Supplementary Information

Diagnostic value of serum sphingolipids in patients with colorectal cancer

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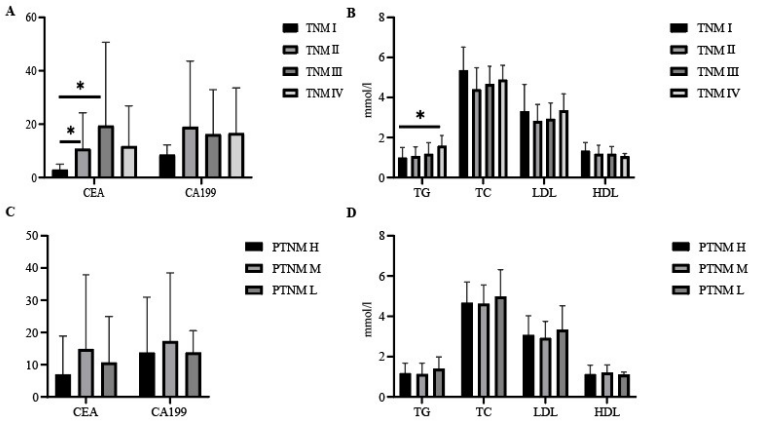

Figure S1. Serum lipids and tumor biomarkers levels of patients with CRC in different stages. *$p < 0.05$.

