

SUPPLEMENTARY MATERIALS

Association of Dietary Choline and Betaine Intake with Diabetes Risk: A Prospective Cohort Study from the China Health and Nutrition Survey

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Table S1. Representative examples of food matching between the China Food Composition Tables and the USDA Database for choline.

Food Matching	China Food Composition Tables (CFCT)					USDA Database for choline				Conversion factor ^b
	Food code	Food names	Edible portion (g)	Ingredient code	Ingredient food names	Edible portion (g)	Food code	Food names	Edible portion (g) ^a	
Exact match	111109	Egg, whole, raw, fresh	100	111109	Egg, whole, raw, fresh	100	01123	Egg, whole, raw, fresh	100	1.00
	071017	Almonds	100	071017	Almonds	100	12061	Nuts, almonds	100	1.00
	101102	Milk, full fat, American breed	100	101102	Milk, full fat, American breed	100	01077	Milk, whole, 3.25% milkfat	100	1.00
	061101	Apple, raw, with skin	100	061101	Apple, raw, with skin	100	09003	Apples, raw, with skin	100	1.00
	031302	Tofu, soybean curd, semisoft, Northern style	100	031302	Tofu, soybean curd, semisoft, Northern style	100	16126	Tofu, firm, prepared with calcium sulfate and magnesium chloride (nigari)	126	1.26
Use of closest analogs	031307	Tofu, soybean curd, soft, Southern style	100	031307	Tofu, soybean curd, soft, Southern style	100	16127	Tofu, soft, prepared with calcium sulfate and magnesium chloride (nigari)	93	0.93
	012401	Rice, white, steamed	100	012401	Rice, white, steamed	100	20045	Rice, white, long grain, regular, cooked	89	0.89
	081110	Pork, lean, raw	100	081110	Pork, lean, raw	100	10084	Pork, fresh, shoulder, (Boston butt), blade (steaks), separable lean only, raw	108	1.08
Disaggregation of mixed dishes				012401	Rice, Steamed	60	20045	Rice, white, long grain, regular, cooked	53.4	0.89
	011407	Shumai, steamed	100	011206	Wheat flour, moderately refined, standard grade	10	20081	Wheat flour, white, all purpose, enriched, bleached	9.7	0.97
				081109	Pork, shoulder, raw	25	10219	Pork, fresh, ground, raw	27.3	1.09
				192004	Oil, soybean	5	04044	Oil, soybean, salad or cooking	5	1.00

Abbreviations: CFCT, China Food Composition Tables; USDA, U.S. Department of Agriculture.

^a The edible portion (g) in the USDA database was calculated using the formula: edible portion in the CFCT \times conversion factor.

^b The conversion factor was calculated as: energy value in the CFCT \div energy value in the USDA database.

Table S2. Hazard ratio (95% CIs)^a for diabetes risk according to quintiles of cumulative average dietary intakes of total choline, choline-containing compounds, and betaine stratified by age, alcohol drinking status, and BMI in men.

