Cohort	n	age	women/men	new onset T1D	long-lasting T1D
T1D patients	17	34.5 ± 3.0	13/4	3	14
Healthy controls	16	43.3 ± 3.5	8/7	NA	NA

Table S1: Demographic Data
All individuals recruited for the study underwent EGD for diagnostic purposes. Exclusion criteria for both HCs and T1D patients were treatment with antibiotics or corticosteroids in the 3 months before EGD and history of gastroenteritis, gastric ulcer, irritable bowel disease, celiac disease, inflammatory bowel disease, and gastric and colorectal cancers. New onset T1D: <6 months from diagnosis; long-lasting T1D: ≥6 months from diagnosis. Some T1D patient (5 out of 19) were also affected by celiac disease (CD).

Patient Code	Age (years)	Sex	Disease duration	Disease type	AutoAbs	HbA1c	GI symptoms	Celiac Disease	Other Autoimmune diseases
J1D003	25	F	<6 months	NO	GAD65	10.2	dyspepsia	no	no
J1D005	33	M	1 year	LS	ND	6.1	none	no	no
J1D006	54	F	19 years	LS	ND	7.4	dyspepsia	no	Hashimoto thyroiditis
J1D007	30	F	9 years	LS	INS	7.4	dyspepsia, pyrosis	no	Hashimoto thyroiditis
J1D008	24	F	7 years	LS	ND	6.6	epigastric pain	no	no
J1D012	23	M	<6 months	NO	ICA,ZnT8, IA2, GAD65	7.3	weight loss	yes	no
J1D013	45	F	5 years	LS	ND	7.5	dyspepsia	no	Autoimmune gastritis Hashimoto thyroiditis
J1D014	19	F	12 years	LS	INS, ZnT8, GAD65	7.1	dyspepsia	no	Autoimmune gastritis Hashimoto thyroiditis
J1D017	45	F	17 years	LS	neg	7.4	dyspepsia	no	Hashimoto thyroiditis
J1D018	57	F	5 years	LADA	ND	7.3	dysphagia, dyspepsia	no	Hashimoto thyroiditis
J1D019	38	F	19 years	LS	INS, ICA, IA2	6.8	dyspepsia	no	Graves disease, Hashimoto thyroiditis
J1D020	19	M	5 years	LS	INS, IA2, GAD65	9.9	dyspepsia	no	Hashimoto thyroiditis
J1D021	47	F	3 years	LS	IA2, GAD65	9.3	dyspepsia	yes	Sjögren syndrome, Hashimoto thyroiditis
J1D022	27	F	23 years	LS	ND	9.5	none	yes	no
J1D023	20	M	<6 months	NO	ICA,ZnT8, IA2, GAD65	6.6	none	yes	no
J1D024	46	F	41 years	LS	ND	6.9	none	no	Hashimoto thyroiditis, Rheumatoid Arthritis
J1D025	34	F	15 years	LS	ND	8.4	none	yes	no

Table S2: Clinical Data of T1D patients enrolled in the study are shown. Diagnosis of T1D was based on the criteria of the American Diabetes Association. Some patients had gastrointestinal (GI) symptoms but turned out negative for any GI pathology. Five out of 17 patients were diagnosed for celiac disease based on histological examination of intestinal tissues (biopsies collected during the EGDS). In some cases, the islet autoantibody positivity was not documented (ND). NO= new onset; LS= long standing; LADA= Latent Autoimmune Diabetes in Adults.