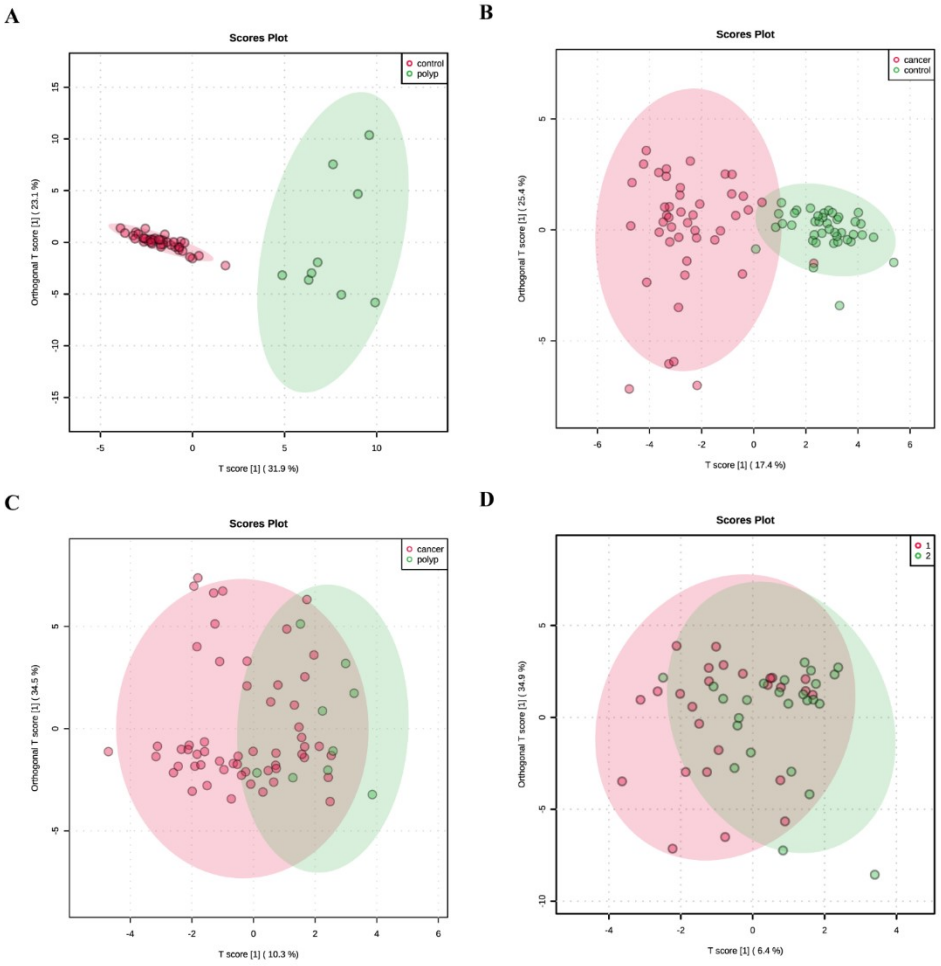

Figure S2. OPLS-DA analysis between groups. (a) OPLS-DA analysis showed distinct metabolic profiles between polyp patients and the healthy; (b) OPLS-DA analysis showed distinct metabolic profiles between CRC patients and the healthy; (c) OPLS-DA analysis showed overlapped metabolites between polyp and CRC patients; (d) OPLS-DA analysis showed overlapped metabolites between early-stage and advanced-stage CRC patients.

Table S1. Identification of lipid species

metabolites	precursor ion	product ions	CE	DP
So (d16:1)	272.4	254.3	12.3	60
Sa (d16:0)	274.4	256.3	12.4	60
So (d18:1)	300.4	282.3	13.7	60
Sa (d18:0)	302.4	284.3	13.8	60
S1P(d18:1)	380.3	264.3	17.6	60
S1P(d17:1)	366.4	250.3	17	60
Sa1P(d17:0)	368.4	252.2	17.1	60
Sa1P(d18:0)	382.4	266.4	17.7	60
ST(d18:1/16:0)	780.6	264.3	37.2	60
ST(d18:1/18:0)	808.6	264.3	38.6	60
CerP(d18:0/15:0)	606.7	266.3	28.7	60
CerP(d18:0/16:0)	620.7	266.3	29.4	60
CerP(d18:1/12:0)	562.6	264.4	26.6	60
CerP(d18:1/14:0)	590.6	264.4	27.9	60
CerP(d18:1/16:0)	618.6	264.4	29.3	60
CerP(d18:1/18:0)	646.6	264.4	30.7	60
CerP(d18:1/20:0)	674.6	264.4	32.1	60
CerP(d18:1/22:0)	702.7	264.4	33.4	60
CerP(d18:1/17:0)	632.7	264.3	30	60
CerP(d18:1/17:1)	630.7	264.3	29.9	60
LacCer(d18:1/16:0)	862.7	264.3	41.3	60
LacCer(d18:1/18:0)	890.7	264.3	42.6	60
LacCer(d18:1/20:0)	918.7	264.4	44	60
LacCer(d18:1/22:0)	946.8	264.3	45.4	60
LacCer(d18:1/24:1)	972.8	264.3	46.7	60
LacCer(d18:1/24:0)	974.8	264.3	46.8	60
LacCer(d18:1/26:0)	1000.8	264.3	48	60
SM(d18:2/15:0)	687.5	184.1	32.7	60
SM(d18:1/14:0)	675.6	184.1	32.1	60
SM(d18:1/16:1)	701.6	184.1	33.4	60
SM(d18:1/15:0)	689.6	184.1	32.8	60
SM(d18:1/16:0)	703.6	184.1	33.5	60
SM(d18:1/18:1)	729.6	184.1	34.8	60
SM(d19:1/16:0)	717.6	184.1	34.2	60
SM(d18:1/17:0)	717.61	184.1	34.2	60
SM(d18:1/18:0)	731.6	184.1	34.8	60
SM(d18:2/20:0)	757.7	184.1	36.1	60
SM(d18:1/22:2)	783.7	184.1	37.4	60
SM(d18:1/19:0)	745.7	184.1	35.5	60
SM(d18:1/20:0)	759.7	184.1	36.2	60

