004016	11213
STAD	IRAK3	8	5	439	1.822323	11213
BRCA	LIN9	7	4	1026	0.682261	286826
COAD	LIN9	5	3	407	1.228501	286826
LUAD	LIN9	7	0	567	1.234568	286826
PRAD	LIN9	1	0	498	0.200803	286826
STAD	LIN9	6	3	439	1.366743	286826
BRCA	OBSCN	47	30	1026	4.580897	84033
COAD	OBSCN	97	58	407	23.83292	84033
LIHC	OBSCN	38	19	365	10.41096	84033
LUAD	OBSCN	93	52	567	16.40212	84033
PRAD	OBSCN	16	11	498	3.212851	84033
STAD	OBSCN	83	60	439	18.90661	84033
BRCA	RAB31	2	1	1026	0.194932	11031
COAD	RAB31	3	0	407	0.737101	11031
LIHC	RAB31	2	0	365	0.547945	11031
LUAD	RAB31	3	1	567	0.529101	11031
BRCA	SEC16B	15	7	1026	1.461988	89866
COAD	SEC16B	11	9	407	2.702703	89866
LIHC	SEC16B	2	1	365	0.547945	89866
LUAD	SEC16B	14	3	567	2.469136	89866
PRAD	SEC16B	3	1	498	0.60241	89866
STAD	SEC16B	5	1	439	1.138952	89866
BRCA	TNPO2	5	4	1026	0.487329	30000
COAD	TNPO2	10	6	407	2.457002	30000
LIHC	TNPO2	2	1	365	0.547945	30000
LUAD	TNPO2	5	2	567	0.881834	30000
PRAD	TNPO2	1	0	498	0.200803	30000
STAD	TNPO2	12	4	439	2.733485	30000

Table S2. Correlation of gene expression and tumor infiltration of the immune cells in hub cancer.

Cancer	Variable	RAB31	IRAK3	OBSCN	LIN9	TNPO2	SEC16B
BRCA	Purity	-0.07114	-0.39882	-0.0793	0.138495	0.11875	-0.22121
BRCA	B Cell	0.028272	0.153182	-0.08747	0.17233		
BRCA	CD8+ T Cell	0.206092	0.430456	-0.16596	0.198325	0.112571	0.069031
BRCA	CD4+ T Cell	0.128787	0.366357	0.198201	0.136632	0.20206	0.270966
BRCA	Macrophage	0.424807	0.376069	-0.10949			0.177569
BRCA	Neutrophil	0.222228	0.397411		0.209792	0.172728	0.132569
BRCA	Dendritic Cell	0.197187	0.363863		0.151738	0.09814	0.089549
COAD	Purity	-0.40478	-0.32391		0.098922		0.10333
COAD	B Cell	0.173817	0.256238	-0.1289	0.237989		0.120667
COAD	CD8+ T Cell	0.381718	0.389297		0.302618	-0.12165	

