

Supplemental Material

Table S1. Mean difference in 4-year changes in lipid traits across beverage consumption groups by cohort*

	Beverage Consumption Groups					<i>P</i> for trend
	<1 serving/ month	1-4 servings/ month	1-2 servings/ week	3-7 servings/ week	>1 serving/ day	
Sugar-Sweetened Beverage Intake						
Offspring Cohort						
No of Observations	3,497	1,666	1,321	1,705	674	
LDL-C (mg/dl)	Reference	-0.6 (0.7)	1.2 (0.8)	-0.004 (0.8)	0.9 (1.2)	0.44
HDL-C (mg/dl)	Reference	-0.4 (0.3)	-0.5 (0.3)	-0.7 (0.3)	-1.8 (0.4)	0.0002
TG (mg/dl)	Reference	1.8 (1.8)	2.5 (2.0)	4.9 (1.9)	2.6 (2.9)	0.03
Non-HDL-C (mg/dl)	Reference	-0.3 (0.8)	-0.5 (0.9)	0.6 (0.9)	1.0 (1.3)	0.31
Generation 3 Cohort						
No of Observations	867	549	483	576	325	
LDL-C	Reference	0.3 (0.8)	-0.3 (0.9)	1.2 (0.9)	2.4 (1.2)	0.08
HDL-C (mg/dl)	Reference	-0.1 (0.4)	-0.4 (0.4)	-1.0 (0.4)	-0.8 (0.5)	0.01
TG (mg/dl)	Reference	4.5 (2.4)	2.8 (2.6)	5.6 (2.6)	10.8 (3.5)	0.006
Non-HDL-C (mg/dl)	Reference	0.8 (0.9)	-0.6 (1.0)	1.6 (1.0)	3.6 (1.4)	0.02
Low-Calorie Sweetened Beverage Intake						
Offspring Cohort						
No of Observations	3,775	1,112	805	1,890	1,275	
LDL-C (mg/dl)	Reference	0.4 (0.8)	1.1 (0.9)	-0.2 (0.7)	0.1 (0.8)	0.99
HDL-C (mg/dl)	Reference	-0.6 (0.3)	-0.3 (0.3)	-0.5 (0.3)	-0.6 (0.3)	0.03
TG (mg/dl)	Reference	1.0 (2.0)	1.7 (2.3)	1.9 (1.7)	1.3 (2.0)	0.28
Non-HDL-C (mg/dl)	Reference	0.5 (0.9)	1.1 (1.0)	0.1 (0.8)	0.04 (0.9)	0.91
Generation 3 Cohort						
No of Observations	1,242	351	287	506	414	
LDL-C	Reference	0.5 (0.9)	0.3 (1.0)	-0.2 (0.8)	-1.7 (0.9)	0.12
HDL-C (mg/dl)	Reference	0.7 (0.4)	-0.5 (0.4)	-0.4 (0.3)	-0.8 (0.4)	0.01
TG (mg/dl)	Reference	4.4 (2.6)	4.3 (2.8)	3.5 (2.3)	0.2 (2.5)	0.40
Non-HDL-C (mg/dl)	Reference	0.5 (1.0)	0.2 (1.1)	0.2 (0.9)	-2.0 (1.0)	0.17
100% Fruit Juice Intake						
Offspring Cohort						
No of Observations	1,122	991	1,009	3,644	2,093	
LDL-C (mg/dl)	Reference	0.6 (1.0)	0.8 (1.0)	-0.5 (0.8)	-0.9 (0.9)	0.12
HDL-C (mg/dl)	Reference	0.2 (0.4)	-0.3 (0.4)	-0.6 (0.3)	-0.2 (0.3)	0.11
TG (mg/dl)	Reference	2.1 (2.5)	-0.03 (2.5)	0.6 (2.0)	-3.0 (2.3)	0.17
Non-HDL-C (mg/dl)	Reference	1.0 (1.1)	0.2 (1.2)	-0.3 (0.9)	-1.5 (1.0)	0.07
Generation 3 Cohort						
No of Observations	307	377	547	1,066	503	
LDL-C	Reference	0.2 (1.1)	0.4 (1.1)	-0.8 (1.0)	-0.6 (1.1)	0.27
HDL-C (mg/dl)	Reference	0.2 (0.5)	-0.03 (0.5)	0.3 (0.4)	0.3 (0.5)	0.42
TG (mg/dl)	Reference	-1.0 (3.3)	-3.9 (3.1)	-4.4 (2.9)	-6.0 (3.3)	0.04
Non-HDL-C (mg/dl)	Reference	0.9 (1.3)	1.3 (1.2)	-0.7 (1.1)	-0.9 (1.3)	0.11