SM(d18:1/22:1)	785.7	184.1	37.5	60
SM(d18:2/22:0)	785.71	184.1	37.5	60
SM(d18:1/24:2)	811.7	184.1	38.8	60
SM(d18:1/21:0)	773.7	184.1	36.9	60
SM(d18:1/23:1)	799.7	184.1	38.2	60
SM(d18:2/23:0)	799.71	184.1	38.2	60
SM(d18:1/22:0)	787.7	184.1	37.6	60
SM(d18:1/24:1)	813.7	184.1	38.9	60
SM(d18:2/24:0)	813.71	184.1	38.9	60
SM(d18:1/23:0)	801.7	184.1	38.3	60
SM(d18:1/25:1)	827.7	184.1	39.6	60
SM(d18:1/24:0)	815.7	184.1	39	60
SM(d18:1/26:0)	843.8	184.1	40.3	60
SM(d18:2/18:1)	727.6	184.1	34.7	60
SM(d18:2/20:2)	753.6	184.1	35.9	60
SM(d18:2/22:2)	781.6	184.1	37.3	60
SM(d18:2/22:3)	779.6	184.1	37.2	60
SM(d18:1/23:2)	797.7	184.1	38.1	60
SM(d18:1/23:3)	795.6	184.1	38	60
SM(d18:1/24:3)	809.7	184.1	38.7	60
SM(d18:2/24:3)	807.6	184.1	38.6	60
SM(d18:1/25:0)	829.7	184.1	39.7	60
SM(d18:1/25:3)	823.7	184.1	39.4	60
SM(d18:1/26:3)	837.7	184.1	40	60
DHSM(d18:0/14:0)	677.6	184.1	32.2	60
DHSM(d18:0/15:0)	691.6	184.1	32.9	60
DHSM(d18:0/16:0)	705.6	184.1	33.6	60
DHSM(d18:0/17:0)	719.6	184.1	34.3	60
DHSM(d18:0/18:0)	733.7	184.1	35	60
DHSM(d18:0/19:0)	747.7	266.3	35.6	60
DHSM(d18:0/19:1)	745.7	266.3	35.5	60
DHSM(d18:0/20:0)	761.7	184.1	36.3	60
DHSM(d18:0/22:0)	789.7	184.1	37.7	60
DHSM(d18:0/23:0)	803.7	184.1	38.4	60
DHSM(d18:0/24:0)	817.7	184.1	39.1	60
HexCer(d18:1/16:0)	700.6	264.3	33.3	60
HexCer(d18:1/18:0)	728.6	264.3	34.7	60
HexCer(d18:1/20:0)	756.7	264.3	36.1	60
HexCer(d18:1/22:0)	784.7	264.3	37.5	60
HexCer(d18:1/24:1)	810.7	264.3	38.7	60
HexCer(d18:0/20:0)	758.7	266.3	36.2	60
HexCer(d18:1/24:0)	812.7	264	38.8	60
Cer(d18:1/14:0)	510.7	264.3	24	60
Cer(d18:1/16:1)	536.6	264.3	25.3	60
Cer(d18:1/16:0)	538.5	264.3	25.4	60
Cer(d18:1/18:1)	564.5	264.3	26.7	60
Cer(d18:0/16:0)	540.5	266.3	25.5	60
Cer(d18:1/17:0)	552.5	264.3	26.1	60
Cer(d18:1/18:0)	566.6	264.3	26.8	60

Cer(d18:2/20:0)	592.6	262.3	28	60
Cer(d18:1/20:0)	594.6	264.3	28.1	60
Cer(d18:2/22:0)	620.6	262.3	29.4	60
Cer(d18:1/23:1)	634.6	264.3	30.1	60
Cer(d18:2/23:0)	634.6	262.3	30.1	60
Cer(d18:1/24:1)	648.7	264.3	30.8	60
Cer(d18:1/23:0)	636.6	264.3	30.2	60
Cer(d18:1/24:0)	650.7	264.3	30.9	60
Cer(d18:1/26:1)	676.7	264.3	32.2	60
Cer(d18:1/26:0)	678.7	264.3	32.3	60
Cer(d18:1/22:0)	622.7	264.3	29.5	60
Cer(d18:0/23:2)	634.7	266.3	30.1	60
Cer(d18:0/23:3)	632.7	266.3	30	60
Cer(d18:0/24:1)	650.7	266.3	30.9	60
(IS)C17So	286.45	268.2	13	60

Table S2. ROC analysis for differential sphingolipids metabolites.