Micro and Macronutrients	DRV f/m	Males T1D mean ± SD	Females T1D mean ± SD	Tot. T1D Patients mean ± SD
Protein, (g/day)	54/63	91,07 ± 21,12	59,90 ± 20,38	68,80 ± 24,6
% (en)	15-20	16,98 ± 0,04	16,66 ± 2,72	16,75 ± 0,03
Carbohydrates, (g/day)	169-225/169-225	281,3 ± 102,70	180,57 ± 54,99	209,35 ± 82,2
% (en)	45-60	47,71 ± 0,10	45,58 ± 0,09	48,33 ± 0,09
Sugars, (g/day)	0	62,51 ± 23,22	48,15 ± 25,45	52,25 ± 24,86
% (en)	<15%	11 ± 0,03	13 ± 6	12 ± 5
Fat, (g/day)	33-58/33-58	82,57 ± 16,40	54,97 ± 20,11	62,21 ± 22,81
% (en)	20-35	35,13 ± 0,09	34,08 ± 0,06	34,38 ± 0,07
Fiber, (g/day)	19-25	14, 65 ± 8,78	14,10 ± 6,63	13,3 ± 6,95
Ca(mg)	1000	928,20 ± 315,91	609,62 ± 321,38	700,64 ± 341,82
P(mg)	700	1255,55 ± 470,32	930,32 ± 389,09	1023,25 ± 423,2
K(mg)	3900	2402,59 ± 1362, 76	1809,30 ± 845,51	2036,67 ± 990,54
Na(mg)	1100	1910,55 ± 171,35	1105,24 ± 523,35	1335,33 ± 582,18
Fe(mg)	10.00	11,81 ± 3,82	7,44 ± 3,39	8,69 ± 3,94
Zn(mg)	11.00	6,00 ± 2,27	4,41 ± 1,66	4,87 ± 1,91
Cu(mg)	0.9	1,21 ± 0,55	1,12 ± 0,57	1,14 ± 0,55
VIT B1(mg)	1.1/1.2	1,26 ± 0,28	0,87 ± 0,48	0,98 ± 0,46
VIT B2(mg)	1.3/1.6	1,75 ± 0,31	1,11 ± 0,51	1,30 ± 0,54
VIT B3(mg)	18	16,39 ± 7,96	12,29 ± 5,99	13,46 ± 6,57
VIT A(µg)	600/700	692,46 ± 289,76	644,03 ± 491,37	657,87 ± 432,48
VIT C(mg)	85/105	145,81 ± 120,1	90,10 ± 58,18	106,02 ± 79,70

Table S3: Diet composition in terms of micro and macronutrients extrapolated from 3-day food diaries filled by our T1D cohort (14 out of 19 enrolled T1D patients filled the dietary questionnaire) at time of sample collection. Dietary Reference Values (DRV): reference intake levels of macro and micronutrients for the Italian population were reviewed in 2014 by the Italian Society of Human Nutrition (ref. Nutrition, Metabolism & Cardiovascular Diseases (2014) 24, e15ee17).

Oligonucleotides	Sequence
H Reg3α FW	5'- GGC ACC GAG CCC AAT G -3'
H Reg3α REV	5'- GGA TTT CTC TCC CAT GCA AAG T -3'
HBD1 FW	5'- CGC CAT GAG AAC TTC CTA CC -3'
HBD1 REV	5'- CCT CTG TAA CAG GTG CCT TG -3'
HD5 FW	5'- GCT GAT GAG GCT ACA ACC CA 3'
HD5 REV	5'- GAT TTC ACA CAC CCC GGA GA -3'
HD6 FW	5'- AGG ACT TTG CCG TCT CCT TT -3'
HD6 REV	5'- CCT TCT GCA ATG GCA AGT GA -3'
HBD3 FW	5'-CTT CTG TTT GCT TTG CTC TTC C -3'
HBD3 REV	5'- CAC TTG CCG ATC TGT TCC TC-3'
HReg1α FW	5'- ATC CTG GCT ACT GTG TGA GC -3'
HReg1α REV	5'- GTT GGA GAG ATG GTC CGG TTT -3'
LL-37 FW	5'- GGA CAG TGA CCC TCA ACC AG -3'
LL-37 REV	5'- AGG GCA CAC ACT AGG ACT CT -3'
HReg3γ FW	5'- GGA CAG TGA CCC TCA ACC AG -3'
HReg3γ REV	5'- AGG GCA CAC ACT AGG ACT CT -3'

Table S4: AMPs primers sequences.

