

**Supplementary Table S1.** Distribution of nutrition and lifestyle factors in men

Variable	Categories	Description	N	Weighted mean (SE) or proportion
alc2day	alcohol	2 or more drink per day (yes,no)	1316	95.61, 4.39
Hpylori	bacterial infection	Helicobacter pylori Ab (yes,no)	1276	66.46, 33.54
tetanus	bacterial infection	Tetanus Ab (U/mL)	1316	1.098763 (0.06446)
caf2day	caffeinated beverages	2 or more caffeinated drink per day (yes,no)	1316	43.96, 56.04
aspi_mo	drug use	# aspirin taken in the past month (yes,no)	510	<10: 68.39, 10-20: 12.67, ≥20: 18.94
aspirin	drug use	Taken aspirin in past month (yes,no)	1311	54.03, 45.97
nsa_mo	drug use	# NSAIDs taken in the past month (yes,no)	171	<10: 85.22, 10-20: 7.3, ≥20: 7.47
nsaid	drug use	Taken NSAIDs in past month (yes,no)	1310	84.11, 15.89
pct	drug use	Taken paracetamol in past month (yes,no)	1310	69.96, 30.04
pct_mo	drug use	# paracetamol taken in the past month (yes,no)	376	<10: 86.79, 10-20: 4.9, ≥20: 8.31
a_toco_g	food nutrient recall	Alpha-tocopherol (mg)	1273	9.249197 (0.258172)
alan_g	food nutrient recall	Alanine (gm)	1273	4.751602 (0.155424)
alco_g	food nutrient recall	Alcohol (gm)	1273	16.75585 (2.492959)
anprot_g	food nutrient recall	Animal Protein (gm)	1273	68.897855 (2.783329)
argin_g	food nutrient recall	Arginine (gm)	1273	5.460872 (0.168145)
ash_g	food nutrient recall	Ash (gm)	1273	21.194439 (0.514409)
aspac_g	food nutrient recall	Aspartic Acid (gm)	1273	8.40544 (0.254058)
aspar_g	food nutrient recall	Aspartame (mg)	1273	53.338189 (4.633019)
b_toco_g	food nutrient recall	Beta-tocopherol (mg)	1273	0.337651 (0.020467)

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bcaro_g	food nutrient recall	Beta-carotene (mcg)	1273	3042.437793 (244.585966)
cafe_g	food nutrient recall	Caffeine (mg)	1273	289.121669 (16.012104)
calc_g	food nutrient recall	Calcium (mg)	1273	918.402049 (26.892269)
carb_g	food nutrient recall	Total carbohydrates (gm)	1273	310.152982 (7.470697)
cfiber_g	food nutrient recall	Crude Fiber (gm)	1273	4.987894 (0.101506)
chol_g	food nutrient recall	Cholesterol (mg)	1273	354.037954 (14.952323)
copp_g	food nutrient recall	Copper (mg)	1273	1.685249 (0.0443)
cyst_g	food nutrient recall	Cystine (gm)	1273	1.283291 (0.037427)
d_toco_g	food nutrient recall	Delta-tocopherol (mg)	1273	5.632767 (0.259652)
fiber_g	food nutrient recall	Dietary fiber (gm)	1273	19.833665 (0.40439)
fola_g	food nutrient recall	Folic acid (mcg)	1273	324.56759 (9.570629)
fruc_g	food nutrient recall	Fructose (gm)	1272	32.048955 (1.137372)
g_toco_g	food nutrient recall	Gamma-tocopherol (mg)	1273	22.809025 (0.871755)
gala_g	food nutrient recall	Galactose (gm)	1273	0.19319 (0.022902)
gluc_g	food nutrient recall	Glucose (gm)	1273	34.001043 (1.281204)
glutac_g	food nutrient recall	Glutamic Acid (gm)	1273	19.163247 (0.573767)
glyc_g	food nutrient recall	Glycine (gm)	1273	4.274716 (0.142044)

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histi_g	food nutrient recall	Histidine (gm)	1273	2.819857 (0.107981)
ifiber_g	food nutrient recall	Water insoluble dietary fiber (gm)	1273	12.742525 (0.271874)
iron_g	food nutrient recall	Iron (mg)	1273	18.446977 (0.324852)
isoleu_g	food nutrient recall	Isoleucine (gm)	1273	4.467264 (0.134656)
kcal	food nutrient recall	Calories (kcal)	1273	2670.24349 (78.181559)
lact_g	food nutrient recall	Lactose (gm)	1273	15.458487 (0.97768)
leuc_g	food nutrient recall	Leucine (gm)	1273	7.694177 (0.251869)
lysin_g	food nutrient recall	Lysine(gm)	1273	6.776958 (0.228592)
magn_g	food nutrient recall	Magnesium (mg)	1273	350.029025 (7.781465)
malt_g	food nutrient recall	Maltose (gm)	1273	3.931091 (0.214201)
meth_g	food nutrient recall	Methionine (gm)	1273	2.257171 (0.072023)
mfa141_g	food nutrient recall	MFA 14:1 (gm)	1273	0.075431 (0.008828)
mfa161_g	food nutrient recall	MFA 16:1 (gm)	1273	2.06091 (0.103387)
mfa181_g	food nutrient recall	Oleic acid (MFA 18:1) (gm)	1273	38.339921 (1.527623)
mfa201_g	food nutrient recall	MFA 20:1 (gm)	1273	0.168113 (0.013458)
mfa221_g	food nutrient recall	MFA 22:1 (gm)	1273	0.015057 (0.00441)
mufat_g	food nutrient recall	Total monounsaturated fatty acids (gm)	1273	41.044001 (1.64217)