COAD	CD4+ T Cell	0.435098	0.422662	0.110091		0.434489	0.278879
COAD	Macrophage	0.70418	0.535847	0.176062	0.185667	0.111776	
COAD	Neutrophil	0.651601	0.56247		0.264135		
COAD	Dendritic Cell	0.653389	0.548536		0.178367	0.112063	
LIHC	Purity	-0.49643	-0.45706	-0.21289	0.216315		0.11
LIHC	B Cell	0.421792	0.250275	0.278656	0.387734	0.237761	
LIHC	CD8+ T Cell	0.484147	0.338181	0.208561	0.248836	0.16781	-0.17703
LIHC	CD4+ T Cell	0.5219	0.431311	0.474799	0.460894	0.501213	
LIHC	Macrophage	0.681213	0.478544	0.474776	0.44294	0.417728	-0.10642
LIHC	Neutrophil	0.584799	0.565076	0.299182	0.408033	0.382461	
LIHC	Dendritic Cell	0.662407	0.450874	0.283084	0.397766	0.334517	
LUAD	Purity	-0.26168	-0.27775		0.133162		-0.0932
LUAD	B Cell	-0.02583	0.307063		-0.18291		
LUAD	CD8+ T Cell	0.266995	0.201114	-0.18584	0.145957		-0.09153
LUAD	CD4+ T Cell	0.102133	0.299907	0.232341	-0.1754	0.306938	0.269201
LUAD	Macrophage	0.350957	0.312079				
LUAD	Neutrophil	0.452357	0.449962		0.109917	0.141522	
LUAD	Dendritic Cell	0.390715	0.401976				
PRAD	Purity	-0.45332	-0.4882	-0.28497			
PRAD	B Cell	0.596777	0.494273	0.155744	0.450827	0.387525	0.291824
PRAD	CD8+ T Cell	0.484187	0.635431		0.412507	0.441604	0.318523
PRAD	CD4+ T Cell	0.520793	0.371931	0.358228	0.184186	0.133199	0.179781
PRAD	Macrophage	0.651215	0.612966	0.223254	0.326646	0.384702	0.267597
PRAD	Neutrophil	0.618639	0.571184	0.3201	0.402695	0.373526	0.341577
PRAD	Dendritic Cell	0.729857	0.611958	0.141348	0.352691	0.329695	0.283255
STAD	Purity	-0.21219	-0.14336		0.188238	0.112129	
STAD	B Cell	-0.1376	0.06274	0.180881			0.131509
STAD	CD8+ T Cell	0.266926	0.305153	-0.11899	-0.1689		
STAD	CD4+ T Cell	0.356594	0.205684	0.261254	-0.11785	0.231008	0.146137
STAD	Macrophage	0.704372	0.318358		-0.2204		
STAD	Neutrophil	0.415955	0.342417	-0.13586	-0.11733		
STAD	Dendritic Cell	0.550791	0.345729		-0.19096		

Table S3. Correlation of gene expression and tumor infiltration of the immunosuppressive cells.

CAF	*RAB31*	*IRAK3*	*0BSCN*	*LIN9*	*TNPO2*	*SEC16B*
BRCA	0.555	0.321	0.14	-0.219	-0.128	0.254
COAD	0.945	0.5114	0.145	-0.139	0.24	-0.138
LIHC	0.701	0.523	0.266	0.184	0.335	
LUAD	0.541	0.132		-0.291	0.283	
PRAD	0.78	0.694	0.126	0.225	0.22	0.137
STAD	0.863	0.166	0.162	-0.343	0.152	-0.218

MDSC	RAB31	IRAK3	0BSCN	LIN9	TNPO2	SEC16B
BRCA	-0.186	-0.305		0.424	0.346	-0.232
COAD	-0.283	-0.349		0.23	0.13	-0.158
LIHC	0.204		0.352	0.58	0.398	-0.271
LUAD				0.44	0.273	-0.121
PRAD	-0.233	-0.358	-0.147	0.174	0.127	-0.101
STAD	-0.305	-0.351	0.123	0.353	0.059	-0.16

TAM	RAB31	IRAK3	0BSCN	LIN9	TNPO2	SEC16B
BRCA	-5.993	-3.2		-0.27		-0.01
COAD	-5.24	-3.65				-0.01
LIHC	-4.95	-2.90			-0.14	-0.04
LUAD	-5.90	-3.02		-0.136	-0.18	-0.01
PRAD	-6.04	-2.93	-2.54	-0.199	-0.23	-0.146
STAD	-5.01	-3.34	0.15	-0.213	-0.19	-0.179

TREG	RAB31	IRAK3	OBSCN	LIN9	TNPO2	SEC16B
BRCA	0.238	0.282	0.245	0.166	0.186	0.152
COAD	0.487	0.415		0.123	0.287	0.19
LIHC	0.453	0.405	0.361	0.416	0.369	0.236
LUAD	0.387	0.525	0.166		0.257	0.123