HDL-C, high density lipoprotein cholesterol concentrations; LDL-C, low-density lipoprotein cholesterol concentrations; mg/dl, milligrams per deciliter; TC, total cholesterol concentrations; TG, triglyceride concentrations.

*Framingham Offspring Cohort: 8,859 observations from 3,124 participants; Framingham Generation 3 Cohort: 2,800 participants. Values are beta-coefficients and standard errors for beverage intake in multivariate mixed effects models accounting for family structure and adjusted for age (continuous), sex (M/F), total energy (continuous), baseline for lipid trait (continuous), education (less than high school, graduated high school, some college, or graduated college), current smoking status (yes/no), current diabetes status (yes/no), physical activity index (continuous), alcohol (grams), use of LDL-lowering medication (yes/no; where applicable), servings per day of vegetables, whole fruits, whole grains, nuts/seeds, and seafood, as well as percent energy from saturated fat (continuous), change in waist circumference, and mutual adjustment for SSB, LCSB, and 100% fruit juice (categorical as continuous).

Table S2. Difference in 4-year changes in lipid traits by SSB and LCSB category*.

SSB Category	LCSB Category	Median SSB Intake (servings/week)	Median LCSB Intake (servings/week)	<i>n</i>	HDL-C (mg/dl)	<i>p</i>	TG (mg/dl)	<i>p</i>
					$\beta \pm SE$		$\beta \pm SE$	
<1 serv/ month	<1 serv/ month	0.1	0.0	1,561	Reference		Reference	
	1-10 serv/month	0.1	1.3	885	-0.2 (0.3)	0.54	0.4 (2.2)	0.84
	>3 serv/week	0.1	7.1	1,913	-0.5 (0.3)	0.08	0.8 (1.8)	0.66
1-10 serv/month	<1 serv/ month	1.2	0.0	1,730	-0.2 (0.3)	0.42	0.3 (1.9)	0.86
	1-10 serv/month	1.1	1.1	1,031	-0.8 (0.3)	0.02	3.7 (2.2)	0.08
	>3 serv/week	1.1	6.2	1,258	-0.7 (0.3)	0.03	4.6 (2.1)	0.03
>3 serv/week	<1 serv/ month	5.5	0.0	1,726	-0.9 (0.3)	0.004	4.8 (2.0)	0.02
	1-10 serv/month	4.5	1.2	639	-1.0 (0.4)	0.02	5.4 (2.6)	0.04
	>3 serv/week	4.4	6.2	914	-1.6 (0.4)	<0.0001	4.3 (2.4)	0.07

HDL-C, high density lipoprotein cholesterol concentrations; LDL-C, low-density lipoprotein cholesterol concentrations; mg/dl, milligrams per deciliter; serv, serving(s); TC, total cholesterol concentrations; TG, triglyceride concentrations.