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niac_g	food nutrient recall	Niacin (mg)	1273	29.668338 (0.807561)
oxal_g	food nutrient recall	Oxalic Acid (mg)	1273	359.406367 (14.39432)
p_alc	food nutrient recall	Energy from alcohol (%kcal)	1273	4.055785 (0.408062)
p_carb	food nutrient recall	Energy from carbohydrate (%kcal)	1273	47.274056 (0.5871)
p_msfat	food nutrient recall	Energy from monosaturated fat (%kcal)	1273	13.395245 (0.181296)
p_prot	food nutrient recall	Energy from protein (%kcal)	1273	15.248454 (0.19076)
p_psfat	food nutrient recall	Energy from polysaturated fat (%kcal)	1273	6.753288 (0.186041)
p_sfat	food nutrient recall	Energy from saturated fat (%kcal)	1273	11.899081 (0.227194)
p_tfat	food nutrient recall	Energy from total fat (%kcal)	1273	34.711743 (0.35868)
pantho_g	food nutrient recall	Pantothenic acid (mg)	1273	5.705518 (0.167879)
pect_g	food nutrient recall	Pectin (gm)	1273	2.199385 (0.076521)
pfa182_g	food nutrient recall	Linoleic acid (PFA 18:2) (gm)	1273	18.079663 (0.570601)
pfa183_g	food nutrient recall	Linolenic acid (PFA 18:3) (gm)	1273	1.682609 (0.048901)
pfa184_g	food nutrient recall	PFA 18:4 (gm)	1273	0.004451 (0.001625)
pfa204_g	food nutrient recall	PFA 20:4 (gm)	1273	0.175944 (0.007247)
pfa205_g	food nutrient recall	PFA 20:5 (gm)	1273	0.055391 (0.007491)
pfa225_g	food nutrient recall	PFA 22:5 (gm)	1273	0.022222 (0.004543)

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pfa226_g	food nutrient recall	PFA 22:6 (gm)	1273	0.121006 (0.019992)
phen_g	food nutrient recall	Phenylalanine (gm)	1273	4.292742 (0.133368)
phos_g	food nutrient recall	Phosphorous (mg)	1273	1532.653562 (43.764485)
phyt_g	food nutrient recall	Phytic Acid (mg)	1273	757.515328 (22.282383)
pots_g	food nutrient recall	Potassium (mg)	1273	3197.403488 (71.01591)
proli_g	food nutrient recall	Proline (gm)	1273	6.440663 (0.214495)
prot_g	food nutrient recall	Protein (gm)	1273	99.104249 (3.093264)
pufat_g	food nutrient recall	Total polyunsaturated fatty acids (gm)	1273	20.29242 (0.601323)
retino_g	food nutrient recall	Retinol (mcg)	1273	629.028869 (56.332475)
ribo_g	food nutrient recall	Riboflavin (mg)	1273	2.385787 (0.07973)
sacch_g	food nutrient recall	Saccharin (mg)	1273	5.459063 (0.981623)
satfat_g	food nutrient recall	Total saturated fatty acids (gm)	1273	36.171417 (1.48297)
sele_g	food nutrient recall	Selenium (mcg)	1273	147.678733 (3.503391)
serin_g	food nutrient recall	Serine (gm)	1273	4.402773 (0.136669)
sfa100_g	food nutrient recall	SFA 10:0 (gm)	1273	0.56396 (0.022099)
sfa120_g	food nutrient recall	SFA 12:0 (gm)	1273	1.300459 (0.066651)
sfa140_g	food nutrient recall	SFA 14:0 (gm)	1273	3.039299 (0.12636)

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sfa160_g	food nutrient recall	SFA 16:0 (gm)	1273	19.438326 (0.826895)
sfa170_g	food nutrient recall	SFA 17:0 (gm)	1273	0.00102 (0.000305)
sfa180_g	food nutrient recall	SFA 18:0 (gm)	1273	9.705042 (0.414024)
sfa200_g	food nutrient recall	SFA 20:0 (gm)	1273	0.027588 (0.005434)
sfa220_g	food nutrient recall	SFA 22:0 (gm)	1273	0.047146 (0.009417)
sfa40_g	food nutrient recall	SFA 4:0 (gm)	1273	0.621466 (0.029625)
sfa60_g	food nutrient recall	SFA 6:0 (gm)	1273	0.309018 (0.015594)
sfa80_g	food nutrient recall	SFA 8:0 (gm)	1273	0.303436 (0.013216)
sfiber_g	food nutrient recall	Water soluble dietary fiber (gm)	1273	6.88882 (0.142873)
sodi_g	food nutrient recall	Sodium (mg)	1273	4274.007199 (110.451375)
star_g	food nutrient recall	Starch (gm)	1273	136.053812 (4.006875)
sucr_g	food nutrient recall	Sucrose (gm)	1273	59.443801 (2.800659)
thia_g	food nutrient recall	Thiamin (mg)	1273	2.084366 (0.059003)
thre_g	food nutrient recall	Threonine (gm)	1273	1.147221 (0.032231)
totfat_g	food nutrient recall	Total fats (gm)	1273	105.451527 (3.682274)
tryp_g	food nutrient recall	Tryptophan (gm)	1273	1.147221 (0.032231)
tyro_g	food nutrient recall	Tyrosine (gm)	1273	3.527363 (0.119926)