	Cumulative average intake of choline and betaine					<i>P</i> -trend ^b	<i>P</i> -interaction
	Q1	Q2	Q3	Q4	Q5		
Total Choline							
Age							0.11
<50 year	1 (ref)	0.89 (0.64, 1.24)	0.80 (0.57, 1.13)	0.71 (0.50, 1.02)	0.84 (0.55, 1.28)	0.29	
≥50 year	1 (ref)	0.56 (0.35, 0.92)	0.59 (0.36, 0.97)	0.64 (0.37, 1.10)	1.40 (0.82, 2.42)	0.06	
Current drinker							0.90
Yes	1 (ref)	0.78 (0.56, 1.11)	0.61 (0.43, 0.88)	0.63 (0.43, 0.91)	0.88 (0.58, 1.33)	0.59	
No	1 (ref)	0.86 (0.56, 1.32)	0.77 (0.49, 1.21)	0.72 (0.45, 1.17)	1.22 (0.73, 2.05)	0.54	
BMI							0.48
<28 kg/m ²	1 (ref)	0.77 (0.58, 1.02)	0.67 (0.50, 0.90)	0.66 (0.49, 0.91)	0.84 (0.59, 1.20)	0.38	
≥28 kg/m ²	1 (ref)	0.32 (0.14, 0.75)	0.49 (0.21, 1.14)	0.94 (0.39, 2.25)	0.70 (0.25, 1.95)	0.97	
Water-soluble choline							
Age							0.45
<50 year	1 (ref)	1.18 (0.84, 1.66)	0.85 (0.59, 1.20)	0.66 (0.44, 0.97)	0.94 (0.64, 1.38)	0.22	
≥50 year	1 (ref)	1.00 (0.62, 1.60)	0.79 (0.48, 1.30)	0.93 (0.55, 1.56)	1.22 (0.70, 2.13)	0.44	
Current drinker							0.87
Yes	1 (ref)	1.00 (0.71, 1.40)	0.68 (0.47, 0.97)	0.64 (0.44, 0.94)	0.86 (0.58, 1.27)	0.26	
No	1 (ref)	1.28 (0.80, 2.04)	0.84 (0.52, 1.37)	1.06 (0.65, 1.74)	1.10 (0.65, 1.85)	0.94	
BMI							0.21
<28 kg/m ²	1 (ref)	1.23 (0.92, 1.65)	0.87 (0.64, 1.19)	0.79 (0.57, 1.10)	1.02 (0.73, 1.43)	0.43	
≥28 kg/m ²	1 (ref)	0.84 (0.38, 1.85)	0.45 (0.19, 1.06)	0.95 (0.40, 2.26)	0.43 (0.14, 1.32)	0.24	
Free Choline							
Age							0.97
<50 year	1 (ref)	0.87 (0.61, 1.23)	0.59 (0.40, 0.85)	0.51 (0.34, 0.75)	0.77 (0.53, 1.13)	0.27	
≥50 year	1 (ref)	1.19 (0.73, 1.95)	0.94 (0.56, 1.58)	0.72 (0.41, 1.26)	1.10 (0.63, 1.94)	0.79	
Current drinker							0.92
Yes	1 (ref)	0.91 (0.64, 1.31)	0.64 (0.44, 0.94)	0.50 (0.33, 0.75)	0.76 (0.51, 1.13)	0.12	
No	1 (ref)	1.00 (0.63, 1.60)	0.81 (0.49, 1.34)	0.58 (0.34, 0.98)	1.03 (0.61, 1.72)	0.97	
BMI							0.31
<28 kg/m ²	1 (ref)	0.94 (0.69, 1.28)	0.83 (0.61, 1.14)	0.53 (0.37, 0.76)	0.93 (0.67, 1.30)	0.51	
≥28 kg/m ²	1 (ref)	0.50 (0.21, 1.17)	0.37 (0.15, 0.89)	0.39 (0.14, 1.05)	0.45 (0.16, 1.25)	0.23	
Phosphocholine							
Age							0.29
<50 year	1 (ref)	0.79 (0.58, 1.09)	0.58 (0.41, 0.82)	0.75 (0.53, 1.05)	0.62 (0.42, 0.92)	0.04	
≥50 year	1 (ref)	0.47 (0.30, 0.74)	0.53 (0.34, 0.83)	0.65 (0.41, 1.03)	0.44 (0.24, 0.81)	0.05	

	Cumulative average intake of choline and betaine					<i>P</i> - trend ^b	<i>P</i> - interaction
	Q1	Q2	Q3	Q4	Q5		
Current drinker							0.83
Yes	1 (ref)	0.59 (0.42, 0.81)	0.56 (0.40, 0.79)	0.62 (0.44, 0.88)	0.53 (0.35, 0.80)	0.01	
No	1 (ref)	0.76 (0.50, 1.17)	0.63 (0.41, 0.98)	0.73 (0.47, 1.14)	0.66 (0.39, 1.11)	0.19	
BMI							0.90
<28 kg/m ²	1 (ref)	0.67 (0.51, 0.88)	0.60 (0.45, 0.80)	0.72 (0.54, 0.96)	0.59 (0.42, 0.83)	0.02	
≥28 kg/m ²	1 (ref)	0.64 (0.29, 1.43)	0.54 (0.24, 1.22)	0.84 (0.35, 1.98)	0.98 (0.38, 2.52)	0.80	
			Glycerophosphocholine				
Age							0.29
<50 year	1 (ref)	0.92 (0.64, 1.30)	0.89 (0.61, 1.30)	0.73 (0.49, 1.10)	0.73 (0.47, 1.12)	0.09	
≥50 year	1 (ref)	1.94 (1.14, 3.29)	2.10 (1.24, 3.57)	1.65 (0.93, 2.93)	2.19 (1.22, 3.92)	0.08	
Current drinker							0.29
Yes	1 (ref)	1.00 (0.69, 1.45)	1.13 (0.77, 1.64)	0.75 (0.50, 1.14)	0.87 (0.56, 1.35)	0.23	
No	1 (ref)	1.34 (0.84, 2.13)	1.13 (0.67, 1.90)	1.24 (0.74, 2.09)	1.32 (0.76, 2.29)	0.47	
BMI							0.83
<28 kg/m ²	1 (ref)	1.13 (0.83, 1.53)	1.10 (0.79, 1.53)	0.93 (0.66, 1.32)	1.03 (0.71, 1.49)	0.71	
≥28 kg/m ²	1 (ref)	1.50 (0.64, 3.52)	1.51 (0.63, 3.66)	1.08 (0.39, 2.99)	0.89 (0.3, 2.71)	0.55	
			Lipid-soluble choline				
Age							0.08
<50 year	1 (ref)	0.75 (0.54, 1.06)	0.73 (0.52, 1.02)	0.74 (0.52, 1.06)	0.82 (0.55, 1.23)	0.46	
≥50 year	1 (ref)	0.46 (0.28, 0.74)	0.50 (0.31, 0.82)	0.55 (0.32, 0.94)	0.89 (0.51, 1.55)	0.70	
Current drinker							0.95
Yes	1 (ref)	0.73 (0.51, 1.03)	0.64 (0.45, 0.91)	0.60 (0.41, 0.87)	0.87 (0.58, 1.32)	0.63	
No	1 (ref)	0.58 (0.37, 0.91)	0.58 (0.37, 0.92)	0.89 (0.57, 1.39)	0.85 (0.50, 1.43)	0.79	
BMI							0.52
<28 kg/m ²	1 (ref)	0.57 (0.43, 0.77)	0.58 (0.44, 0.78)	0.62 (0.45, 0.84)	0.76 (0.54, 1.07)	0.38	
≥28 kg/m ²	1 (ref)	0.61 (0.28, 1.31)	0.54 (0.23, 1.29)	0.69 (0.28, 1.69)	0.94 (0.36, 2.45)	0.84	
			Phosphatidylcholine				
Age							0.18
<50 year	1 (ref)	0.73 (0.52, 1.01)	0.68 (0.48, 0.95)	0.72 (0.51, 1.03)	0.78 (0.52, 1.16)	0.35	
≥50 year	1 (ref)	0.51 (0.31, 0.83)	0.51 (0.31, 0.83)	0.55 (0.32, 0.95)	0.89 (0.51, 1.57)	0.75	
Current drinker							0.87
Yes	1 (ref)	0.70 (0.49, 1.00)	0.64 (0.45, 0.92)	0.59 (0.40, 0.86)	0.87 (0.57, 1.31)	0.67	
No	1 (ref)	0.51 (0.32, 0.81)	0.63 (0.41, 0.98)	0.76 (0.48, 1.20)	0.82 (0.49, 1.39)	0.97	
BMI							0.84
<28 kg/m ²	1 (ref)	0.58 (0.43, 0.77)	0.60 (0.45, 0.81)	0.60 (0.44, 0.81)	0.76 (0.54, 1.07)	0.37	
≥28 kg/m ²	1 (ref)	0.62 (0.29, 1.33)	0.47 (0.19, 1.16)	0.66 (0.27, 1.63)	0.92 (0.35, 2.41)	0.80	
			Sphingomyelin				