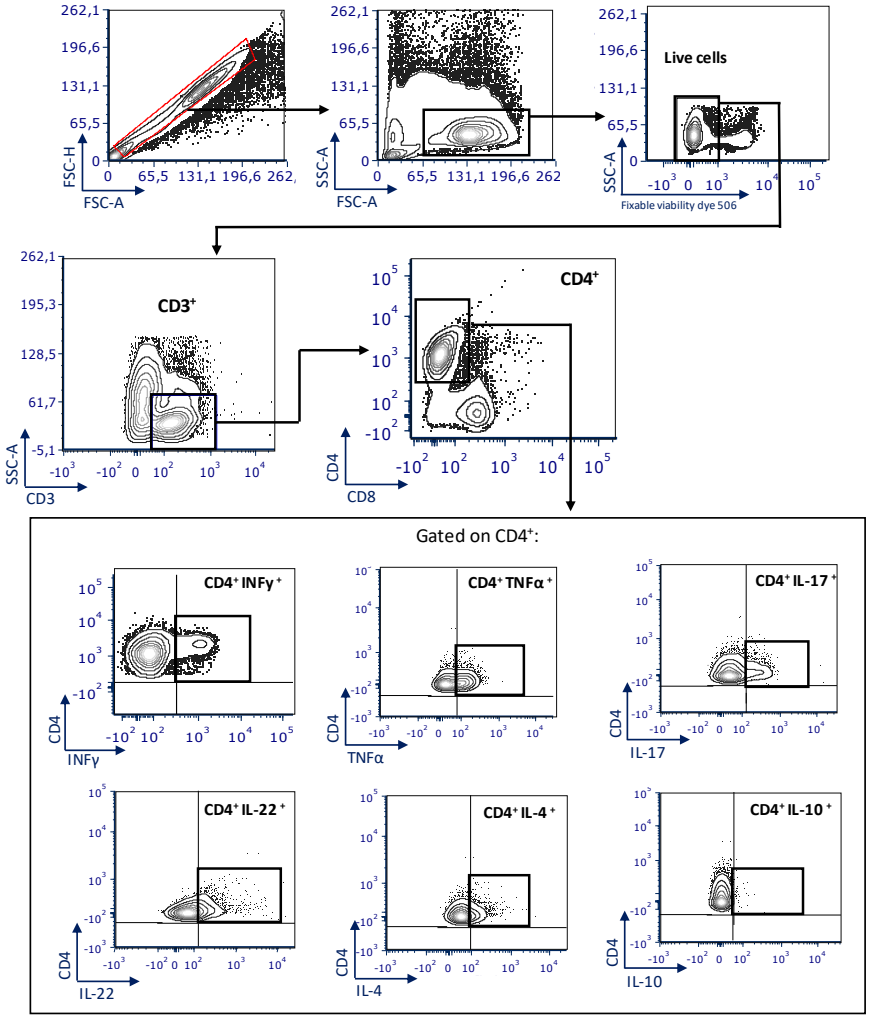

Figure S1. Flow cytometry gating strategy used to identify the following T cell subsets in peripheral blood and intestinal biopsies: Th1 cells ($CD3^+CD4^+INF\text{-}\gamma^+$), TNF-$\alpha^+$ T cells ($CD3^+CD4^+$ TNF-α^+), Th17 cells ($CD3^+$ $CD4^+IL\text{-}17^+$), Th22 cells ($CD3^+CD4^+IL\text{-}22^+$), Type 1 regulatory T (Tr1) cells ($CD3^+CD4^+IL\text{-}10^+$), Th2 cells ($CD3^+CD4^+IL\text{-}4^+$). Lymphocytes were gated based on SSC-A versus FSC-A and singlets were selected from the FSC-A versus FSC-H dot plot. Dead cells were excluded with Fixable Viability Dye eFluor 506 (FvD 506).