*Framingham Offspring Cohort: 8,857 observations from 3,124 participants; Framingham Generation 3 Cohort: 2,800 participants. Values are pooled beta-coefficients for beverage intake in multivariate mixed effects models accounting for family structure and adjusted for age (continuous), sex (M/F), total energy (continuous), baseline for lipid trait (continuous), education (less than high school, graduated high school, some college, or graduated college), current smoking status (yes/no), current diabetes status (yes/no), physical activity index (continuous), alcohol (grams), use of LDL-lowering medication (yes/no; where applicable), change in waist circumference (continuous), servings per day of vegetables, whole fruits, whole grains, nuts/seeds, and seafood, as well as percent energy from saturated fat (continuous) and mutual adjustment for SSB, LCSB, and 100% fruit juice (categorical as continuous).

Table S3. HRs (95% CIs) for incident dyslipidemia according to recent beverage consumption category (Framingham Offspring Cohort)*

	SSB Intake			LCSB Intake			100% Fruit Juice Intake		
	Incident Cases	Person-Years	HR (95% CI)	Incident Cases	Person-Years	HR (95% CI)	Incident Cases	Person-Years	HR (95% CI)
Incidence of high LDL-C (≥ 160 mg/dl)									
<1 serving/month	394	9956	Reference	419	11653	Reference	129	3290	Reference
1-4 servings/month	216	6190	0.99 (0.84-1.17)	138	3830	1.00 (0.83-1.20)	162	4011	1.13 (0.90-1.40)
1-2 servings/week	70	2239	0.98 (0.76-1.28)	42	1336	0.85 (0.63-1.15)	67	2009	0.94 (0.70-1.26)
3-7 servings/week	206	5010	1.22 (1.01-1.47)	216	5162	1.17 (0.99-1.39)	376	10091	0.98 (0.81-1.20)
>1 serving/day	75	2044	1.19 (0.88-1.59)	144	3428	1.27 (1.05-1.53)	227	6033	1.08 (0.86-1.36)
			$p_{\text{trend}}=0.05$			$p_{\text{trend}}=0.01$			$p_{\text{trend}}=0.94$
Incidence of low HDL-C (Women: <50 mg/dl; Men <40 mg/dl)									
<1 serving/month	108	9784	Reference	124	10481	Reference	45	3221	Reference
1-4 servings/month	90	5610	1.47 (1.11-1.95)	51	3495	1.18 (0.85-1.63)	45	3579	0.83 (0.55-1.25)
1-2 servings/week	29	2030	1.24 (0.80-1.92)	9	1240	0.54 (0.25-1.13)	20	1804	0.63 (0.38-1.07)
3-7 servings/week	63	4064	1.43 (1.02-2.01)	85	4823	1.38 (1.04-1.84)	135	9064	0.96 (0.67-1.37)
>1 serving/day	28	1396	1.98 (1.20-3.28)	49	2809	1.32 (0.92-1.88)	74	5215	0.87 (0.58-1.30)
			$p_{\text{trend}}=0.01$			$p_{\text{trend}}=0.05$			$p_{\text{trend}}=0.98$
Incidence of high TG (≥ 175 mg/dl)									
<1 serving/month	167	11515	Reference	194	12684	Reference	59	3971	Reference
1-4 servings/month	99	6784	1.03 (0.80-1.31)	65	4263	1.04 (0.77-1.39)	75	4398	1.15 (0.82-1.63)
1-2 servings/week	49	2427	1.50 (1.07-2.10)	35	1534	1.43 (0.99-2.04)	44	2184	1.24 (0.83-1.84)
3-7 servings/week	98	5097	1.42 (1.07-1.88)	93	5724	1.07 (0.83-1.37)	179	10823	1.14 (0.83-1.56)
>1 serving/day	43	1937	1.53 (1.01-2.31)	68	3534	1.18 (0.88-1.59)	99	6384	1.06 (0.74-1.52)
			$p_{\text{trend}}=0.004$			$p_{\text{trend}}=0.23$			$p_{\text{trend}}=0.84$
Incidence of high Non-HDL-C (≥ 190 mg/dl)									
<1 serving/month	402	10351	Reference	404	11864	Reference	145	3435	Reference
1-4 servings/month	222	6298	1.02 (0.87-1.20)	144	3895	1.12 (0.93-1.34)	159	4110	0.99 (0.81-1.23)
1-2 servings/week	82	2367	1.11 (0.87-1.42)	47	1402	0.98 (0.73-1.30)	65	2080	0.84 (0.63-1.12)
3-7 servings/week	193	5021	1.16 (0.96-1.41)	223	5352	1.26 (1.07-1.49)	386	10335	0.92 (0.77-1.12)
>1 serving/day	75	2065	1.17 (0.87-1.57)	155	3565	1.40 (1.17-1.69)	220	6141	0.95 (0.77-1.18)
			$p_{\text{trend}}=0.10$			$p_{\text{trend}}=0.0002$			$p_{\text{trend}}=0.49$

