

Supplementary Information

Bowel movement frequency and risks of major vascular and non-vascular diseases: a population-based cohort study among Chinese adults

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Supplementary Tables

Supplementary Table 1 | HRs (95% CIs) for associations between BMF and multiple vascular and non-vascular diseases with stepwise adjustment

Diseases	More than once a day	Once a day	Once every 2 to 3 days	Less than three times a week	P value for trend*
Vascular diseases					
IHD					
No. of participants	46 426	373 054	46 570	21 148	
No. of cases	4668	30 470	3448	1761	
Cases/PYs (1/1000)	10.43	8.45	7.60	8.59	
Model 1	1.16 (1.13-1.20)	1.00	0.96 (0.93-0.99)	1.03 (0.98-1.08)	<0.001
Model 2	1.16 (1.13-1.20)	1.00	0.96 (0.93-1.00)	1.03 (0.98-1.08)	<0.001
Model 3	1.17 (1.13-1.20)	1.00	0.95 (0.92-0.99)	1.01 (0.96-1.06)	<0.001
Model 4	1.12 (1.09-1.16)	1.00	1.00 (0.96-1.03)	1.07 (1.02-1.12)	0.008
MCEs					
No. of participants	46 426	373 054	46 570	21 148	
No. of cases	871	5960	765	376	
Cases/PYs (1/1000)	1.88	1.61	1.64	1.78	
Model 1	1.05 (0.98-1.13)	1.00	1.12 (1.04-1.21)	1.28 (1.16-1.43)	<0.001
Model 2	1.05 (0.98-1.13)	1.00	1.09 (1.01-1.18)	1.23 (1.10-1.36)	0.005
Model 3	1.05 (0.98-1.13)	1.00	1.08 (1.00-1.16)	1.19 (1.07-1.32)	0.023
Model 4	1.03 (0.96-1.11)	1.00	1.10 (1.02-1.19)	1.22 (1.10-1.36)	0.002
Haemorrhagic stroke					
No. of participants	46 426	373 054	46 570	21 148	
No. of cases	1028	6856	723	336	
Cases/PYs (1/1000)	2.22	1.85	1.56	1.60	
Model 1	1.02 (0.95-1.09)	1.00	0.95 (0.88-1.03)	1.03 (0.92-1.15)	0.576
Model 2	1.01 (0.94-1.08)	1.00	0.93 (0.86-1.01)	1.00 (0.89-1.11)	0.306
Model 3	0.99 (0.93-1.06)	1.00	0.93 (0.86-1.01)	0.98 (0.88-1.10)	0.340
Model 4	0.97 (0.90-1.03)	1.00	0.98 (0.91-1.06)	1.07 (0.95-1.19)	0.256
Ischaemic stroke					
No. of participants	46 426	373 054	46 570	21 148	
No. of cases	4044	28 594	3291	1650	
Cases/PYs (1/1000)	9.00	7.91	7.24	8.03	
Model 1	1.07 (1.04-1.11)	1.00	0.99 (0.96-1.03)	1.05 (1.00-1.10)	0.178
Model 2	1.07 (1.03-1.10)	1.00	0.99 (0.95-1.03)	1.04 (0.99-1.09)	0.135
Model 3	1.06 (1.03-1.10)	1.00	0.99 (0.95-1.02)	1.03 (0.98-1.08)	0.073
Model 4	1.01 (0.98-1.05)	1.00	1.04 (1.00-1.08)	1.10 (1.05-1.16)	0.002
Heart failure					
No. of participants	46 426	373 054	46 570	21 148	
No. of cases	535	3068	398	203	