	Cumulative average intake of choline and betaine					<i>P</i> -trend ^b	<i>P</i> -interaction
	Q1	Q2	Q3	Q4	Q5		
Age							0.60
<50 year	1 (ref)	0.93 (0.66, 1.31)	1.01 (0.71, 1.44)	0.80 (0.54, 1.18)	1.18 (0.78, 1.77)	0.60	
≥50 year	1 (ref)	0.73 (0.45, 1.19)	0.66 (0.39, 1.12)	0.77 (0.46, 1.28)	1.40 (0.81, 2.43)	0.19	
Current drinker							0.46
Yes	1 (ref)	0.81 (0.57, 1.16)	0.68 (0.47, 0.99)	0.70 (0.47, 1.03)	0.97 (0.64, 1.49)	0.82	
No	1 (ref)	0.72 (0.46, 1.12)	1.00 (0.64, 1.57)	0.66 (0.40, 1.12)	1.42 (0.85, 2.35)	0.22	
BMI							0.65
<28 kg/m ²	1 (ref)	0.76 (0.57, 1.02)	0.79 (0.58, 1.08)	0.69 (0.50, 0.96)	1.08 (0.76, 1.53)	0.69	
≥28 kg/m ²	1 (ref)	1.26 (0.58, 2.74)	0.78 (0.33, 1.87)	1.59 (0.66, 3.82)	1.30 (0.45, 3.77)	0.56	
Betaine							
Age							0.48
<50 year	1 (ref)	0.83 (0.58, 1.18)	0.77 (0.52, 1.12)	0.77 (0.51, 1.16)	1.19 (0.81, 1.74)	0.07	
≥50 year	1 (ref)	0.63 (0.37, 1.09)	1.05 (0.63, 1.75)	0.85 (0.49, 1.48)	0.97 (0.56, 1.68)	0.74	
Current drinker							0.36
Yes	1 (ref)	0.82 (0.55, 1.21)	0.96 (0.65, 1.43)	0.91 (0.60, 1.38)	1.22 (0.81, 1.82)	0.11	
No	1 (ref)	0.75 (0.48, 1.17)	0.61 (0.38, 1.00)	0.61 (0.36, 1.03)	0.94 (0.57, 1.54)	0.61	
BMI							0.72
<28 kg/m ²	1 (ref)	0.79 (0.58, 1.07)	0.76 (0.55, 1.05)	0.72 (0.51, 1.03)	1.06 (0.76, 1.47)	0.18	
≥28 kg/m ²	1 (ref)	1.15 (0.48, 2.75)	1.41 (0.57, 3.50)	0.98 (0.37, 2.57)	1.00 (0.37, 2.71)	0.77	

^a Covariates adjusted: age, BMI and daily energy intake, residence area (urban or rural), regions, education level (junior school or below, senior school, college or higher), per capita household income level (low, medium, high, very high), PAL, smoking status (former or current, never), current alcohol drinking status (yes, no), history of hypertension at baseline (yes, no) and CHEI score. Total choline, choline-containing compounds models were further adjusted for dietary betaine intake, betaine model models were further adjusted for dietary total choline intake.

^b Linear trends across quintiles of dietary intakes of total choline, choline-containing compounds, and betaine were assessed by using the median values of corresponding quintiles.