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valin_g	food nutrient recall	Valine (gm)	1273	5.021192 (0.153526)
vit_a_g	food nutrient recall	Total vitamin A (IU)	1273	7174.651052 (490.078152)
vit_b6_g	food nutrient recall	Vitamin B6 (mg)	1273	2.217218 (0.048083)
vit_c_g	food nutrient recall	Vitamin C (mg)	1273	100.189626 (4.637102)
vit_d_g	food nutrient recall	Vitamin D (mcg)	1273	5.484227 (0.220845)
vit_e_g	food nutrient recall	Total alpha-tocopherol equivalents (mg)	1273	11.728389 (0.329232)
vitb12_g	food nutrient recall	Vitamin B12 (mcg)	1273	7.215981 (0.454379)
vprot_g	food nutrient recall	Vegetable Protein (gm)	1273	28.622574 (0.739136)
water_g	food nutrient recall	Water (gm)	1273	2424.499226 (69.51972)
zinc_g	food nutrient recall	Zinc (mg)	1273	14.462347 (0.537058)
cho_hei	healthy eating index	Cholesterol, HEI Score	1273	6.398321 (0.223666)
dai_hei	healthy eating index	Dairy, HEI Score	1273	6.668739 (0.196456)
fat_hei	healthy eating index	Fats, HEI Score	1273	6.110421 (0.140767)
fru_hei	healthy eating index	Fruits, HEI Score	1273	3.513191 (0.179638)
gra_hei	healthy eating index	Grains, HEI Score	1273	6.691145 (0.110348)
HEISCOR E	healthy eating index	Healthy Eating Index Score	1273	61.825724 (0.647717)
mea_hei	healthy eating index	Meats, HEI Score	1273	7.779143 (0.081918)

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sfa_hei	healthy eating index	Saturated Fat, HEI Score	1273	5.858953 (0.252637)
sod_hei	healthy eating index	Sodium, HEI Score	1273	4.634559 (0.150713)
veg_hei	healthy eating index	Vegetables, HEI Score	1273	6.082206 (0.141065)
a_carot	nutrients/mineral	Serum alpha carotene (umol/L)	1307	0.073402 (0.003387)
b_carot	nutrients/mineral	Serum beta carotene (umol/L)	1307	0.296075 (0.013846)
b_crypto	nutrients/mineral	Serum beta cryptoxanthin (umol/L)	1307	0.147939 (0.004687)
ca_norm	nutrients/mineral	Serum normalized calcium (mmol/L)	1157	1.233416 (0.003035)
ca_tot	nutrients/mineral	Serum total calcium (mmol/L)	1304	2.294228 (0.006598)
cadmium	nutrients/mineral	Urine cadmium (umol/L)	1294	6.528018 (0.25601)
folate_r	nutrients/mineral	RBC folate (nmol/L)	1308	419.486708 (9.823217)
folate_s	nutrients/mineral	Serum folate (nmol/L)	1316	12.605811 (0.451136)
iodine	nutrients/mineral	Urine iodine (ug/dL)	1279	27.929832 (8.010699)
lead	nutrients/mineral	Serum lead (umol/L)	1316	0.251097 (0.012118)
lut_zea	nutrients/mineral	Serum lutein/zeaxanthin (umol/L)	1307	0.408457 (0.013083)
lycopene	nutrients/mineral	Serum lycopene (umol/L)	1307	0.46946 (0.011235)
phosp	nutrients/mineral	Serum phosphorus (mmol/L)	1310	1.040831 (0.004768)
selenium	nutrients/mineral	Serum selenium (mmol/L)	1314	1.592166 (0.014396)
sum_ret	nutrients/mineral	Serum sum retinyl esters (umol/L)	1307	0.198827 (0.008189)
vit_a	nutrients/mineral	Serum vit A (umol/L)	1307	2.211591 (0.019225)
vit_c	nutrients/mineral	Serum vit C (mmol/L)	1302	37.54998 (1.307739)
vit_d	nutrients/mineral	Serum vitamin D (nmol/L)	1315	78.31879 (1.849005)
vit_e	nutrients/mineral	Serum vit E (umol/L)	1307	25.452745 (0.329354)
toxop	parasite infection	Toxoplasmosis Ab (yes,no)	1211	22.421784 (2.859353)
vig	physical activity	Vigorous physical activity (no, yes)	1316	88.81, 11.19
age_stop	smoking	Age last smoke cigarettes regularly (years)	226	<25: 34.81, 25-35: 39.03, ≥35: 26.16
chewsnu	smoking	Ever used chewing tobacco or snuff (yes,no)	1316	81.45, 18.55
cig_100	smoking	Smoked 100+ cigarettes in life (yes,no)	1316	34.37, 65.63
cig_age	smoking	Age first smoked cigarette regularly (yes,no)	836	<30: 99.23, 30-40: 0.69, 40-50: 0.03, ≥50: 0.05



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cig_day	smoking	# cigarettes smoked per day	377	<2: 0.85, 2-10: 14.43, 10-20: 21.27, ≥20: 63.46
cig_dmax	smoking	# cigarettes per day when smoking most	140	<10: 3.15, 10-20: 10.22, 20-50: 64.96, ≥50: 21.67
cig_form	smoking	Former smoking (vs never smoking)	901	51.96, 48.04
cig_now	smoking	Current smoking (vs never smoking)	872	50.38, 49.62
cigar_20	smoking	Ever smoked at least 20 cigars in life (yes,no)	1316	70.71, 29.29
COP	smoking	Cotinine (ng/mL)	1309	98.594524 (6.392028)
fcig_day	smoking	# cigarettes smoked per day before quitting	421	<2: 0.25, 2-10: 14.77, 10-20: 16.18, ≥20: 68.8
pipe_20	smoking	Ever smoked 20 pipes of tobacco in life (yes,no)	1315	76.27, 23.73
SHS	smoking	Secondhand smoking (vs no secondhand smoking)	457	7.13, 92.87
SHS_home	smoking	Does anyone smoke in the home (yes,no)	1316	59.27, 40.73
SHS_work	smoking	Can smell smoking in the office (yes,no)	858	44.99, 55.01
smoke_hm	smoking	# persons who smoke cigarettes in home	1316	<2: 81.46, 2-4: 17.65, ≥4: 0.89
smoke_ofc	smoking	At work, hours per day can smell smoking (yes,no)	427	1-3: 36.35, 3-5: 10.53, ≥5: 53.12
y_cig	smoking	Years smoked this amount (years)	395	<5: 21.06, 5-10: 15.33, 10-20: 35.44, ≥20: 28.17
meet_yr	social support	# get together with friends or relatives or neighbours per year	1316	<12: 5.24, 12-48: 12.77, ≥48: 81.99
phone_wk	social support	# talk on the phone with family, friends or neighbours per week	1243	<2: 24.9, 2-7: 33.74, ≥7: 41.36
HA_ab	viral infection	Hepatitis A Ab (yes,no)	1313	63.89, 36.11
HBc_ab	viral infection	Hepatitis B core Ab (yes,no)	1314	92.75, 7.25
HBs_ab	viral infection	Hepatitis B surface Ab (yes,no)	101	11.9, 88.1
HC_ab	viral infection	Hepatitis C Ab (yes,no)	1310	98.57, 1.43
HSV1	viral infection	HSV I Ab (yes,no)	1310	32.65, 67.35
HSV2	viral infection	HSV II Ab (yes,no)	1304	79.84, 20.16
rubella	viral infection	Rubella Ab (yes,no)	1313	119.801564 (3.802838)
vcella	viral infection	Varicella Ab (yes,no)	1313	13.747675 (0.400698)