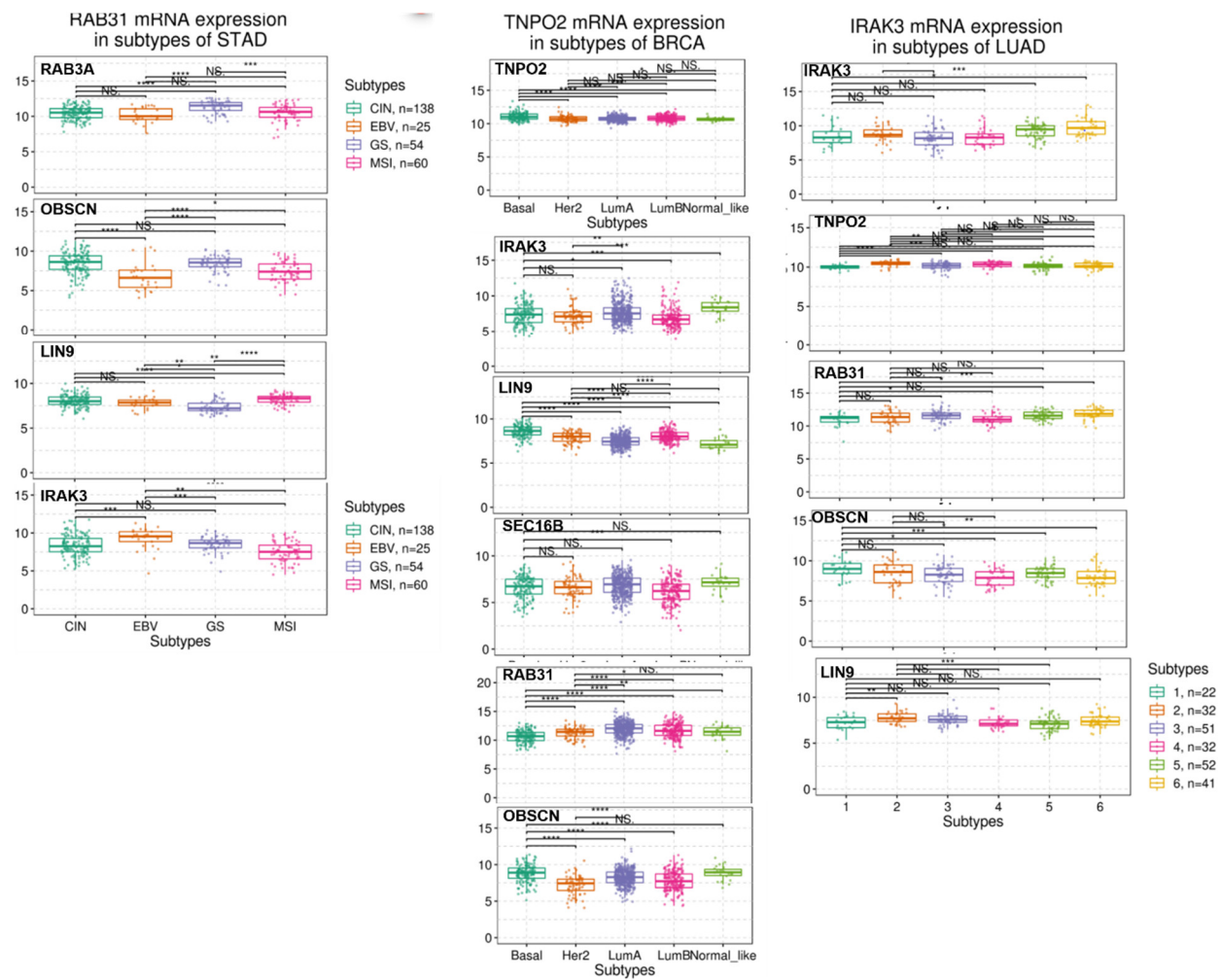|						
PRAD	0.504	0.473	0.209	0.359	0.317	0.224
STAD	0.365	0.364	0.247	0.104	0.309	0.217