Table S3. Hazard ratio (95% CIs)^a for diabetes risk according to quintiles of cumulative average dietary intakes of total choline, choline-containing compounds, and betaine stratified by age, drinker status and BMI in women.

	Cumulative average intake of choline and betaine					<i>P</i> -	<i>P</i> -
	Q1	Q2	Q3	Q4	Q5	trend ^b	interaction
Total Choline							
Age							0.48
<50 year	1 (ref)	0.70 (0.49, 0.99)	0.85 (0.60, 1.21)	0.82 (0.56, 1.20)	0.89 (0.55, 1.45)	0.74	
≥50 year	1 (ref)	0.98 (0.64, 1.50)	0.78 (0.50, 1.21)	1.02 (0.65, 1.60)	1.07 (0.62, 1.84)	0.68	
Drinker status							0.47
Yes	1 (ref)	1.36 (0.65, 2.86)	0.71 (0.31, 1.64)	0.95 (0.39, 2.32)	0.87 (0.29, 2.63)	0.63	
No	1 (ref)	0.74 (0.55, 0.99)	0.71 (0.53, 0.95)	0.90 (0.67, 1.22)	0.95 (0.66, 1.36)	0.79	
BMI							0.33
<28 kg/m ²	1 (ref)	0.82 (0.61, 1.10)	0.79 (0.59, 1.07)	0.80 (0.58, 1.11)	0.95 (0.65, 1.39)	0.83	
≥28 kg/m ²	1 (ref)	0.71 (0.38, 1.34)	1.00 (0.53, 1.92)	0.85 (0.43, 1.68)	0.94 (0.43, 2.04)	0.95	
Water-soluble choline							
Age							0.73
<50 year	1 (ref)	0.90 (0.62, 1.32)	0.90 (0.61, 1.33)	0.86 (0.57, 1.29)	1.21 (0.79, 1.84)	0.30	
≥50 year	1 (ref)	0.73 (0.49, 1.10)	0.73 (0.49, 1.08)	0.72 (0.47, 1.09)	1.01 (0.62, 1.64)	0.78	
Drinker status							0.76
Yes	1 (ref)	0.94 (0.44, 2.00)	0.90 (0.41, 1.96)	0.43 (0.16, 1.14)	1.20 (0.49, 2.96)	0.91	
No	1 (ref)	0.84 (0.62, 1.12)	0.86 (0.64, 1.15)	0.78 (0.57, 1.06)	1.08 (0.77, 1.50)	0.50	
BMI							0.01
<28 kg/m ²	1 (ref)	0.78 (0.57, 1.05)	0.91 (0.68, 1.23)	0.75 (0.54, 1.03)	0.99 (0.70, 1.40)	0.81	
≥28 kg/m ²	1 (ref)	0.98 (0.51, 1.90)	0.45 (0.22, 0.90)	0.64 (0.31, 1.31)	0.97 (0.43, 2.18)	0.87	
Free Choline							
Age							0.88
<50 year	1 (ref)	0.69 (0.47, 1.03)	0.68 (0.45, 1.02)	0.63 (0.41, 0.95)	1.00 (0.66, 1.50)	0.46	
≥50 year	1 (ref)	0.74 (0.47, 1.15)	0.93 (0.62, 1.42)	0.53 (0.33, 0.86)	1.00 (0.63, 1.61)	0.95	
Drinker status							0.99
Yes	1 (ref)	0.53 (0.24, 1.16)	0.83 (0.39, 1.79)	0.28 (0.10, 0.84)	0.77 (0.31, 1.87)	0.65	
No	1 (ref)	0.77 (0.56, 1.06)	0.75 (0.55, 1.02)	0.64 (0.46, 0.89)	0.92 (0.66, 1.28)	0.96	
BMI							0.30
<28 kg/m ²	1 (ref)	0.68 (0.49, 0.94)	0.73 (0.53, 1.00)	0.60 (0.43, 0.84)	0.84 (0.60, 1.17)	0.70	
≥28 kg/m ²	1 (ref)	0.85 (0.42, 1.73)	0.72 (0.35, 1.47)	0.64 (0.29, 1.40)	1.14 (0.52, 2.50)	0.64	
Phosphocholine							
Age							0.38
<50 year	1 (ref)	0.63 (0.45, 0.89)	0.64 (0.44, 0.92)	0.60 (0.41, 0.87)	0.64 (0.42, 0.99)	0.08	
≥50 year	1 (ref)	0.79 (0.54, 1.16)	0.73 (0.50, 1.09)	0.64 (0.42, 0.99)	0.69 (0.41, 1.17)	0.12	
Drinker status							0.70