	AUC	P value	95%CI
ST(d18:1/16:0)	0.776	<0.001	0.685-0.867
ST(d18:1/18:0)	0.817	<0.001	0.724-0.91
CerP(d18:1/18:0)	0.655	0.008	0.548-0.763
LacCer(d18:1/20:0)	0.690	0.001	0.587-0.794
LacCer(d18:1/22:0)	0.706	<0.001	0.603-0.809
LacCer(d18:1/24:1)	0.639	0.018	0.529-0.748
LacCer(d18:1/24:0)	0.681	0.002	0.575-0.788
SM(d18:1/21:0)	0.125	<0.001	0.056-0.194
SM(d18:1/23:1)	0.101	<0.001	0.042-0.161
SM(d18:2/23:0)	0.109	<0.001	0.047-0.171
SM(d18:1/23:0)	0.104	<0.001	0.045-0.162
SM(d18:1/25:3)	0.170	<0.001	0.088-0.253
SM(d18:1/26:3)	0.152	<0.001	0.075-0.228
CerP(d18:1/17:0)	0.811	<0.001	0.725-0.896
CerP(d18:1/17:1)	0.699	<0.001	0.596-0.802

Table S3. Normalized peak area of differential sphingolipids metabolites.

group	ST(d18:1/16:0)	ST(d18:1/18:0)	LacCer(d18:1/20:0)	LacCer(d18:1/24:0)	SM(d18:1/21:0)	SM(d18:1/23:1)	SM(d18:2/23:0)	SM(d18:1/25:3)	SM(d18:1/26:3)	CerP(d18:1/17:0)	CerP(d18:1/17:1)	CerP(d18:1/18:0)
cancer	33.377	14.603	2.384	1.192	0.596	0.596	0.298	0.298	0.298	136.039	18.476	14.900
cancer	47.094	30.385	1.115	6.412	0.558	1.951	0.558	0.557	0.557	25.367	22.850	3.066
cancer	29.624	19.455	0.884	3.095	0.884	0.884	0.884	0.221	0.221	23.655	70.744	2.653
cancer	17.164	20.555	1.271	5.933	0.636	0.636	0.212	0.212	0.636	6.359	18.230	4.238
cancer	23.120	24.574	0.582	1.454	0.291	1.744	1.600	0.145	0.145	23.839	30.380	5.962
cancer	13.998	11.181	0.418	3.553	0.105	0.836	0.941	0.104	0.104	60.244	38.300	2.821
cancer	17.447	11.478	0.574	5.051	0.344	1.377	0.229	0.115	0.115	6.198	8.377	4.017
cancer	11.013	0.482	0.116	0.019	3.440	1.676	3.420	0.376	1.484	6.949	1.050	1.637
cancer	3.709	7.855	0.364	3.418	0.218	0.873	0.073	0.073	0.073	6.762	1.818	2.473
cancer	1.809	3.556	0.254	1.080	0.063	0.159	0.286	0.064	0.032	4.061	1.746	0.699