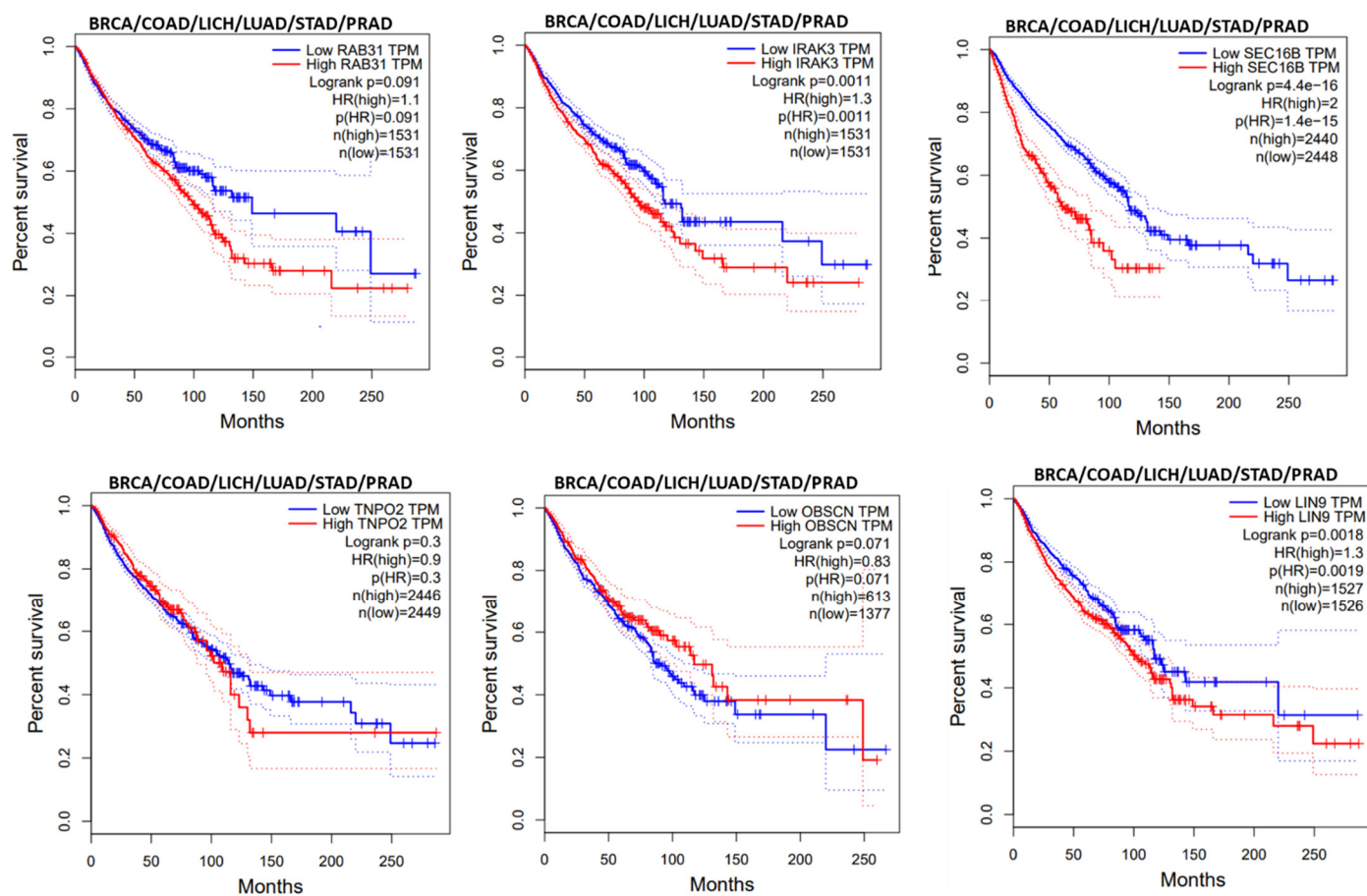**Figure S1.** Summary the associations between subtypes and gene expression.