HDL-C, high density lipoprotein cholesterol concentrations; LDL-C, low-density lipoprotein cholesterol concentrations; mg/dl, milligrams per deciliter; TG, total cholesterol concentrations; TG, triglyceride concentrations.

Participants were free of dyslipidemia at baseline (according to each definition), thus sample sizes were as follows LDL-C (n=2,161), HDL-C (n=1,703), TG (n=2,116), and non-HDL-C (n=2,205).

*Models adjusted for age (continuous), sex (M/F), total energy (continuous), education (less than high school, graduated high school, some college, or graduated college), current smoking status (yes/no), physical activity index (continuous), body mass index (BMI), alcohol (grams), servings per day of vegetables, whole fruits, whole grains, nuts/seeds, and seafood, as well as percent energy from saturated fat (continuous) and mutual adjustment for SSB, LCSB, and 100% fruit juice (categorical as continuous).

Table S4. HRs (95% CIs) for incident dyslipidemia according to cumulative beverage consumption category (Framingham Offspring Cohort)*

	SSB Intake			LCSB Intake			100% Fruit Juice Intake		
	Incident Cases	Person-Years	HR (95% CI)	Incident Cases	Person-Years	HR (95% CI)	Incident Cases	Person-Years	HR (95% CI)
Incidence of high LDL-C (≥ 160 mg/dl)									
<1 serving/month	288	7665	Reference	355	9585	Reference	66	1680	Reference
1-4 servings/month	189	4852	1.01 (0.84-1.22)	100	3165	0.75 (0.60-0.93)	82	2331	0.78 (0.56-1.07)
1-2 servings/week	180	5172	0.92 (0.75-1.11)	109	2944	0.82 (0.66-1.01)	142	3767	0.75 (0.56-1.01)
3-7 servings/week	223	5615	1.05 (0.87-1.28)	231	5856	0.93 (0.77-1.11)	415	10463	0.83 (0.63-1.08)
>1 serving/day	81	2138	1.11 (0.84-1.47)	166	3891	1.00 (0.82-1.21)	256	7202	0.79 (0.59-1.05)
			$p_{\text{trend}}=0.61$			$p_{\text{trend}}=0.94$			$p_{\text{trend}}=0.47$
Incidence of low HDL-C (Women <50 mg/dl; Men <40 mg/dl)									
<1 serving/month	95	7487	Reference	108	8422	Reference	27	1559	Reference
1-4 servings/month	55	4531	0.91 (0.65-1.27)	45	2962	1.06 (0.74-1.51)	23	1992	0.69 (0.39-1.22)
1-2 servings/week	63	4662	1.03 (0.74-1.44)	35	2725	0.90 (0.59-1.37)	43	3415	0.72 (0.43-1.19)
3-7 servings/week	76	4760	1.17 (0.84-1.63)	80	5445	1.04 (0.77-1.40)	134	9601	0.81 (0.52-1.25)
>1 serving/day	30	1447	1.57 (0.97-2.54)	51	3333	1.06 (0.74-1.52)	92	6320	0.87 (0.54-1.39)
			$p_{\text{trend}}=0.09$			$p_{\text{trend}}=0.79$			$p_{\text{trend}}=0.88$
Incidence of high TG (≥ 175 mg/dl)									
<1 serving/month	130	8713	Reference	156	10308	Reference	36	2037	Reference
1-4 servings/month	81	5336	1.03 (0.77-1.37)	55	3517	1.01 (0.73-1.39)	50	2522	1.18 (0.77-1.82)
1-2 servings/week	92	5717	1.10 (0.83-1.46)	60	3310	1.14 (0.83-1.56)	62	4064	0.96 (0.62-1.49)
3-7 servings/week	109	5984	1.25 (0.94-1.68)	116	6563	1.12 (0.87-1.45)	192	11369	1.07 (0.72-1.58)
>1 serving/day	45	2019	1.52 (1.03-2.25)	70	4070	1.03 (0.76-1.39)	117	7776	1.00 (0.65-1.54)
			$p_{\text{trend}}=0.03$			$p_{\text{trend}}=0.51$			$p_{\text{trend}}=0.82$
Incidence of high Non-HDL-C (≥ 3.5)									
<1 serving/month	301	7989	Reference	345	9762	Reference	71	1736	Reference
1-4 servings/month	188	4976	0.98 (0.81-1.18)	104	3209	0.82 (0.66-1.04)	84	2360	0.76 (0.56-1.05)
1-2 servings/week	179	5286	0.90 (0.74-1.09)	106	3029	0.83 (0.66-1.03)	137	3867	0.68 (0.51-0.92)
3-7 servings/week	227	5672	1.07 (0.88-1.30)	248	6079	1.03 (0.87-1.23)	423	10745	0.79 (0.61-1.04)
>1 serving/day	80	2186	1.07 (0.81-1.41)	172	4031	1.09 (0.90-1.32)	260	7402	0.75 (0.56-1.00)
			$p_{\text{trend}}=0.58$			$p_{\text{trend}}=0.31$			$p_{\text{trend}}=0.34$