Gene (species)	BaseMean	Log2FoldChange	lfcSE	stat	p value	FDR
Clostridium butyricum	1.716345307	-1.175712929	0.5544662064	-2.120441094	0.03396886422	0.2441829177
Bifidobacterium dentium	1.651513134	-0.9650302398	0.4988014399	-1.934698184	0.05302734339	0.2539974285
Roseburia intestinalis	2.704207805	-1.0306416	0.5393935137	-1.910741553	0.05603780197	0.2539974285
Neisseria sicca	18.43711065	3.275541578	0.6823651198	4.800276983	1.58E-06	6.61E-04
Haemophilus parahaemolyticus	258.8396091	3.669222472	0.9078592336	4.041620481	5.31E-05	0.01106782547
Neisseria lactamica	3.226694865	2.041784817	0.5416014257	3.769902958	1.63E-04	0.01919901169
Haemophilus influenzae	9.227574429	2.484084565	0.6719634504	3.696755476	2.18E-04	0.01919901169
Selenomonas sp. oral taxon 136	10.96738133	2.638241611	0.7193499657	3.667535604	2.45E-04	0.01919901169
Capnocytophaga gingivalis	87.99943705	3.195214232	0.8786232757	3.636614599	2.76E-04	0.01919901169
Tepidimonas taiwanensis	3.167867861	-2.215070679	0.6401723558	-3.460116107	5.40E-04	0.03216514723
Neisseria dentiae	7.224192508	2.594193009	0.7603236199	3.411958988	6.45E-04	0.03361948674
Acinetobacter haemolyticus	3.350886808	1.932248849	0.5985944963	3.227976303	0.001246693011	0.05294633306
Muribaculum gordoncarteri	4.11075764	1.913288095	0.5936831979	3.222742535	0.001269696236	0.05294633306
Helicobacter pylori	9.705930207	-2.394338679	0.762188075	-3.14140139	0.001681414191	0.06374088343
Lautropia mirabilis	6.181556095	1.832520976	0.6063970323	3.021982098	0.002511253989	0.08726607613
Neisseria bacilliformis	6.150982055	1.961136044	0.6612286855	2.965896802	0.003018017404	0.09680871212
Clostridium isatidis	2.434740246	1.730473621	0.6020795783	2.874160964	0.004051024442	0.1206626566
Prevotella sp. oral taxon 299	656.2689203	2.417620532	0.8679447113	2.785454535	0.00534527354	0.1485986044
Selenomonas sputigena	11.87671304	1.996198541	0.7296112494	2.735975552	0.006219564658	0.1620974039
Tannerella serpentiformis	65.08174348	-2.386619139	0.8984514013	-2.656369766	0.007898695326	0.1937503501
Coprococcus comes	11.00939015	-1.921993752	0.7385580446	-2.602359783	0.009258466646	0.2074038689
Ralstonia mannitolilytica	1.91869974	-1.400213643	0.5410998567	-2.587717638	0.009661414117	0.2074038689
Schaalia meyeri	87.01219177	1.957752642	0.7717481223	2.536776683	0.01118782961	0.2074038689
Clostridium botulinum	7.045348424	1.668536201	0.6680912076	2.497467684	0.01250838656	0.2074038689
Granulicatella adiacens	661.5589346	1.798967118	0.7329111178	2.454550183	0.01410609743	0.2074038689
Capnocytophaga sp. FDAARGOS_737	11.01443355	1.84662536	0.7527587639	2.453143621	0.01416137849	0.2074038689
Clostridium perfringens	16.50594658	1.975311645	0.8080413614	2.444567493	0.01450259425	0.2074038689
Corynebacterium matruchotii	4.871916566	1.480651944	0.6062010965	2.442509511	0.01458554527	0.2074038689
Prevotella scopos	11.19375339	-1.773460137	0.7277344372	-2.436960581	0.01481129385	0.2074038689
Limosilactobacillus fermentum	2.771793486	1.394168916	0.5751430942	2.424038349	0.01534898456	0.2074038689
Staphylococcus capitis	2.320540446	1.417212882	0.5867207508	2.415481097	0.01571443816	0.2074038689
Bradyrhizobium sp. S2-11-2	2.575675918	-1.447058178	0.6003074541	-2.410528418	0.0159294303	0.2074038689
Cupriavidus malaysiensis	2.349709511	-1.259591539	0.5239966783	-2.403815886	0.01622494255	0.2074038689
Aggregatibacter aphrophilus	3.900960445	-1.49244904	0.6244173185	-2.390146775	0.01684164073	0.2074038689
Cellvibrio sp. PSBB006	1.820235587	1.276811402	0.5343608205	2.389418074	0.01687508706	0.2074038689
Saccharomonospora viridis	2.737238296	1.37255938	0.5745418867	2.388963122	0.01689599824	0.2074038689
Planctomyces sp. SH-PL14	1.850172795	1.311631592	0.5491111125	2.388645143	0.0169106272	0.2074038689
Helicobacter suis	1.828290542	-1.298602689	0.5496529621	-2.362586539	0.01814790382	0.2094343053
Selenomonas timonae	5.74521822	1.517588146	0.6433671168	2.358821435	0.01833307497	0.2094343053
Ethanoligenens harbinense	1.880654869	-1.362057817	0.5786648045	-2.353794124	0.01858289999	0.2094343053
Leptotrichia hofstadii	2.545977536	1.407498516	0.6025208137	2.336016423	0.01949038564	0.2138813371
Cardiobacterium sp. Marseille-Q4385	1.913402538	1.139020149	0.4978251616	2.287992325	0.02213796807	0.2367059663
Prevotella fusca	364.344508	-1.677830255	0.7389158368	-2.2706649	0.02316727141	0.2375019246
Chitinibacter bivalviorum	1.863087557	-1.212504896	0.5347003796	-2.267634253	0.02335150818	0.2375019246
Ralstonia solanacearum	20.64633987	-1.498399526	0.6634956248	-2.258341232	0.02392439358	0.2375350506
Haemophilus parainfluenzae	639.0718264	1.937346078	0.8630356523	2.244804224	0.02478070347	0.2403151941
Streptococcus pyogenes	81.53166032	1.490278338	0.669521783	2.225884767	0.02602190096	0.2441829177