	Cumulative average intake of choline and betaine					<i>P</i> -trend ^b	<i>P</i> -interaction
	Q1	Q2	Q3	Q4	Q5		
Yes	1 (ref)	1.03 (0.51, 2.09)	0.47 (0.20, 1.10)	0.49 (0.19, 1.27)	0.97 (0.38, 2.50)	0.70	
No	1 (ref)	0.75 (0.57, 0.98)	0.70 (0.53, 0.93)	0.64 (0.48, 0.86)	0.62 (0.43, 0.88)	0.01	
BMI							0.01
<28 kg/m ²	1 (ref)	0.70 (0.53, 0.93)	0.68 (0.51, 0.91)	0.70 (0.52, 0.95)	0.58 (0.40, 0.84)	0.01	
≥28 kg/m ²	1 (ref)	0.93 (0.51, 1.70)	0.67 (0.36, 1.26)	0.41 (0.20, 0.88)	0.66 (0.28, 1.54)	0.11	
Glycerophosphocholine							
Age							0.67
<50 year	1 (ref)	0.78 (0.53, 1.16)	0.67 (0.43, 1.03)	0.91 (0.59, 1.40)	0.88 (0.54, 1.45)	0.91	
≥50 year	1 (ref)	0.76 (0.50, 1.15)	0.77 (0.50, 1.20)	0.74 (0.47, 1.17)	1.02 (0.62, 1.67)	0.68	
Drinker status							0.83
Yes	1 (ref)	0.69 (0.32, 1.51)	0.86 (0.39, 1.88)	0.77 (0.33, 1.81)	0.85 (0.33, 2.23)	0.87	
No	1 (ref)	0.92 (0.68, 1.25)	0.76 (0.53, 1.07)	0.94 (0.67, 1.32)	1.14 (0.80, 1.64)	0.25	
BMI							0.51
<28 kg/m ²	1 (ref)	0.70 (0.51, 0.95)	0.60 (0.42, 0.86)	0.76 (0.54, 1.08)	1.05 (0.73, 1.53)	0.20	
≥28 kg/m ²	1 (ref)	1.33 (0.67, 2.64)	1.09 (0.51, 2.34)	1.04 (0.47, 2.30)	1.16 (0.50, 2.72)	0.97	
Lipid-soluble choline							
Age							0.36
<50 year	1 (ref)	0.92 (0.65, 1.30)	0.91 (0.64, 1.31)	0.89 (0.59, 1.32)	0.83 (0.51, 1.36)	0.46	
≥50 year	1 (ref)	1.04 (0.67, 1.61)	0.97 (0.63, 1.50)	1.00 (0.63, 1.58)	1.19 (0.71, 2.00)	0.53	
Drinker status							0.34
Yes	1 (ref)	1.62 (0.77, 3.39)	0.79 (0.34, 1.84)	0.90 (0.35, 2.35)	1.02 (0.32, 3.30)	0.74	
No	1 (ref)	0.83 (0.62, 1.10)	0.85 (0.64, 1.14)	0.84 (0.62, 1.15)	0.90 (0.63, 1.28)	0.65	
BMI							0.59
<28 kg/m ²	1 (ref)	0.86 (0.64, 1.16)	0.86 (0.64, 1.16)	0.87 (0.63, 1.20)	0.76 (0.52, 1.12)	0.23	
≥28 kg/m ²	1 (ref)	0.86 (0.47, 1.59)	0.85 (0.45, 1.63)	0.74 (0.36, 1.50)	1.15 (0.54, 2.45)	0.86	
Phosphatidylcholine							
Age							0.32
<50 year	1 (ref)	0.84 (0.59, 1.18)	0.80 (0.55, 1.14)	0.87 (0.58, 1.28)	0.78 (0.48, 1.28)	0.38	
≥50 year	1 (ref)	0.84 (0.55, 1.30)	0.93 (0.61, 1.41)	0.94 (0.60, 1.48)	1.07 (0.64, 1.79)	0.59	
Drinker status							0.24
Yes	1 (ref)	1.66 (0.80, 3.45)	0.70 (0.29, 1.68)	0.92 (0.35, 2.40)	0.92 (0.29, 2.99)	0.61	
No	1 (ref)	0.85 (0.64, 1.13)	0.85 (0.63, 1.14)	0.88 (0.65, 1.20)	0.95 (0.66, 1.36)	0.93	
BMI							0.23
<28 kg/m ²	1 (ref)	0.91 (0.68, 1.22)	0.82 (0.60, 1.12)	0.92 (0.67, 1.27)	0.82 (0.56, 1.21)	0.40	
≥28 kg/m ²	1 (ref)	0.89 (0.48, 1.65)	0.85 (0.45, 1.60)	0.64 (0.31, 1.31)	1.20 (0.56, 2.56)	0.91	
Sphingomyelin							
Age							0.23
<50 year	1 (ref)	0.91 (0.66, 1.27)	0.54 (0.36, 0.81)	0.82 (0.56, 1.21)	1.01 (0.64, 1.60)	0.75	