**Supplementary Table S2.** Associations between nutrition and lifestyle factors and T deficiency in the discovery set. All models were adjusted for age, race/ethnicity, education, and PIR. P-values for trend are shown for ordinal variables. Benjamin—Hochberg adjusted P-values for FDR < 5% are shown.

Variable	Description	nTotal	nLowT	OR	lower CI	upper CI	P-value
cig_100	Smoked 100+ cigarettes in life (yes,no)	1316	243	0.798	0.3682	1.7295	0.75
cig_age	Age first smoked cigarette regularly (yes,no)	836	162	1.975	0.3351	11.641	0.67
cig_now	Current smoking (vs never smoking)	872	112	0.447	0.1687	1.1866	0.35
cig_form	Former smoking (vs never smoking)	901	208	1.017	0.4608	2.2466	0.99
SHS	Secondhand smoking (vs no secondhand smoking)	457	77	0.328	0.0882	1.2189	0.33
cig_day	# cigarettes smoked per day	377	33	0.821	0.4877	1.3827	0.67
y_cig	Years smoked this amount (years)	395	34	0.806	0.5103	1.2738	0.62
cig_dma	# cigarettes per day when smoking most	140	14	1.397	0.4732	4.1259	0.74
age_sto	Age last smoke cigarettes regularly (years)	226	54	0.724	0.3699	1.4186	0.62
fcig_day	# cigarettes smoked per day before quitting	421	127	0.889	0.6172	1.2816	0.74
chewsn	Ever used chewing tobacco or snuff (yes,no)	1316	243	1.121	0.6885	1.8265	0.78
cigar_20	Ever smoked at least 20 cigars in life (yes,no)	1316	243	0.682	0.4197	1.1079	0.36
pipe_20	Ever smoked 20 pipes of tobacco in life (yes,no)	1315	243	0.693	0.4392	1.0946	0.36
SHS_ho	Does anyone smoke in the home (yes,no)	1316	243	0.745	0.3762	1.4755	0.64
smoke_hm	# persons who smoke cigarettes in home	1316	243	1.123	0.4827	2.611	0.87
SHS_wo	Can smell smoking in the office (yes,no)	858	130	1.037	0.4653	2.3095	0.96
smoke_ofc	At work, hours per day can smell smoking (yes,no)	427	62	0.701	0.4191	1.1723	0.43
COP	Cotinine (ng/mL)	1309	242	0.97	0.7035	1.3386	0.9
alc2day	2 or more drink per day (yes,no)	1316	243	0.884	0.409	1.9122	0.86
caf2day	2 or more caffeinated drink per day (yes,no)	1316	243	0.835	0.5567	1.2509	0.64

vig	Vigorous physical activity (no, yes)	1316	243	0.8 49	0.318 5	2.261 6	0.8 6
tetanus	Tetanus Ab (U/mL)	1316	243	1.1 03	0.752 1	1.617 4	0.7 7
Hpylori	Helicobacter pylori Ab (yes,no)	1276	237	1.1 44	0.781 8	1.673	0.7
toxop	Toxoplasmosis Ab (yes,no)	1211	221	0.9 65	0.706 2	1.317 5	0.8 9
HSV1	HSV1 Ab (yes,no)	1310	243	1.1 69	0.746	1.831 1	0.7
HSV2	HSV2 Ab (yes,no)	1304	242	0.6 93	0.398 7	1.205 9	0.4 5
HA_ab	Hepatitis A Ab (yes,no)	1313	242	0.8 74	0.500 2	1.526 8	0.7 8
HBc_ab	Hepatitis B core Ab (yes,no)	1314	243	0.8 99	0.333 2	2.423 1	0.8 9
HBs_ab	Hepatitis B surface Ab (yes,no)	101	22	4.5 71	0.541 1	38.61 6	0.5 4
HC_ab	Hepatitis C Ab (yes,no)	1310	242	0.3 73	0.069 2	2.004 7	0.5 1
rubella	Rubella Ab (yes,no)	1313	242	1.0 11	0.831 1	1.230 6	0.9 5
vcella	Varicella Ab (yes,no)	1313	242	0.9 64	0.849	1.095 5	0.7 6
ca_norm	Serum normalized calcium (mmol/L)	1157	215	0.7 95	0.613 2	1.031 4	0.3 2
ca_tot	Serum total calcium (mmol/L)	1304	242	1.0 39	0.869	1.242 5	0.8 1
seleniu m	Serum selenium (mmol/L)	1314	243	0.9 59	0.788 8	1.166 6	0.8 1
folate_s	Serum folate (nmol/L)	1316	243	1.1 75	0.909 9	1.517 2	0.4 7
folate_r	RBC folate (nmol/L)	1308	240	1.1 24	0.862 2	1.465 1	0.6 4
vit_c	Serum vit C (mmol/L)	1302	240	0.9 96	0.757	1.309 5	0.9 9
vit_a	Serum vit A (umol/L)	1307	243	0.8 32	0.639 5	1.081 8	0.4 3
vit_e	Serum vit E (umol/L)	1307	243	0.9 09	0.760 7	1.086 1	0.5 7
a_carot	Serum alpha carotene (umol/L)	1307	243	0.9 4	0.611 8	1.444 8	0.8 7
b_carot	Serum beta carotene (umol/L)	1307	243	0.8 82	0.586 8	1.325 3	0.7 4
b_crypto	Serum beta cryptoxanthin (umol/L)	1307	243	1.0 3	0.749 2	1.416 2	0.9
lut_zea	Serum lutein/zeaxanthin (umol/L)	1307	243	0.9 65	0.794 4	1.172 6	0.8 4