Figure S2: Kaplan–Meir plots survival differences between the mRNA expression levels of the hub genes in the combined cohorts of the hub cancer.
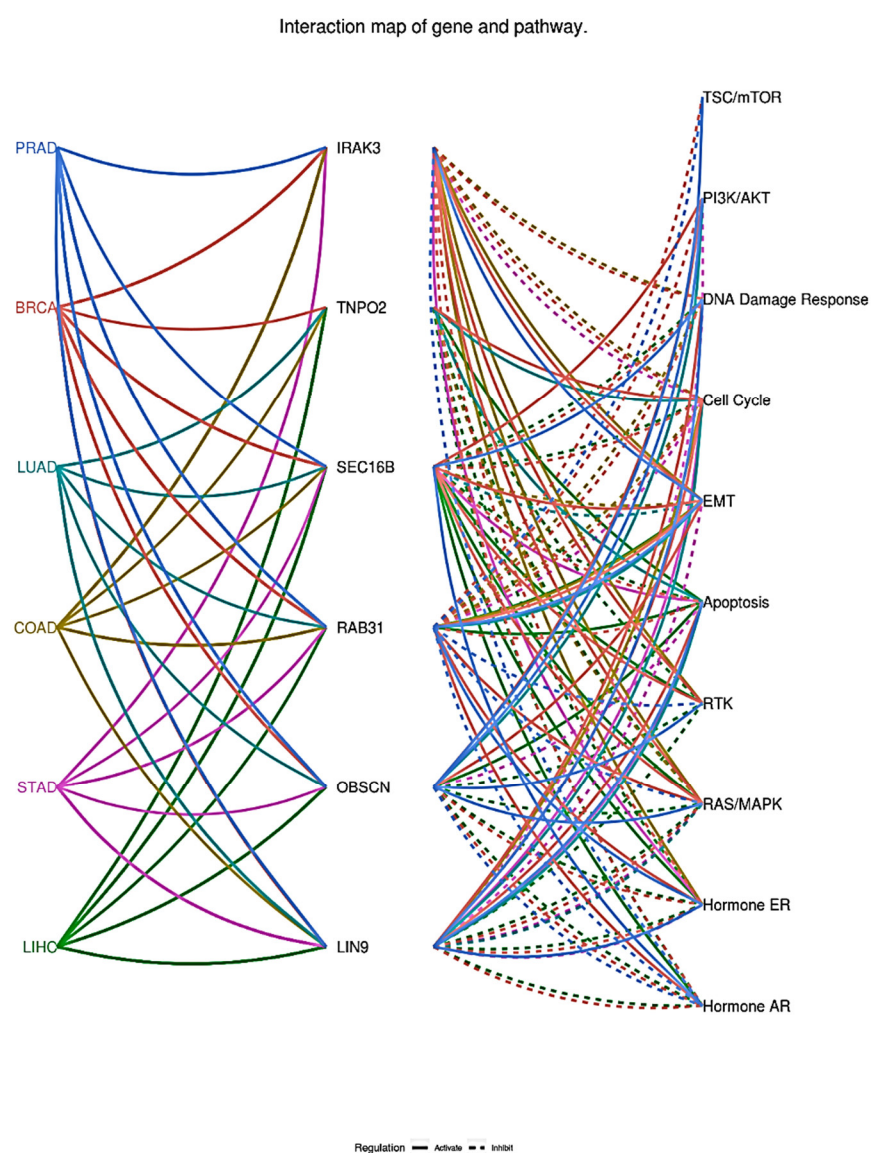
Interaction map of gene and pathway.

Figure S3. Interaction map of the hub genes and pathway.