	Cumulative average intake of choline and betaine					<i>P</i> -trend ^b	<i>P</i> -interaction
	Q1	Q2	Q3	Q4	Q5		
≥50 year	1 (ref)	0.85 (0.56, 1.29)	0.80 (0.51, 1.25)	0.85 (0.53, 1.35)	1.29 (0.79, 2.11)	0.23	
Drinker status							0.59
Yes	1 (ref)	0.51 (0.22, 1.19)	0.99 (0.46, 2.16)	0.71 (0.30, 1.67)	1.00 (0.35, 2.84)	0.83	
No	1 (ref)	1.01 (0.77, 1.33)	0.70 (0.51, 0.97)	0.80 (0.58, 1.11)	1.33 (0.93, 1.88)	0.33	
BMI							0.13
<28 kg/m ²	1 (ref)	1.03 (0.77, 1.36)	0.64 (0.46, 0.90)	0.76 (0.55, 1.07)	1.27 (0.88, 1.82)	0.60	
≥28 kg/m ²	1 (ref)	0.64 (0.34, 1.23)	0.70 (0.34, 1.43)	1.34 (0.69, 2.63)	0.93 (0.41, 2.12)	0.41	
			Betaine				
Age							0.21
<50 year	1 (ref)	0.94 (0.65, 1.35)	0.84 (0.56, 1.27)	0.70 (0.45, 1.09)	1.00 (0.68, 1.49)	0.78	
≥50 year	1 (ref)	0.97 (0.61, 1.53)	1.07 (0.66, 1.71)	1.36 (0.82, 2.23)	1.50 (0.93, 2.43)	0.04	
Drinker status							0.71
Yes	1 (ref)	0.90 (0.41, 2.01)	0.88 (0.37, 2.09)	0.97 (0.40, 2.35)	1.20 (0.53, 2.75)	0.52	
No	1 (ref)	0.90 (0.66, 1.23)	0.93 (0.67, 1.29)	0.89 (0.62, 1.26)	1.10 (0.79, 1.53)	0.29	
BMI							0.62
<28 kg/m ²	1 (ref)	0.94 (0.69, 1.28)	0.87 (0.62, 1.22)	0.88 (0.62, 1.26)	1.05 (0.75, 1.46)	0.52	
≥28 kg/m ²	1 (ref)	0.87 (0.43, 1.77)	1.44 (0.70, 2.95)	1.48 (0.72, 3.05)	1.70 (0.84, 3.42)	0.06	

^a Covariates adjusted: age, BMI and daily energy intake, residence area (urban or rural), regions, education level (junior school or below, senior school, college or higher), per capita household income level (low, medium, high, very high), PAL, smoking status (former or current, never), current alcohol drinking status (yes, no), history of hypertension at baseline (yes, no) and CHEI score. Total choline, choline-containing compounds models were further adjusted for dietary betaine intake, betaine model models were further adjusted for dietary total choline intake.

^b Linear trends across quintiles of dietary intakes of total choline, choline-containing compounds, and betaine were assessed by using the median values of corresponding quintiles.

Table S4. Hazard ratio (95% CIs)^a for diabetes risk according to quintiles of cumulative average dietary intakes of total choline, choline-containing compounds, and betaine after excluding those that occurred diabetes within 2 years among men and women.

	Cumulative average intake of total choline, choline-containing compounds, and betaine					<i>P</i> -trend ^b
	Q1	Q2	Q3	Q4	Q5	
Men						
Total Choline	1 (ref)	0.80 (0.61, 1.06)	0.69 (0.52, 0.92)	0.70 (0.52, 0.95)	0.95 (0.67, 1.33)	0.79
Water-soluble choline	1 (ref)	1.12 (0.85, 1.48)	0.82 (0.61, 1.09)	0.73 (0.54, 1.00)	0.96 (0.70, 1.33)	0.33
Free Choline	1 (ref)	0.87 (0.65, 1.17)	0.72 (0.53, 0.97)	0.49 (0.35, 0.69)	0.81 (0.59, 1.12)	0.18
Phosphocholine	1 (ref)	0.67 (0.52, 0.88)	0.60 (0.46, 0.79)	0.69 (0.53, 0.92)	0.58 (0.42, 0.81)	0.01
Glycerophosphocholine	1 (ref)	1.14 (0.85, 1.52)	1.16 (0.85, 1.58)	0.96 (0.69, 1.34)	0.99 (0.69, 1.41)	0.52
Lipid-soluble choline	1 (ref)	0.65 (0.49, 0.86)	0.66 (0.50, 0.87)	0.66 (0.49, 0.88)	0.85 (0.61, 1.19)	0.64
Phosphatidylcholine	1 (ref)	0.58 (0.43, 0.76)	0.61 (0.46, 0.81)	0.61 (0.46, 0.82)	0.78 (0.56, 1.08)	0.42
Sphingomyelin	1 (ref)	0.89 (0.67, 1.17)	0.89 (0.67, 1.20)	0.77 (0.57, 1.06)	1.32 (0.95, 1.83)	0.18
Betaine	1 (ref)	0.80 (0.59, 1.08)	0.83 (0.61, 1.14)	0.80 (0.58, 1.11)	1.14 (0.83, 1.56)	0.07
Women						
Total Choline	1 (ref)	0.79 (0.60, 1.04)	0.76 (0.57, 1.00)	0.88 (0.66, 1.18)	0.92 (0.65, 1.31)	0.90
Water-soluble choline	1 (ref)	0.82 (0.62, 1.08)	0.82 (0.62, 1.08)	0.78 (0.58, 1.04)	0.95 (0.68, 1.31)	0.90
Free Choline	1 (ref)	0.74 (0.55, 1.00)	0.77 (0.57, 1.04)	0.63 (0.46, 0.86)	0.86 (0.63, 1.19)	0.59
Phosphocholine	1 (ref)	0.74 (0.57, 0.96)	0.71 (0.55, 0.93)	0.65 (0.49, 0.87)	0.58 (0.41, 0.83)	<0.01
Glycerophosphocholine	1 (ref)	0.78 (0.60, 1.01)	0.98 (0.74, 1.29)	1.08 (0.78, 1.49)	1.15 (0.77, 1.72)	0.30
Lipid-soluble choline	1 (ref)	0.88 (0.67, 1.16)	0.91 (0.69, 1.20)	0.87 (0.65, 1.18)	0.84 (0.58, 1.20)	0.38
Phosphatidylcholine	1 (ref)	0.92 (0.70, 1.21)	0.89 (0.67, 1.18)	0.88 (0.65, 1.18)	0.88 (0.61, 1.26)	0.47
Sphingomyelin	1 (ref)	0.90 (0.70, 1.17)	0.66 (0.49, 0.90)	0.84 (0.62, 1.14)	1.22 (0.87, 1.72)	0.39
Betaine	1 (ref)	0.92 (0.69, 1.24)	0.92 (0.68, 1.26)	0.96 (0.69, 1.34)	1.09 (0.79, 1.49)	0.35