cancer	19.803	13.202	6.599	6.599	6.599	6.601	6.599	6.599	6.599	26.404	13.202	6.599
cancer	1.461	1.500	0.154	0.961	0.115	0.038	0.308	0.038	0.038	18.530	7.650	0.692
cancer	2.059	2.257	0.435	0.950	0.158	0.040	0.238	0.119	0.040	73.050	13.762	0.515
cancer	0.976	2.139	0.225	1.051	0.075	0.450	0.075	0.075	0.038	20.860	7.241	0.488
cancer	7.577	16.073	0.459	0.230	3.675	5.281	5.168	0.230	1.148	48.465	11.944	5.512
cancer	1.886	2.179	0.228	0.911	0.130	0.098	0.130	0.033	0.033	21.588	1.920	0.748
cancer	2.225	3.107	0.422	1.074	0.230	0.153	0.268	0.077	0.008	4.638	1.036	0.460
cancer	1.552	1.620	0.069	0.552	0.103	0.345	0.448	0.138	0.103	5.173	0.862	0.655
cancer	1.096	1.096	0.152	0.518	0.548	0.518	0.548	0.061	0.091	3.014	1.188	0.213
cancer	0.883	1.060	0.247	0.495	1.201	0.495	0.212	0.177	0.283	7.173	1.342	0.318
cancer	0.977	1.162	0.211	0.686	1.584	0.317	0.291	0.132	0.832	0.528	0.158	0.343
cancer	0.752	0.865	0.075	0.451	4.382	1.392	1.354	0.564	1.936	5.414	0.602	0.376
cancer	1.073	2.146	0.330	0.619	2.023	0.949	0.991	0.537	1.796	1.775	0.454	0.248
cancer	1.658	1.859	0.503	1.005	4.320	0.452	0.603	0.151	0.528	2.864	0.201	0.754
cancer	1.010	2.074	0.106	0.372	2.711	0.904	0.904	0.638	2.153	17.390	0.851	0.691
cancer	2.162	1.393	0.144	0.721	3.362	1.057	1.153	0.576	1.874	2.690	0.817	0.384
cancer	3.011	3.338	0.065	0.524	4.384	1.112	0.982	0.916	2.291	11.914	0.851	0.589
cancer	2.350	1.176	0.044	0.696	4.135	0.479	0.827	1.132	3.636	10.080	0.566	0.218
cancer	1.411	0.940	0.007	0.977	5.283	1.158	1.592	1.121	3.219	0.868	0.253	0.253
cancer	0.740	1.048	0.031	0.586	2.943	1.310	1.187	0.924	2.295	1.787	0.216	0.308
cancer	0.421	0.368	0.053	0.228	2.760	1.130	1.016	0.893	1.972	1.139	0.088	0.088
cancer	0.972	0.476	0.020	0.099	2.280	1.169	1.160	1.091	1.884	9.140	0.278	0.040
cancer	0.580	0.844	0.053	0.176	2.312	0.615	0.440	0.580	1.204	2.498	1.706	0.123
cancer	1.052	0.318	0.033	0.153	1.607	0.494	0.691	1.031	1.875	0.230	0.186	0.110
cancer	1.637	0.919	0.029	0.287	3.319	1.063	1.207	0.920	1.437	2.759	0.948	0.144
cancer	2.402	1.235	0.200	0.667	3.673	0.668	0.968	0.851	1.301	1.235	0.467	0.267
cancer	0.607	0.429	0.018	0.250	2.563	0.938	1.715	0.759	1.367	0.214	0.071	0.125
cancer	1.912	2.185	0.341	0.102	2.013	4.929	3.071	0.973	1.963	19.605	0.444	6.776
cancer	0.244	0.679	0.027	0.109	3.257	2.552	2.579	1.901	3.393	2.172	0.978	0.081
cancer	0.704	0.183	0.104	0.313	4.615	1.343	3.415	0.717	2.099	0.365	0.130	0.365
cancer	0.391	0.224	0.028	0.140	5.075	4.166	3.264	1.090	3.900	0.266	0.112	0.098
cancer	0.253	0.199	0.004	0.217	4.656	6.206	3.067	0.893	2.445	0.180	0.144	0.162
cancer	1.435	0.763	0.183	0.305	3.679	3.985	2.580	1.236	3.634	6.411	1.222	0.244
cancer	0.442	0.327	0.019	0.404	5.969	3.326	3.382	2.517	4.497	2.383	0.769	0.096
cancer	22.300	8.259	0.688	0.551	0.413	1.377	1.238	0.413	0.275	16.105	2.340	2.202
cancer	1.271	1.078	0.039	0.308	5.084	3.427	4.198	0.462	3.640	9.190	1.887	0.193
cancer	0.067	0.089	0.044	0.156	5.655	4.031	4.888	1.189	2.754	1.444	0.555	0.044
cancer	0.923	0.879	0.132	0.879	3.099	6.153	2.549	1.143	1.978	0.791	0.132	0.352
cancer	1.353	0.742	0.131	0.436	2.161	3.296	4.278	1.484	1.921	5.937	1.441	0.044
cancer	1.000	0.846	0.231	0.731	3.712	3.617	3.521	1.500	1.923	0.615	0.231	0.308
cancer	0.437	0.553	0.058	0.728	4.340	2.010	1.529	1.252	1.544	6.479	1.893	0.146
cancer	0.416	0.167	0.062	0.604	1.562	3.103	3.883	0.895	1.353	6.830	0.604	0.125
cancer	21.954	9.283	1.811	0.453	1.585	0.905	2.038	0.226	0.453	199.305	33.395	2.942
cancer	1.086	1.217	0.197	1.316	2.188	2.582	3.191	1.218	1.464	0.756	0.395	0.395
cancer	0.884	0.746	0.028	0.552	3.452	2.500	3.204	0.635	2.210	0.304	0.249	0.166
cancer	1.574	0.900	0.112	0.787	4.646	4.779	4.760	1.274	2.267	0.599	0.187	0.225
cancer	1.949	1.379	0.143	0.190	8.418	5.158	2.781	1.569	3.044	5.089	5.897	0.285
control	0.555	0.392	0.065	0.229	2.353	1.699	0.882	0.948	1.650	4.019	2.777	0.163
control	0.917	0.478	0.040	0.239	3.267	1.096	1.435	1.076	1.654	3.508	2.232	0.199