lycopen e	Serum lycopene (umol/L)	1307	243	0.9 84	0.85	1.138 2	0.8 9
sum_ret	Serum sum retinyl esters (umol/L)	1307	243	0.8 94	0.776 4	1.029 8	0.3 6
phosp	Serum phosphorus (mmol/L)	1310	242	1.2 27	0.896 7	1.678 5	0.4 5
lead	Serum lead (umol/L)	1316	243	1.0 2	0.873 6	1.191 8	0.8 8
cadmiu m	Urine cadmium (umol/L)	1294	238	0.9 65	0.772 3	1.206 6	0.8 6
iodine	Urine iodine (ug/dL)	1279	234	0.8 93	0.710 5	1.123 5	0.6 2
vit_d	Serum vitamin D (nmol/L)	1315	243	0.9 44	0.708 1	1.257 8	0.8 2
aspirin	Taken aspirin in past month (yes,no)	1311	241	1.1 35	0.639 2	2.013 8	0.8
aspi_mo	# aspirin taken in the past month (yes,no)	510	98	0.9 97	0.627 8	1.582 4	0.9 9
pct	Taken paracetamol in past month (yes,no)	1310	240	0.9 08	0.630 4	1.308 9	0.7 7
pct_mo	# paracetamol taken in the past month (yes,no)	376	63	0.7 88	0.466 1	1.333 8	0.6 4
nsaid	Taken NSAIDs in past month (yes,no)	1310	240	0.8 98	0.442 3	1.823 9	0.8 6
nsa_mo	# NSAIDs taken in the past month (yes,no)	171	29	0.8 66	0.502	1.495 3	0.7 7
water_g	Water (gm)	1273	234	0.7 42	0.548 9	1.001 7	0.2 7
kcal	Calories (kcal)	1273	234	0.7 42	0.593 2	0.929 1	0.1 2
prot_g	Protein (gm)	1273	234	0.6 73	0.535 2	0.847 1	0.0 5
totfat_g	Total fats (gm)	1273	234	0.7 46	0.627 7	0.887 5	0.0 5
satfat_g	Total saturated fatty acids (gm)	1273	234	0.7 15	0.584	0.874 4	0.0 5
mufat_g	Total monounsaturated fatty acids (gm)	1273	234	0.7 58	0.641 5	0.894 6	0.0 5
pufat_g	Total polyunsaturated fatty acids (gm)	1273	234	0.9 17	0.764 9	1.098 8	0.6 2
chol_g	Cholesterol (mg)	1273	234	0.8 5	0.605 7	1.192 6	0.6 2
carb_g	Total carbohydrates (gm)	1273	234	0.8 66	0.716 2	1.047 4	0.3 7
fiber_g	Dietary fiber (gm)	1273	234	0.8 98	0.691 9	1.165 6	0.6 6
alco_g	Alcohol (gm)	1273	234	0.8 59	0.614 9	1.200 1	0.6 4

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vit_a_g	Total vitamin A (IU)	1273	234	0.805	0.7131	0.9086	0.05
retino_g	Retinol (mcg)	1273	234	0.871	0.6144	1.2346	0.67
bcaro_g	Beta-carotene (mcg)	1273	234	0.833	0.723	0.9589	0.13
vit_e_g	Total alpha-tocopherol equivalents (mg)	1273	234	0.882	0.7288	1.0671	0.45
vit_c_g	Vitamin C (mg)	1273	234	0.942	0.8072	1.0992	0.67
thia_g	Thiamin (mg)	1273	234	0.848	0.7199	0.999	0.26
ribo_g	Riboflavin (mg)	1273	234	0.79	0.6325	0.988	0.23
niac_g	Niacin (mg)	1273	234	0.704	0.5425	0.9142	0.12
vit_b6_g	Vitamin B6 (mg)	1273	234	0.816	0.6378	1.0437	0.35
foia_g	Folic acid (mcg)	1273	234	0.873	0.7173	1.0637	0.43
vitb12_g	Vitamin B12 (mcg)	1273	234	0.88	0.7658	1.0117	0.3
calc_g	Calcium (mg)	1273	234	0.857	0.7483	0.9809	0.19
phos_g	Phosphorous (mg)	1273	234	0.7	0.5632	0.8701	0.05
magn_g	Magnesium (mg)	1273	234	0.751	0.5635	0.9999	0.26
iron_g	Iron (mg)	1273	234	0.788	0.6438	0.9649	0.18
zinc_g	Zinc (mg)	1273	234	0.559	0.349	0.8953	0.16
copp_g	Copper (mg)	1273	234	0.821	0.5838	1.1545	0.51
sodi_g	Sodium (mg)	1273	234	0.838	0.6837	1.0272	0.32
pots_g	Potassium (mg)	1273	234	0.801	0.6381	1.0061	0.27
cfiber_g	Crude Fiber (gm)	1273	234	0.89	0.7372	1.0748	0.48
ash_g	Ash (gm)	1273	234	0.796	0.6379	0.993	0.25
cafe_g	Caffeine (mg)	1273	234	0.753	0.6019	0.9428	0.14
sele_g	Selenium (mcg)	1273	234	0.738	0.562	0.9679	0.2
pantho_g	Pantothenic acid (mg)	1273	234	0.869	0.6935	1.0889	0.48