Acaryochloris sp. 'Moss Beach'	3.16222305	1.27220647	0.5729823174	2.220324137	0.0263967726	0.2441829177
Avibacterium paragallinarum	1.8499219	1.068661278	0.4943171579	2.16189396	0.03062635064	0.2441829177
Enterococcus faecium	2.703143235	1.016572858	0.4726516103	2.150786828	0.03149302925	0.2441829177
Blautia producta	1.881645753	-1.120973927	0.5223028369	-2.14621451	0.03185586844	0.2441829177
Desulfoscipio gibsoniae	1.878398045	1.102713689	0.5143315027	2.143974621	0.03203492033	0.2441829177
Metamycoplasma orale	2.339353709	-1.16057149	0.5432133989	-2.136492752	0.03263927111	0.2441829177
Streptomyces albidoflavus	2.079336728	1.094423544	0.5133273286	2.132018857	0.03300529641	0.2441829177
Actinobacillus pleuropneumoniae	3.837209608	1.205512082	0.5656501231	2.131197419	0.0330728816	0.2441829177
Nosocomiicoccus ampullae	1.715888594	1.158265368	0.5436068341	2.130704206	0.03311351834	0.2441829177
Pseudomonas veronii	1.818299767	1.151527774	0.5427047529	2.12183101	0.03385193154	0.2441829177
Burkholderia stabilis	1.711778172	-1.172896575	0.5538823344	-2.117591593	0.03420967082	0.2441829177
Sphingomonas sp. CL5.1	1.71611695	1.158361834	0.5483001602	2.112641793	0.03463143876	0.2441829177
Bacillus cereus	6.190862661	1.054518294	0.4994485054	2.111365401	0.03474091654	0.2441829177
Veillonella parvula	579.1467171	1.712754559	0.8143819029	2.103134356	0.03545402655	0.2441829177
Treponema vincentii	4.497433977	1.366556613	0.6519066937	2.096245714	0.0360603996	0.2441829177
Abiotrophia defectiva	2.941263517	1.268755717	0.6054054209	2.095712515	0.03610770099	0.2441829177
Selenomonas sp. oral taxon 478	16.02108988	1.575323578	0.7552580854	2.085808293	0.03699599192	0.2441829177
Bergeyella cardium	3.528912865	1.22261386	0.5869816329	2.082882652	0.03726192131	0.2441829177
Barnesiella viscericola	2.909967404	1.169124584	0.5626097476	2.078038265	0.03770583489	0.2441829177
Nitratireductor kimnyeongensis	1.750397232	-1.08943754	0.5252363083	-2.074185509	0.0380620855	0.2441829177
Coprococcus sp. ART55/1	1.659911911	-1.099197066	0.5343668962	-2.05700816	0.03968544094	0.2507398314
Aquicella siphonis	1.692721671	1.123530526	0.5508123971	2.039769861	0.04137325302	0.2539974285
Labilithrix luteola	1.944439086	1.060539973	0.5213045428	2.034396185	0.04191166619	0.2539974285
Neisseria subflava	69.66804013	1.767711956	0.8723279705	2.026430443	0.04272069391	0.2539974285
Halomonas sp. 1513	1.755350309	-1.091659608	0.5392359123	-2.024456427	0.04292321093	0.2539974285
Clostridium bornimense	5.357928631	1.253724179	0.6236754556	2.010218885	0.04440802745	0.2539974285
Acidaminococcus intestini	1.650621482	-1.093823851	0.5441958436	-2.009982002	0.04443309377	0.2539974285
Arachidicoccus sp. BS20	2.348855499	-1.070684631	0.5340695507	-2.004766289	0.04498803802	0.2539974285
Leptotrichia sp. oral taxon 221	31.76621978	-1.586714598	0.7936789681	-1.999189422	0.0455878626	0.2539974285
Rothia mucilaginosa	270.5770136	1.562183322	0.7837345194	1.99325573	0.04623345134	0.2539974285
Bacillus subtilis	2.769879758	0.9129299177	0.4586547587	1.990451206	0.04654125392	0.2539974285
Acetivibrio saccincola	3.655597176	1.101975141	0.5559973885	1.981978987	0.04748159256	0.2539974285
Leptotrichia trevisanii	4.75186434	1.382220527	0.6979873748	1.980294454	0.04767045159	0.2539974285
Prevotella dentalis	33.77698419	1.490635708	0.7552766614	1.973628716	0.04842397605	0.2539974285
Polynucleobacter necessarius	1.783636682	-1.007551536	0.5164876713	-1.95077558	0.05108374804	0.2539974285
Rubrivivax gelatinosus	1.943071389	1.062109329	0.5445735064	1.950350718	0.05113433146	0.2539974285
Heliorestis convoluta	1.61775957	-1.051052368	0.5389889784	-1.950044269	0.05117084287	0.2539974285
Megamonas funiformis	1.583030213	0.9883126139	0.508500767	1.943581363	0.05194595505	0.2539974285
Prevotella intermedia	304.7174959	-1.496029384	0.7754353591	-1.929276717	0.05369651858	0.2539974285
Actinomyces gaoshouyii	1.587901925	0.9905330531	0.5143044219	1.925966433	0.05410856526	0.2539974285
Streptococcus dysgalactiae	16.39884628	1.13943222	0.5916703573	1.925788922	0.05413073528	0.2539974285
Bacteroides zoogleoformans	1.550435281	-0.961482083	0.5008243557	-1.919798972	0.05488329683	NA
[Clostridium] innocuum	1.583755874	0.9885444343	0.5151314981	1.919013762	0.05498259218	0.2539974285
Pseudomonas sp. Z003-0.4C(8344-21)	1.620951604	1.03507591	0.5396204994	1.91815528	0.05509132475	0.2539974285
Corynebacterium crudilactis	1.613877505	1.030978737	0.5387040056	1.913813015	0.05564405195	0.2539974285
Hippea maritima	1.613877505	1.030978737	0.5387040056	1.913813015	0.05564405195	0.2539974285
[Ruminococcus] gnavus	4.569921838	1.298984693	0.6833885453	1.900799628	0.05732826283	0.2570525333
Bacillus sp. RZ2MS9	1.777501997	0.9871830217	0.5224581727	1.889496755	0.05882529724	0.2609590314