control	1.014	0.420	0.074	0.445	3.649	1.583	2.473	0.989	1.892	5.863	0.495	0.099
control	1.065	0.479	0.080	0.719	2.037	1.545	0.945	1.224	1.665	0.825	0.293	0.293
control	0.664	0.260	0.058	0.693	2.557	2.022	1.097	0.404	1.675	0.260	0.173	0.376
control	0.753	0.474	0.112	0.335	2.552	2.371	1.827	0.613	1.478	0.502	0.251	0.139
control	0.604	0.529	0.076	0.352	6.607	2.592	2.227	0.918	1.762	0.403	0.101	0.151
control	0.795	0.513	0.026	0.333	5.166	2.473	3.115	1.308	2.883	0.256	0.205	0.179
control	0.337	0.389	0.005	0.285	5.797	2.568	2.347	0.700	2.438	0.389	0.130	0.156
control	0.781	0.364	0.104	0.130	3.616	2.913	3.746	1.249	2.160	1.197	0.156	0.130
control	1.466	1.324	0.284	0.567	5.486	3.947	5.840	0.875	1.868	1.229	0.615	0.331
control	1.403	1.479	0.152	0.417	5.005	4.175	3.965	0.987	2.733	0.607	0.303	0.493
control	0.622	0.322	0.023	0.438	8.189	5.506	5.596	0.921	4.444	0.345	0.207	0.184
control	0.329	0.312	0.003	0.345	8.128	6.184	5.462	1.018	4.846	0.246	0.230	0.115
control	0.547	0.445	0.142	0.202	5.428	5.204	4.799	1.073	4.375	0.425	0.081	0.243
control	0.839	0.528	0.062	0.684	3.418	4.134	3.620	0.901	3.495	0.218	0.186	0.404
control	0.349	0.206	0.095	0.318	3.956	3.438	4.217	1.033	2.574	0.381	0.143	0.127
control	0.431	0.478	0.048	0.311	4.881	2.858	3.695	1.053	3.972	0.407	0.048	0.191
control	0.676	0.246	0.102	0.184	3.555	3.287	4.466	1.209	3.340	0.348	0.082	0.184
control	0.374	0.156	0.047	0.156	3.510	4.943	4.344	1.435	2.698	3.970	1.076	0.078
control	0.492	0.138	0.003	0.077	2.998	4.772	5.103	1.122	2.275	1.814	0.707	0.092
control	0.548	0.329	0.044	0.088	3.103	4.190	4.464	1.031	1.689	0.987	0.877	0.088
control	0.883	0.390	0.130	0.338	4.196	4.144	5.248	1.091	2.208	0.494	0.234	0.234
control	0.678	0.261	0.052	0.209	3.600	4.160	3.196	1.474	2.479	0.678	0.287	0.313
control	0.430	0.331	0.033	0.248	5.811	4.919	4.266	1.438	2.975	0.248	0.066	0.132
control	0.576	0.221	0.022	0.177	6.079	5.027	4.197	1.262	2.945	0.664	0.509	0.199
control	0.487	0.339	0.212	0.106	7.194	4.554	4.533	1.865	3.771	0.254	0.297	0.233
control	0.502	0.177	0.059	0.443	7.164	7.058	5.567	2.127	3.693	1.063	0.384	0.118