Diseases	More than once a day	Once a day	Once every 2 to 3 days	Less than three times a week	P value for trend*
Cases/PYs (1/1000)	1.16	0.83	0.86	0.96	
Model 1	1.35 (1.23-1.48)	1.00	0.98 (0.88-1.09)	1.04 (0.90-1.21)	<0.001
Model 2	1.34 (1.23-1.48)	1.00	0.97 (0.87-1.08)	1.02 (0.88-1.17)	<0.001
Model 3	1.35 (1.23-1.48)	1.00	0.95 (0.85-1.05)	0.98 (0.85-1.13)	<0.001
Model 4	1.33 (1.22-1.46)	1.00	0.96 (0.86-1.06)	0.99 (0.86-1.15)	<0.001
Non-vascular diseases					
COPD					
No. of participants	42 122	347 771	43 350	19 414	
No. of cases	1518	8167	926	443	
Cases/PYs (1/1000)	3.63	2.37	2.14	2.29	
Model 1	1.26 (1.19-1.33)	1.00	0.93 (0.87-1.00)	1.00 (0.91-1.11)	<0.001
Model 2	1.25 (1.19-1.33)	1.00	0.92 (0.86-0.99)	0.97 (0.88-1.07)	<0.001
Model 3	1.26 (1.19-1.34)	1.00	0.91 (0.85-0.97)	0.94 (0.86-1.04)	<0.001
Model 4	1.28 (1.22-1.36)	1.00	0.89 (0.83-0.95)	0.92 (0.84-1.02)	<0.001
T2DM					
No. of participants	43 703	353 573	44 037	19 724	
No. of cases	2207	11 514	1077	483	
Cases/PYs (1/1000)	5.14	3.30	2.46	2.46	
Model 1	1.44 (1.38-1.51)	1.00	0.73 (0.69-0.78)	0.68 (0.62-0.75)	<0.001
Model 2	1.42 (1.36-1.49)	1.00	0.73 (0.69-0.78)	0.68 (0.62-0.75)	<0.001
Model 3	1.43 (1.36-1.50)	1.00	0.73 (0.69-0.78)	0.68 (0.62-0.74)	<0.001
Model 4	1.20 (1.15-1.26)	1.00	0.86 (0.81-0.92)	0.84 (0.77-0.92)	<0.001
CKD					
No. of participants	45 706	368 119	45 846	20 749	
No. of cases	821	4786	605	314	
Cases/PYs (1/1000)	1.81	1.31	1.33	1.52	
Model 1	1.20 (1.11-1.29)	1.00	1.05 (0.96-1.14)	1.20 (1.07-1.35)	0.754
Model 2	1.20 (1.11-1.29)	1.00	1.05 (0.96-1.14)	1.20 (1.07-1.35)	0.755
Model 3	1.20 (1.12-1.30)	1.00	1.03 (0.95-1.12)	1.16 (1.04-1.31)	0.360
Model 4	1.15 (1.07-1.24)	1.00	1.07 (0.98-1.17)	1.20 (1.07-1.35)	0.577

PYs: person-years; BMF: bowel movement frequency; IHD: ischaemic heart disease; MCEs: major coronary events; COPD: chronic obstructive pulmonary disease; T2DM: type 2 diabetes mellitus; CKD: chronic kidney disease.

Model 1 was adjusted for sex.

Model 2 was additionally adjusted for level of education, occupation, household income, marital status, smoking status, and total physical activity level, and family history (for corresponding disease only; no adjustment for heart failure, COPD, and CKD).

Model 3 was additionally adjusted for alcohol consumption, and intake frequency of fresh vegetables, fresh fruits, and red meat.

Model 4 was additionally adjusted for body mass index, waist circumference, prevalent hypertension and diabetes at baseline (no adjustment for T2DM).

*Assessed by assigning consecutive integers to four BMF categories in a separate model. A Bonferroni corrected threshold was used, $\alpha=0.00625$.

Supplementary Table 2 | HRs (95% CIs) for associations between BMF and multiple vascular and non-vascular diseases stratified by sex

Diseases	Subgroups	More than once a day		Once every 1 to 3 days*		Less than three times a week		P value for interaction†
		Cases	HR (95%CI)	Cases	HR (95%CI)	Cases	HR (95%CI)	
Vascular diseases								
IHD								
	Men	2335	1.09 (1.04-1.14)	13 822	1.00	385	1.11 (1.00-1.23)	0.099
	Women	2333	1.16 (1.11-1.21)	20 096	1.00	1376	1.05 (0.99-1.11)	
MCEs								
	Men	553	1.00 (0.91-1.09)	3762	1.00	137	1.26 (1.06-1.50)	0.756
	Women	318	1.05 (0.93-1.18)	2963	1.00	239	1.20 (1.05-1.37)	
Haemorrhagic stroke								
	Men	645	0.97 (0.89-1.05)	3950	1.00	117	1.19 (0.99-1.43)	0.322
	Women	383	0.96 (0.86-1.07)	3629	1.00	219	1.01 (0.88-1.16)	
Ischaemic stroke								
	Men	2234	1.01 (0.97-1.06)	14 229	1.00	460	1.25 (1.13-1.37)	0.006
	Women	1810	1.01 (0.96-1.06)	17 656	1.00	1190	1.04 (0.98-1.11)	
Heart failure								
	Men	268	1.26 (1.11-1.44)	1575	1.00	53	0.99 (0.75-1.30)	0.559
	Women	267	1.42 (1.25-1.62)	1891	1.00	150	0.98 (0.83-1.16)	
Non-vascular diseases								
COPD								
	Men	885	1.25 (1.16-1.35)	4390	1.00	120	1.00 (0.83-1.20)	0.212
	Women	633	1.37 (1.26-1.49)	4703	1.00	323	0.89 (0.80-1.00)	
T2DM								
	Men	1035	1.20 (1.12-1.29)	4721	1.00	74	0.89 (0.70-1.12)	0.997
	Women	1172	1.22 (1.15-1.30)	7870	1.00	409	0.84 (0.76-0.93)	
CKD								
	Men	423	1.13 (1.01-1.25)	2250	1.00	75	1.38 (1.09-1.74)	0.249
	Women	398	1.16 (1.05-1.29)	3141	1.00	239	1.13 (0.99-1.29)	