a_toco_g	Alpha-tocopherol (mg)	1273	234	0.903	0.7318	1.115	0.62
b_toco_g	Beta-tocopherol (mg)	1273	234	0.998	0.8354	1.1921	0.99
g_toco_g	Gamma-tocopherol (mg)	1273	234	0.861	0.7546	0.9825	0.19
d_toco_g	Delta-tocopherol (mg)	1273	234	0.864	0.7625	0.979	0.18
vit_d_g	Vitamin D (mcg)	1273	234	0.897	0.7814	1.0293	0.36
sfa40_g	SFA 4:0 (gm)	1273	234	0.824	0.6702	1.0127	0.3
sfa60_g	SFA 6:0 (gm)	1273	234	0.865	0.6996	1.0697	0.43
sfa80_g	SFA 8:0 (gm)	1273	234	0.884	0.6969	1.1216	0.59
sfa100_g	SFA 10:0 (gm)	1273	234	0.808	0.6342	1.0296	0.32
sfa120_g	SFA 12:0 (gm)	1273	234	0.925	0.7522	1.1367	0.67
sfa140_g	SFA 14:0 (gm)	1273	234	0.743	0.5801	0.9513	0.17
sfa160_g	SFA 16:0 (gm)	1273	234	0.714	0.5812	0.8769	0.05
sfa170_g	SFA 17:0 (gm)	1273	234	0.84	0.7043	1.0028	0.27
sfa180_g	SFA 18:0 (gm)	1273	234	0.721	0.6013	0.8651	0.05
sfa200_g	SFA 20:0 (gm)	1273	234	1.04	0.9007	1.2006	0.77
sfa220_g	SFA 22:0 (gm)	1273	234	1.048	0.9261	1.1857	0.67
mfa141_g	MFA 14:1 (gm)	1273	234	0.659	0.5069	0.857	0.06
mfa161_g	MFA 16:1 (gm)	1273	234	0.724	0.5449	0.9626	0.19
mfa181_g	Oleic acid (MFA 18:1) (gm)	1273	234	0.767	0.652	0.9032	0.05
mfa201_g	MFA 20:1 (gm)	1273	234	0.802	0.6781	0.9494	0.13
mfa221_g	MFA 22:1 (gm)	1273	234	1.001	0.799	1.2539	0.99
pfa182_g	Linoleic acid (PFA 18:2) (gm)	1273	234	0.927	0.7789	1.104	0.64
pfa183_g	Linolenic acid (PFA 18:3) (gm)	1273	234	0.913	0.7281	1.1458	0.67
pfa184_g	PFA 18:4 (gm)	1273	234	0.892	0.7662	1.0375	0.37

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pfa204_g	PFA 20:4 (gm)	1273	234	0.749	0.5503	1.0206	0.3
pfa205_g	PFA 20:5 (gm)	1273	234	0.914	0.7426	1.1253	0.64
pfa225_g	PFA 22:5 (gm)	1273	234	0.817	0.6302	1.0588	0.36
pfa226_g	PFA 22:6 (gm)	1273	234	0.883	0.7711	1.0102	0.3
gluc_g	Glucose (gm)	1273	234	0.977	0.8435	1.1325	0.86
fruc_g	Fructose (gm)	1272	234	1.051	0.8667	1.2736	0.77
gala_g	Galactose (gm)	1273	234	1.16	0.9473	1.4214	0.4
sucr_g	Sucrose (gm)	1273	234	0.965	0.8585	1.0856	0.74
lact_g	Lactose (gm)	1273	234	0.878	0.7453	1.0339	0.36
malt_g	Maltose (gm)	1273	234	0.965	0.8392	1.1102	0.77
ifiber_g	Water insoluble dietary fiber (gm)	1273	234	0.939	0.7265	1.2141	0.78
sfiber_g	Water soluble dietary fiber (gm)	1273	234	0.845	0.6672	1.0694	0.41
pect_g	Pectin (gm)	1273	234	1.026	0.8147	1.2917	0.89
star_g	Starch (gm)	1273	234	0.805	0.616	1.0508	0.35
aspar_g	Aspartame (mg)	1273	234	0.705	0.5704	0.871	0.05
tryp_g	Tryptophan (gm)	1273	234	0.651	0.5307	0.7974	0.05
thre_g	Threonine (gm)	1273	234	0.651	0.5307	0.7974	0.05
isoleu_g	Isoleucine (gm)	1273	234	0.68	0.5455	0.8486	0.05
leuc_g	Leucine (gm)	1273	234	0.681	0.5475	0.846	0.05
lysin_g	Lysine(gm)	1273	234	0.684	0.5468	0.8545	0.05
meth_g	Methionine (gm)	1273	234	0.685	0.5443	0.861	0.05
cyst_g	Cystine (gm)	1273	234	0.716	0.5717	0.8958	0.08
phen_g	Phenylalanine (gm)	1273	234	0.695	0.5586	0.8635	0.05
tyro_g	Tyrosine (gm)	1273	234	0.673	0.5449	0.8307	0.05