control	1.039	0.286	0.104	0.156	6.894	4.180	6.346	1.363	3.661	2.362	0.623	0.338
control	0.903	0.319	0.053	0.292	6.191	5.183	5.037	1.422	3.615	1.727	0.585	0.345
control	0.557	0.342	0.108	0.144	6.303	6.598	5.950	1.276	3.793	0.216	0.108	0.144
control	1.097	0.406	0.005	0.239	5.844	6.190	5.607	1.479	4.723	0.620	0.215	0.262
control	0.571	0.507	0.032	0.190	5.392	6.455	4.011	1.427	2.759	0.412	0.190	0.159
control	0.464	0.401	0.042	0.148	5.731	6.027	5.022	1.477	3.893	0.506	0.317	0.127
control	0.960	0.306	0.022	0.218	4.856	4.442	4.681	1.463	2.794	0.895	0.393	0.131
control	0.660	0.462	0.066	0.198	4.970	3.798	3.880	0.991	2.708	0.925	1.057	0.330
control	0.487	0.257	0.051	0.180	5.505	5.080	3.875	1.386	2.360	0.513	0.128	0.180
control	0.504	0.394	0.044	0.131	6.437	4.697	4.784	1.511	2.770	1.445	0.701	0.241
control	0.275	0.236	0.020	0.118	4.954	4.549	4.354	1.199	3.488	0.983	0.766	0.118
control	0.303	0.250	0.004	0.036	5.225	4.678	3.561	1.214	3.203	0.661	0.411	0.071
control	0.281	0.243	0.037	0.131	5.952	3.762	3.491	1.441	2.910	0.075	0.150	0.056
control	0.198	0.054	0.018	0.054	5.828	3.784	4.785	1.117	3.162	1.045	0.324	0.036
control	0.393	0.476	0.083	0.062	5.881	4.506	4.361	1.347	2.351	0.207	0.145	0.104
control	0.881	0.407	0.034	0.441	5.052	2.746	3.458	0.712	2.323	1.525	1.152	0.203
control	0.121	0.048	0.005	0.024	4.554	3.865	3.658	1.114	2.798	0.266	0.291	0.242
control	0.584	0.424	0.080	0.239	4.458	3.503	3.158	1.327	1.791	0.398	0.159	0.186
polyp	3.455	27.870	0.691	1.152	0.691	2.073	0.461	0.230	0.230	291.241	8.986	2.303
polyp	60.159	36.023	1.801	2.522	0.360	1.801	3.602	0.720	0.360	47.206	6.124	11.527
polyp	35.546	31.507	0.588	3.231	0.294	1.028	1.616	0.147	0.147	13.068	15.863	2.938
polyp	1.301	1.970	0.112	1.004	0.074	0.112	0.372	0.074	0.037	28.559	5.169	0.483
polyp	1.344	0.873	0.202	0.470	3.039	0.537	0.537	0.235	0.940	14.456	0.638	0.370

polyp	3.435	2.322	0.194	0.581	2.467	1.306	0.774	0.194	2.709	2.128	0.145	0.581
polyp	0.995	0.862	0.033	0.464	3.417	0.929	1.161	0.265	2.256	6.716	1.128	0.133
polyp	1.243	5.266	0.414	1.716	2.011	1.065	0.592	0.177	2.011	2.130	0.414	0.769