BMF: bowel movement frequency; IHD: ischaemic heart disease; MCEs: major coronary events; COPD: chronic obstructive pulmonary disease; T2DM: type 2 diabetes mellitus; CKD: chronic kidney disease.

Multivariable models adjusted for same set of covariates as Table 2, except for the stratified variable of interest.

* Combined group including “once a day” and “once every 2 to 3 days”.

† A Bonferroni corrected threshold was used, $\alpha=0.00625$.

Supplementary Table 3 | HRs (95% CIs) for associations between BMF and multiple vascular and non-vascular diseases stratified by baseline age

Diseases	Subgroups	More than once a day		Once every 1 to 3 days*		Less than three times a week		P value for interaction†
		Cases	HR (95%CI)	Cases	HR (95%CI)	Cases	HR (95%CI)	
Vascular diseases								
IHD								0.362
	<60 years	2531	1.14 (1.09-1.19)	18 064	1.00	810	1.04 (0.97-1.12)	
	≥60 years	2137	1.10 (1.06-1.16)	15 854	1.00	951	1.09 (1.02-1.17)	
MCEs								0.014
	<60 years	357	1.08 (0.96-1.21)	2377	1.00	81	1.08 (0.86-1.35)	
	≥60 years	514	0.97 (0.88-1.06)	4348	1.00	295	1.25 (1.11-1.41)	
Haemorrhagic stroke								0.094
	<60 years	521	0.96 (0.87-1.05)	3568	1.00	106	0.93 (0.77-1.14)	
	≥60 years	507	0.97 (0.88-1.06)	4011	1.00	230	1.15 (1.01-1.32)	
Ischaemic stroke								0.902
	<60 years	2212	1.02 (0.97-1.06)	16 347	1.00	717	1.08 (1.00-1.16)	
	≥60 years	1832	1.00 (0.95-1.05)	15 538	1.00	933	1.11 (1.04-1.19)	
Heart failure								0.761
	<60 years	204	1.38 (1.19-1.61)	1269	1.00	52	0.88 (0.66-1.16)	
	≥60 years	331	1.31 (1.16-1.47)	2197	1.00	151	1.04 (0.88-1.23)	
Non-vascular diseases								
COPD								0.309
	<60 years	706	1.27 (1.17-1.38)	4180	1.00	182	0.96 (0.82-1.11)	
	≥60 years	812	1.33 (1.24-1.44)	4913	1.00	261	0.91 (0.81-1.04)	
T2DM								0.331
	<60 years	1549	1.19 (1.13-1.26)	8826	1.00	308	0.83 (0.74-0.94)	
	≥60 years	658	1.25 (1.15-1.36)	3765	1.00	175	0.92 (0.79-1.07)	
CKD								0.567
	<60 years	537	1.20 (1.10-1.32)	3446	1.00	189	1.19 (1.02-1.38)	

Diseases	Subgroups	More than once a day		Once every 1 to 3 days*		Less than three times a week		P value for interaction†
		Cases	HR (95%CI)	Cases	HR (95%CI)	Cases	HR (95%CI)	
	≥60 years	284	1.06 (0.94-1.20)	1945	1.00	125	1.17 (0.98-1.41)	

BMF: bowel movement frequency; IHD: ischaemic heart disease; MCEs: major coronary events; COPD: chronic obstructive pulmonary disease; T2DM: type 2 diabetes mellitus; CKD: chronic kidney disease.

Multivariable models adjusted for same set of covariates as Table 2, except for the stratified variable of interest.

* Combined group including “once a day” and “once every 2 to 3 days”.

† A Bonferroni corrected threshold was used, $\alpha=0.00625$.