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valin_g	Valine (gm)	1273	234	0.689	0.5561	0.8532	0.05
argin_g	Arginine (gm)	1273	234	0.69	0.5496	0.8675	0.05
histi_g	Histidine (gm)	1273	234	0.709	0.577	0.8724	0.05
alan_g	Alanine (gm)	1273	234	0.675	0.5312	0.8571	0.05
aspac_g	Aspartic Acid (gm)	1273	234	0.696	0.5425	0.8927	0.08
glutac_g	Glutamic Acid (gm)	1273	234	0.658	0.5388	0.8026	0.05
glyc_g	Glycine (gm)	1273	234	0.667	0.5299	0.8396	0.05
proli_g	Proline (gm)	1273	234	0.682	0.566	0.8224	0.05
serin_g	Serine (gm)	1273	234	0.707	0.5763	0.8669	0.05
sacch_g	Saccharin (mg)	1273	234	1.018	0.8483	1.2218	0.9
anprot_g	Animal Protein (gm)	1273	234	0.694	0.5517	0.8722	0.06
vprot_g	Vegetable Protein (gm)	1273	234	0.845	0.6607	1.0816	0.43
oxal_g	Oxalic Acid (mg)	1273	234	0.945	0.8671	1.0299	0.45
phyt_g	Phytic Acid (mg)	1273	234	0.945	0.7602	1.1749	0.77
p_tfat	Energy from total fat (%kcal)	1273	234	0.855	0.6971	1.0477	0.37
p_sfat	Energy from saturated fat (%kcal)	1273	234	0.802	0.6224	1.0323	0.32
p_msfat	Energy from monosaturated fat (%kcal)	1273	234	0.838	0.6742	1.0414	0.35
p_psfat	Energy from polysaturated fat (%kcal)	1273	234	1.114	0.9285	1.3365	0.51
p_prot	Energy from protein (%kcal)	1273	234	0.94	0.7694	1.1473	0.74
p_carb	Energy from carbohydrate (%kcal)	1273	234	1.231	0.9894	1.5311	0.29
p_alc	Energy from alcohol (%kcal)	1273	234	0.938	0.6686	1.317	0.84
gra_hei	Grains, HEI Score	1273	234	0.806	0.6631	0.9799	0.2
fru_hei	Fruits, HEI Score	1273	234	1.092	0.8705	1.3696	0.67
veg_hei	Vegetables, HEI Score	1273	234	0.979	0.7129	1.3451	0.94



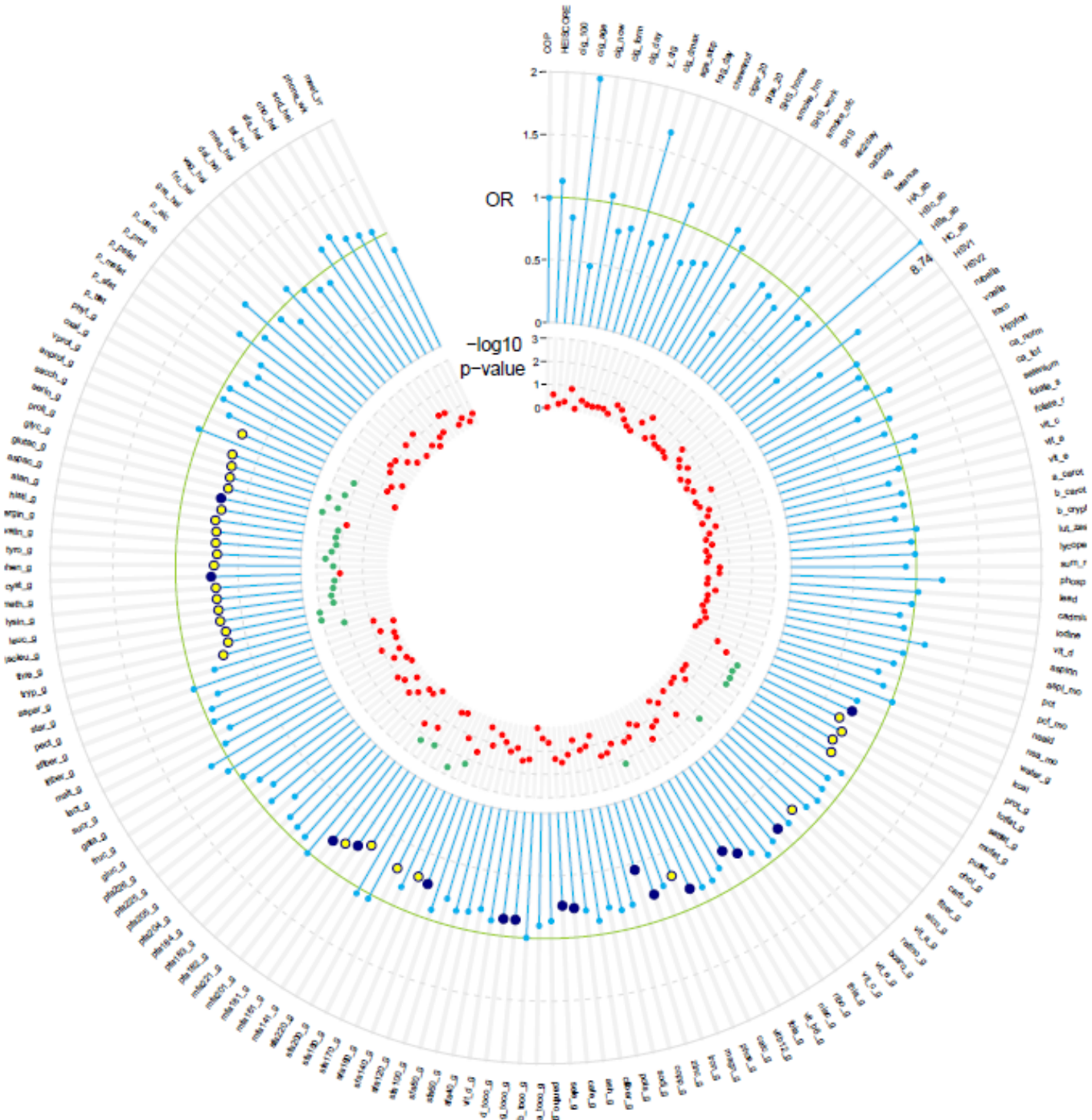
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dai_hei	Dairy, HEI Score	1273	234	0.9 14	0.690 7	1.210 5	0.7 4
mea_hei	Meats, HEI Score	1273	234	0.8 94	0.703 5	1.136 1	0.6 2
fat_hei	Fats, HEI Score	1273	234	1.1 42	0.988 7	1.320 2	0.3
sfa_hei	Saturated Fat, HEI Score	1273	234	1.1 85	0.976 2	1.439	0.3 2
cho_hei	Cholesterol, HEI Score	1273	234	1.1 16	0.823 9	1.511 4	0.6 9
sod_hei	Sodium, HEI Score	1273	234	1.0 83	0.925 9	1.267 8	0.6
HEISCO RE	Healthy Eating Index Score	1273	234	1.1 3	0.918	1.391 2	0.5 1
phone_ wk	# talk on the phone with family, friends or neighbours per week	1243	236	1.0 67	0.866 8	1.314	0.7 4
meet_yr	# get together with friends or relatives or neighbours per year	1316	243	0.8 68	0.628 2	1.198 9	0.6 4