^a Models were adjusted for age, BMI and daily energy intake, residence area (urban or rural), regions, education level (junior school or below, senior school, college or higher), per capita household income level (low, medium, high, very high), PAL, smoking status (former or current, never), current alcohol drinking status (yes, no), history of hypertension at baseline (yes, no) and CHEI score. Choline and betaine were further adjusted for mutually.

^b Linear trends across quintiles of dietary intakes of total choline, choline-containing compounds, and betaine were assessed by using the median values of corresponding quintiles.

Table S5. Hazard ratio (95% CIs)^a for diabetes risk according to quintiles of cumulative average dietary intake of total choline, choline-containing compounds, and betaine after excluding those that occurred diabetes before 2009 among men and women.

	Cumulative average intake of total choline, choline-containing compounds, and betaine					<i>P</i> -trend ^b
	Q1	Q2	Q3	Q4	Q5	
Men						
Total Choline	1 (ref)	0.74 (0.54, 1.03)	0.70 (0.50, 0.98)	0.73 (0.52, 1.05)	0.92 (0.61, 1.40)	0.78
Water-soluble choline	1 (ref)	1.07 (0.76, 1.50)	0.81 (0.57, 1.15)	0.70 (0.48, 1.02)	0.95 (0.64, 1.40)	0.42
Free Choline	1 (ref)	0.95 (0.67, 1.35)	0.70 (0.48, 1.01)	0.55 (0.37, 0.82)	0.79 (0.53, 1.17)	0.17
Phosphocholine	1 (ref)	0.75 (0.55, 1.03)	0.68 (0.49, 0.95)	0.65 (0.46, 0.92)	0.66 (0.45, 0.98)	0.05
Glycerophosphocholine	1 (ref)	1.08 (0.76, 1.54)	0.92 (0.63, 1.36)	0.91 (0.61, 1.36)	0.93 (0.60, 1.44)	0.54
Lipid-soluble choline	1 (ref)	0.64 (0.46, 0.89)	0.68 (0.49, 0.94)	0.73 (0.52, 1.04)	0.88 (0.59, 1.33)	0.86
Phosphatidylcholine	1 (ref)	0.57 (0.41, 0.80)	0.63 (0.45, 0.88)	0.70 (0.49, 0.98)	0.79 (0.52, 1.18)	0.58
Sphingomyelin	1 (ref)	0.92 (0.66, 1.28)	0.90 (0.63, 1.27)	0.74 (0.51, 1.09)	1.40 (0.94, 2.08)	0.27
Betaine	1 (ref)	0.77 (0.54, 1.10)	0.84 (0.58, 1.21)	0.79 (0.53, 1.18)	0.99 (0.67, 1.44)	0.53
Women						
Total Choline	1 (ref)	0.78 (0.56, 1.08)	0.82 (0.59, 1.14)	0.93 (0.65, 1.31)	0.78 (0.50, 1.21)	0.52
Water-soluble choline	1 (ref)	0.73 (0.52, 1.03)	0.77 (0.55, 1.07)	0.64 (0.45, 0.92)	0.93 (0.64, 1.37)	0.89
Free Choline	1 (ref)	0.80 (0.55, 1.15)	0.79 (0.55, 1.13)	0.60 (0.40, 0.88)	0.90 (0.61, 1.32)	0.68
Phosphocholine	1 (ref)	0.82 (0.59, 1.13)	0.88 (0.63, 1.22)	0.76 (0.53, 1.07)	0.59 (0.38, 0.92)	0.02
Glycerophosphocholine	1 (ref)	0.64 (0.45, 0.90)	0.52 (0.35, 0.76)	0.70 (0.48, 1.02)	0.73 (0.48, 1.12)	0.60
Lipid-soluble choline	1 (ref)	0.86 (0.62, 1.21)	0.94 (0.67, 1.32)	0.98 (0.69, 1.40)	0.79 (0.50, 1.24)	0.51
Phosphatidylcholine	1 (ref)	0.87 (0.62, 1.22)	0.97 (0.69, 1.36)	0.97 (0.68, 1.39)	0.86 (0.55, 1.33)	0.68
Sphingomyelin	1 (ref)	0.94 (0.69, 1.28)	0.68 (0.47, 0.97)	0.88 (0.62, 1.27)	1.19 (0.78, 1.82)	0.59
Betaine	1 (ref)	0.99 (0.70, 1.40)	0.89 (0.61, 1.30)	1.00 (0.67, 1.48)	0.97 (0.66, 1.42)	0.94