Supplementary Table 4 | HRs (95% CIs) for associations between BMF and multiple vascular and non-vascular diseases stratified by baseline hypertension

Diseases	Subgroups	More than once a day		Once every 1 to 3 days*		Less than three times a week		P value for interaction†
		Cases	HR (95%CI)	Cases	HR (95%CI)	Cases	HR (95%CI)	
Vascular diseases								
IHD								
	No	2019	1.17 (1.12-1.23)	16 300	1.00	995	1.07 (1.00-1.14)	0.192
	Yes	2649	1.09 (1.04-1.13)	17 618	1.00	766	1.06 (0.99-1.14)	
MCEs								
	No	328	1.12 (1.00-1.26)	2498	1.00	157	1.22 (1.04-1.44)	0.102
	Yes	543	0.96 (0.88-1.05)	4227	1.00	219	1.20 (1.05-1.38)	
Haemorrhagic stroke								
	No	266	1.00 (0.87-1.13)	2108	1.00	128	1.17 (0.98-1.41)	0.059
	Yes	762	0.95 (0.88-1.03)	5471	1.00	208	1.01 (0.88-1.17)	
Ischaemic stroke								
	No	1441	1.03 (0.97-1.09)	13 429	1.00	845	1.10 (1.02-1.18)	0.134
	Yes	2603	0.99 (0.95-1.03)	18 456	1.00	805	1.09 (1.02-1.17)	
Heart failure								
	No	230	1.47 (1.27-1.69)	1570	1.00	102	0.95 (0.78-1.16)	0.432
	Yes	305	1.25 (1.10-1.41)	1896	1.00	101	1.05 (0.85-1.28)	
Non-vascular diseases								
COPD								
	No	779	1.29 (1.20-1.40)	5191	1.00	278	0.92 (0.81-1.04)	0.654
	Yes	739	1.30 (1.20-1.41)	3902	1.00	165	0.96 (0.82-1.13)	
T2DM								
	No	925	1.26 (1.18-1.36)	6063	1.00	264	0.82 (0.72-0.93)	0.011
	Yes	1282	1.16 (1.10-1.24)	6528	1.00	219	0.96 (0.84-1.10)	
CKD								
	No	355	1.20 (1.08-1.35)	2605	1.00	170	1.12 (0.96-1.32)	0.255

Diseases	Subgroups	More than once a day		Once every 1 to 3 days*		Less than three times a week		P value for interaction†
		Cases	HR (95%CI)	Cases	HR (95%CI)	Cases	HR (95%CI)	
	Yes	466	1.10 (0.99-1.21)	2786	1.00	144	1.29 (1.09-1.53)	

BMF: bowel movement frequency; IHD: ischaemic heart disease; MCEs: major coronary events; COPD: chronic obstructive pulmonary disease; T2DM: type 2 diabetes mellitus; CKD: chronic kidney disease..

Multivariable models adjusted for same set of covariates as Table 2, except for the stratified variable of interest.

* Combined group including “once a day” and “once every 2 to 3 days”.

† A Bonferroni corrected threshold was used, $\alpha=0.00625$.

Supplementary Note

1. CKB collaborative group

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2. Food frequency questionnaire

Section 5: Diet

5.1 During the past 12 months, about how often did you eat the following foods?

	Daily	4 to 6 days per week	1 to 3 days per week	Monthly	Never /rarely
Rice					
Wheat					
Other staple food (corn, millet etc.)					
Meat					
Poultry					
Fish/sea food					
Fresh eggs					
Fresh vegetables					
Soybean products					
Preserved vegetables					
Fresh fruit					
Dairy products (milk, yogurt)					

5.2 During the past 12 months, have you taken the following supplements regularly?

Yes	No	
		Fish oil/cod liver oil
		Vitamins
		Calcium/iron/zinc
		Ginseng (at least 5 or more times during a year)
		Other herbal products

(5.3 to 5.6 are omitted)

5.7 During the past month, about how often did you eat hot spicy food?

- Never or almost never → Go to section 6
- Only occasionally → Go to section 6
- 1 to 2 days/week
- 3 to 5 days/week
- Daily or almost every day

The complete questionnaire is available below:

<https://www.ckbiobank.org/site/Study+Resources/Baseline+Data>

The categories of covariates in Cox models: intake frequency of rice, wheat, other staple food (daily, 4 to 6 days/week, 1 to 3 days/week, monthly or rarely or never); spicy food (6 to 7, 3 to 5, 1 to 2 days/week, occasionally, never); consumption of nutritional supplements (fish oil/cod liver oil, vitamins, calcium/iron/zinc, ginseng and other herbal products; yes or no);