Table S5: Bacterial species differentially expressed between T1D patients and HC. Bacterial species that are increased (+log2FoldChange) or decreased (-Log2FoldChange) in T1D patients (statistically significant differences: $p<0.05$) are shown. SCFA-producing species reduced in T1D patients are highlighted in yellow. The red box indicates the three SCFA-producing bacterial species that are directly associated with mucus regeneration and are also decreased in T1D patients (*Bifidobacterium dentium*, *Roseburia intestinalis* and *Clostridium butyricum*).

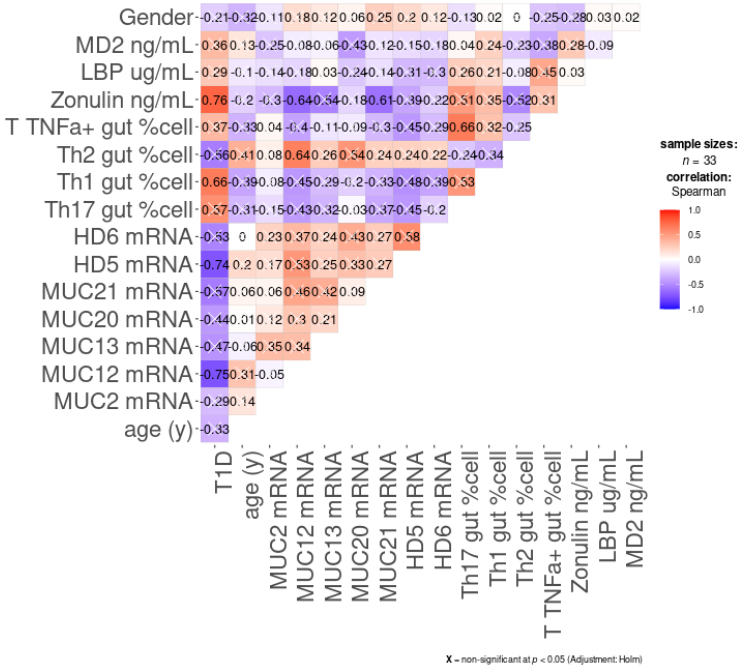

Figure S2. Nonparametric multivariate analysis was performed with the ggstatplot R package (https://joss.theoj.org/papers/10.21105/joss.03167) with a significance level = 0.05, confidence level = 0.95, and Bonferroni–Holm method for multiple comparison p-value adjustment.