^a Covariates adjusted: age, BMI and daily energy intake, residence area (urban or rural), regions, education level (junior school or below, senior school, college or higher), per capita household income level (low, medium, high, very high), PAL, smoking status (former or current, never), current alcohol drinking status (yes, no), history of hypertension at baseline (yes, no) and CHEI score. Choline and betaine were further adjusted for mutually.

^b Linear trends across quintiles of dietary intakes of total choline, choline-containing compounds, and betaine were assessed by using the median values of corresponding quintiles.

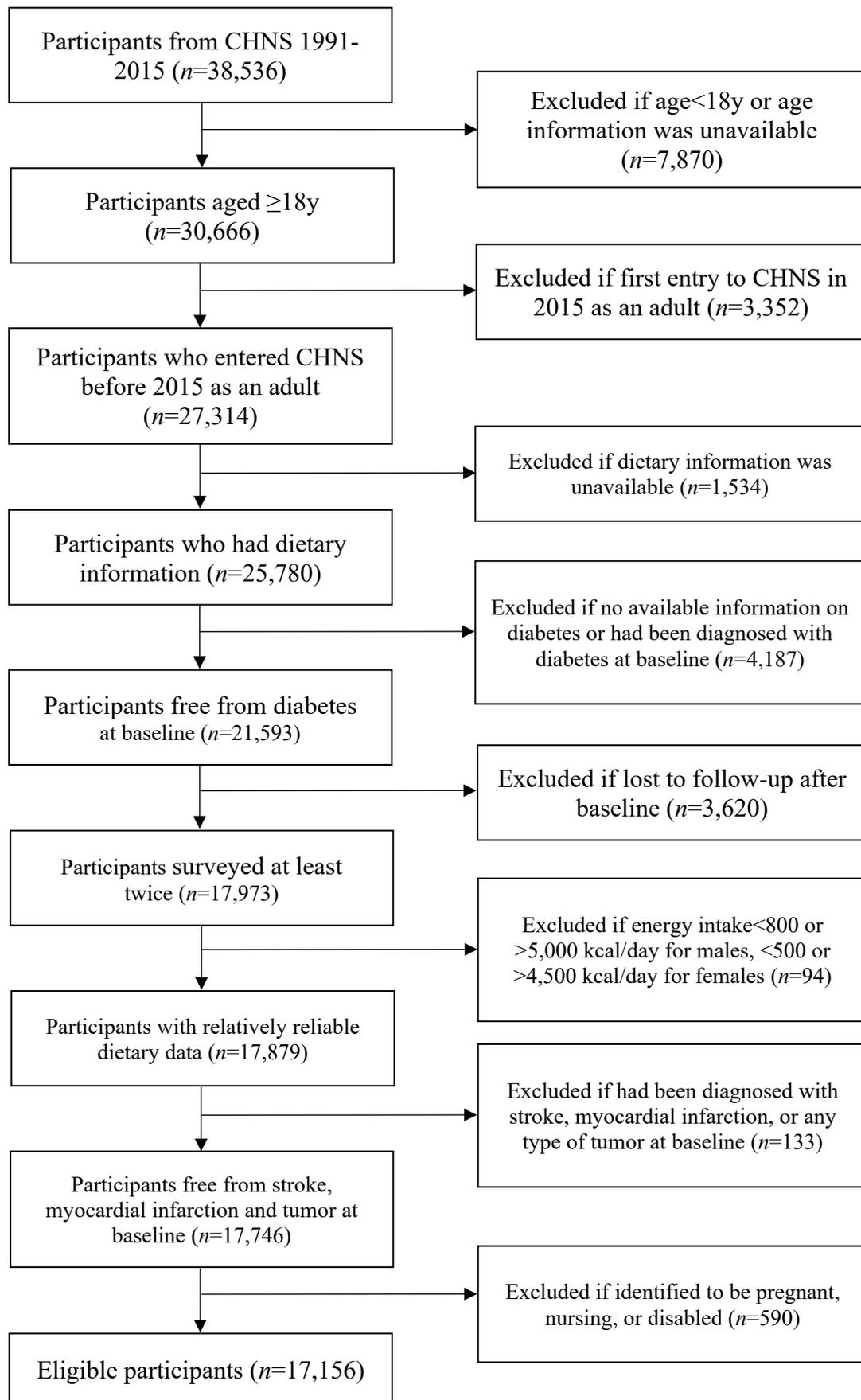


Figure S1. Flowchart of study participant selection.