**Supplementary Table S3.** Descriptive characteristics of study participants in NHANES III (discovery set) by calculated free testosterone deficiency

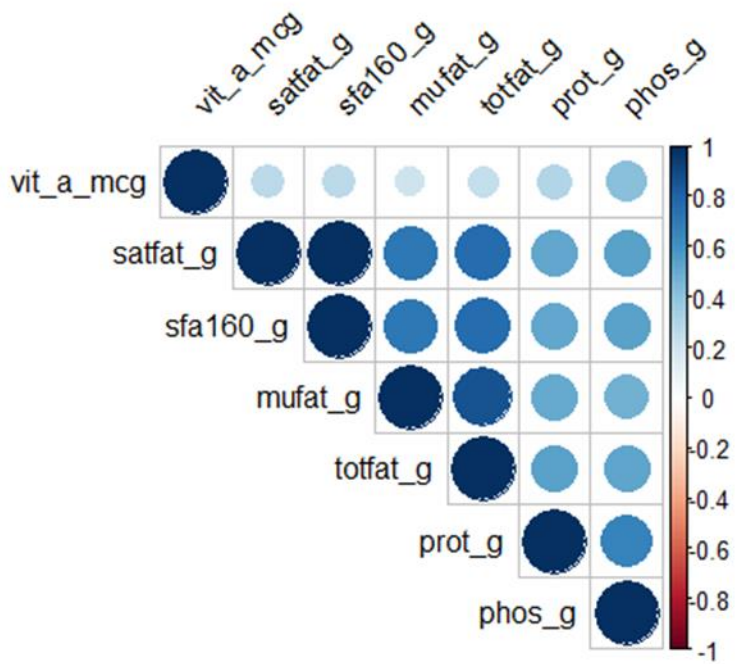
	< 225 calculate free testosterone (N= 257)	≥ 225 calculated free testosterone (N= 1047)	P-value
<b>Age – mean (SE)</b>	51.40 (1.08)	41.36 (0.73)	0.0001
<b>Race (%)</b>			0.40
Non-Hispanic white	76.72	78.89	
Non-Hispanic black	9.54	9.52	
Mexican-American	4.03	4.65	
Others	9.71	6.94	
<b>Poverty-to-income ratio (PIR) (%)</b>			0.01
<1	3.94	10.75	
1-2	21.16	18.30	
2-3	32.09	19.74	
≥3	42.81	51.20	
<b>Body mass index (kg/m<sup>2</sup>) – mean (SD)</b>	28.70 (0.70)	25.93 (0.22)	0.03
<b>Metabolic disorder (%)</b>			
Hypertension	61.69	37.37	<0.0001
Diabetes	19.17	9.95	0.0006
Low HDL-cholesterol	40.73	30.89	0.91
Triglyceridemia	49.02	28.84	0.03
<b>Hormone levels – mean (SD)</b>			
Testosterone (ng/mL)	2.62 (0.10)	5.91 (0.10)	<0.0001
SHBG (nmol/L)	32.30 (1.95)	39.24 (0.78)	<0.0001
Estradiol (ng/mL)	31.33 (1.64)	38.22 (0.63)	0.0002

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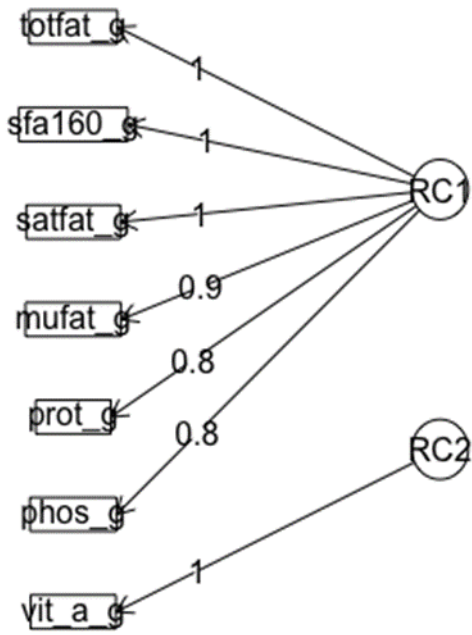
**Supplementary Figure S1.** Circle Manhattan plot shows the associations between nutrition and lifestyle factors and T deficiency. Factors were ordered based on the size of effects (odds ratio). For abbreviations of investigated factors, see Supplementary Table S1. Filled yellow dots represent those significant associations in multiple comparisons in the discovery set (FDR < 5%) and filled blue dots represent P value < 0.05 in the replication set that were considered valid.

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**Supplementary Figure S2.** Correlation between validated nutrition and lifestyle factors.

# Factor Analysis



Supplementary Figure S3. Principal component factors analysis.