HDL-C, high density lipoprotein cholesterol concentrations; LDL-C, low-density lipoprotein cholesterol concentrations; mg/dl, milligrams per deciliter; TC, total cholesterol concentrations; TG, triglyceride concentrations.

Participants were free of dyslipidemia at baseline (according to each definition), thus sample sizes were as follows LDL-C (n=2,161), HDL-C (n=1,703), TG (n=2,116), and non-HDL-C (n=2,205).

*Models adjusted for age (continuous), sex (M/F), total energy (continuous), education (less than high school, graduated high school, some college, or graduated college), current smoking status (yes/no), physical activity index (continuous), body mass index (BMI), alcohol (grams), servings per day of vegetables, whole fruits, whole grains, nuts/seeds, and seafood, as well as percent energy from saturated fat (continuous) and mutual adjustment for SSB, LCSB, and 100% fruit juice (categorical as continuous).

Table S5. HRs (95% CIs) for incident dyslipidemia according to recent beverage consumption category (Framingham Generation 3 Cohort)*

	SSB Intake			LCSB Intake			100% Fruit Juice Intake		
	Incident Cases	Person-Years	HR (95% CI)	Incident Cases	Person-Years	HR (95% CI)	Incident Cases	Person-Years	HR (95% CI)
Incidence of high LDL-C (≥ 160 mg/dl)									
<1 serving/month	81	4261	Reference	118	6909	Reference	33	1627	Reference
1-4 servings/month	47	3613	0.76 (0.53-1.09)	31	2275	0.84 (0.57-1.26)	52	2667	0.82 (0.52-1.32)
1-2 servings/week	30	1764	1.15 (0.72-1.83)	12	705	1.14 (0.58-2.22)	27	2078	0.72 (0.42-1.24)
3-7 servings/week	56	3046	1.18 (0.80-1.73)	50	2597	1.17 (0.83-1.64)	77	5081	0.69 (0.44-1.08)
>1 serving/day	30	1872	1.04 (0.61-1.76)	33	2064	0.82 (0.53-1.28)	55	3102	0.87 (0.53-1.44)
			$p_{\text{trend}}=0.32$			$p_{\text{trend}}=0.92$			$p_{\text{trend}}=0.45$
Incidence of low HDL-C (Women:<50 mg/dl; Men <40 mg/dl)									
<1 serving/month	25	3851	Reference	44	6010	Reference	14	1495	Reference
1-4 servings/month	27	3316	1.15 (0.64-2.05)	13	1930	0.87 (0.44-1.70)	17	2322	0.67 (0.30-1.47)
1-2 servings/week	15	1555	1.15 (0.54-2.46)	5	617	1.27 (0.44-3.64)	24	1806	1.42 (0.69-2.93)
3-7 servings/week	28	2548	1.55 (0.81-2.95)	25	2324	1.33 (0.78-2.28)	35	4363	0.88 (0.43-1.79)
>1 serving/day	14	1461	1.07 (0.42-2.72)	23	1851	1.55 (0.89-2.72)	20	2753	0.85 (0.39-1.86)
			$p_{\text{trend}}=0.44$			$p_{\text{trend}}=0.09$			$p_{\text{trend}}=0.88$
Incidence of high TG (≥ 175 mg/dl)									
<1 serving/month	48	4394	Reference	73	7026	Reference	21	1739	Reference
1-4 servings/month	35	3690	0.89 (0.56-1.43)	32	2267	1.24 (0.81-1.90)	39	2767	1.01 (0.56-1.81)
1-2 servings/week	21	1806	0.92 (0.53-1.62)	10	765	1.41 (0.72-2.77)	27	2091	1.08 (0.59-1.97)
3-7 servings/week	40	3090	1.04 (0.63-1.72)	31	2579	1.18 (0.75-1.86)	52	5111	0.80 (0.46-1.42)
>1 serving/day	32	1843	1.49 (0.83-2.69)	30	2187	1.00 (0.62-1.61)	37	3121	1.00 (0.55-1.83)
			$p_{\text{trend}}=0.30$			$p_{\text{trend}}=0.77$			$p_{\text{trend}}=0.64$
Incidence of high Non-HDL-C (≥ 190 mg/dl)									
<1 serving/month	76	4269	Reference	117	6988	Reference	31	1659	Reference
1-4 servings/month	48	3648	0.86 (0.59-1.25)	31	2267	0.91 (0.61-1.35)	54	2675	0.92 (0.57-1.47)
1-2 servings/week	29	1784	1.28 (0.80-2.04)	12	697	1.51 (0.80-2.85)	27	2102	0.72 (0.42-1.23)
3-7 servings/week	54	3077	1.16 (0.78-1.72)	50	2633	1.25 (0.88-1.76)	85	5168	0.76 (0.49-1.18)
>1 serving/day	43	1909	1.49 (0.92-2.42)	40	2103	1.01 (0.66-1.54)	53	3091	0.80 (0.49-1.31)
			$p_{\text{trend}}=0.09$			$p_{\text{trend}}=0.46$			$p_{\text{trend}}=0.25$

HDL-C, high density lipoprotein cholesterol concentrations; LDL-C, low-density lipoprotein cholesterol concentrations; mg/dl, milligrams per deciliter; TC, total cholesterol concentrations; TG, triglyceride concentrations.

Participants were free of dyslipidemia at baseline (according to each definition), thus sample sizes were as follows LDL-C (n=2,377), HDL-C (n=2,084), TG (n=2,426), and non-HDL-C (n=2,400).

*Models adjusted for age (continuous), sex (M/F), total energy (continuous), education (less than high school, graduated high school, some college, or graduated college), current smoking status (yes/no), physical activity index (continuous), body mass index (BMI), alcohol (grams), servings per day of vegetables, whole fruits, whole grains, nuts/seeds, and seafood, as well as percent energy from saturated fat (continuous) and mutual adjustment for SSB, LCSB, and 100% fruit juice (categorical as continuous).
