

Leung YY *et al.* Food sources of dietary fibre and risk of total knee replacement related to severe osteoarthritis, the Singapore Chinese Health Study

Online Supplementary Material

for

Food sources of dietary fibre and risk of total knee replacement related to severe osteoarthritis,
the Singapore Chinese Health Study

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Supplementary Table 1. Baseline characteristics of cohort participants stratified by sources of fibre intake (grain, legumes, nuts and seeds): The Singapore Chinese Health Study (1993-2017)

Characteristics	Grain products		Legumes		Nuts and seeds	
	Q1	Q4	Q1	Q4	Q1	Q4
Number of participants	15,784	15,770	15,783	15,794	15,758	15,766
Women, n (%)	9,502 (60.2)	7,993 (50.7)	6,282 (39.8)	9,300 (58.9)	6,528 (41.4)	8,786 (55.7)
Age, years ¹	54.6 ± 7.6	58.5 ± 8.1	56.4 ± 7.8	55.3 ± 7.9	56.1 ± 7.7	55.7 ± 8.0
Body mass index, kg/m ² ¹	23.2 ± 3.4	23.0 ± 3.3	23.2 ± 3.3	23.0 ± 3.2	23.1 ± 3.3	23.1 ± 3.3
Dialect group, n (%)						
Hokkien	8,347 (52.9)	8,493 (53.9)	7,874 (49.9)	8,471 (53.6)	8,055 (51.1)	8,114 (51.5)
Cantonese	7,437 (47.1)	7,277 (46.1)	7,909 (50.1)	7,323 (46.4)	7,703 (48.9)	7,652 (48.5)
Secondary school or higher, n (%)	6,163 (39.1)	3,069 (19.5)	4,857 (30.8)	5,132 (32.5)	4,602 (29.2)	5,471 (34.7)
Ever smoker, n (%)	4,300 (27.2)	5,511 (35.0)	6,382 (40.4)	4,138 (26.2)	5,862 (37.2)	4,773 (30.3)
Hypertension, n (%)	3,484 (22.1)	3,975 (25.2)	3,886 (24.6)	3,380 (21.4)	3,524 (22.4)	3,673 (23.3)
Diabetes, n (%)	1,264 (8.0)	1,602 (10.2)	1,834 (11.6)	768 (4.9)	1,269 (8.1)	1,409 (8.9)
Coronary heart disease, n (%)	551 (3.5)	763 (4.8)	680 (4.3)	521 (3.3)	622 (4.0)	609 (3.9)
Stroke, n (%)	196 (1.2)	324 (2.1)	263 (1.7)	185 (1.2)	241 (1.5)	218 (1.4)
Physical activity, hour/week ¹	1.6 ± 4.0	1.6 ± 4.3	1.9 ± 4.7	1.6 ± 4.2	2.0 ± 5.0	1.6 ± 4.0
Sitting, hours/day ¹	6.9 ± 3.7	6.1 ± 3.5	6.9 ± 3.8	6.7 ± 3.6	6.7 ± 3.7	7.0 ± 3.6
Sleep, hours/day ¹	7.0 ± 1.2	7.0 ± 1.1	7.0 ± 1.2	7.0 ± 1.1	7.1 ± 1.1	7.0 ± 1.1
Total energy intake, kcal/day ¹	1,680.7 ± 627.9	1,478.5 ± 518.9	1,894.6 ± 510.1	1,633.2 ± 589.9	1,938.9 ± 501.0	1,598.0 ± 633.6
Total fibre, g/day ¹	15.7 ± 6.6	12.3 ± 5.5	14.5 ± 5.8	14.2 ± 6.3	15.1 ± 5.9	13.5 ± 6.4
Grain products, g/day ¹	407.0 ± 161.1	776.2 ± 227.5	678.5 ± 236.7	518.0 ± 208.5	702.3 ± 237.3	495.2 ± 211.0
Legumes, g/day ¹	4.6 ± 6.3	2.5 ± 3.8	0.6 ± 1.0	8.6 ± 6.5	3.3 ± 5.1	4.2 ± 5.6
Soy food, g/day ¹	159.5 ± 121.2	89.8 ± 76.1	123.4 ± 103.1	135.7 ± 103.2	133.7 ± 109.1	122.4 ± 99.3
Nuts and seeds, g/day ¹	4.1 ± 5.7	1.9 ± 3.0	2.9 ± 4.6	3.4 ± 4.5	0.8 ± 1.0	6.8 ± 6.1
Fruits, g/day ¹	296.5 ± 215.8	155.3 ± 131.9	231.0 ± 191.5	227.7 ± 178.3	241.3 ± 196.0	219.0 ± 178.3
Vegetables, g/day ¹	144.4 ± 78.4	94.9 ± 52.8	123.6 ± 68.3	122.8 ± 69.2	129.3 ± 71.5	117.5 ± 67.6

Q = quadrant; ¹Mean ± SD

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Supplementary Table 2. Baseline characteristics of cohort participants stratified by sources of fibre intake (soy food, fruits and vegetables): The Singapore Chinese Health Study (1993-2017)

Characteristics	Soy food		Fruits		Vegetables	
	Q1	Q4	Q1	Q4	Q1	Q4
Number of participants	15,784	15,794	15,784	15,786	15,790	15,788
Women, n (%)	6,251 (39.6)	9,728 (61.6)	7,068 (44.8)	9,237 (58.5)	6,037 (38.2)	10,287 (65.2)
Age, years ¹	56.6 ± 8.1	55.7 ± 7.8	57.4 ± 8.1	55.2 ± 7.7	57.3 ± 8.2	55.2 ± 7.7
Body mass index, kg/m ² ¹	23.0 ± 3.3	23.2 ± 3.3	22.9 ± 3.3	23.3 ± 3.3	22.9 ± 3.2	23.3 ± 3.3
Dialect group, n (%)						
Hokkien	7,838 (49.7)	8,706 (55.1)	9,057 (57.4)	7,748 (49.1)	8,764 (55.5)	7,908 (50.1)
Cantonese	7,946 (50.3)	7,088 (44.9)	6,727 (42.6)	8,038 (50.9)	7,026 (44.5)	7,880 (49.9)
Secondary school or higher, n (%)	4,646 (29.4)	4,969 (31.5)	3,278 (20.8)	6,214 (39.4)	4,096 (25.9)	5,300 (33.6)
Ever smoker, n (%)	6,529 (41.4)	4,020 (25.5)	7,042 (44.6)	3,611 (22.9)	6,887 (43.6)	3,618 (22.9)
Hypertension, n (%)	3,662 (23.2)	3,820 (24.2)	3,390 (21.5)	3,934 (24.9)	3,535 (22.4)	3,855 (24.4)
Diabetes, n (%)	1,344 (8.5)	1,426 (9.0)	1,388 (8.8)	1,312 (8.3)	1,323 (8.4)	1,378 (8.7)
Coronary heart disease, n (%)	610 (3.9)	678 (4.3)	634 (4.0)	668 (4.2)	634 (4.0)	638 (4.0)
Stroke, n (%)	266 (1.7)	202 (1.3)	241 (1.5)	204 (1.3)	291 (1.8)	212 (1.3)
Physical activity, hour/week ¹	1.9 ± 4.8	1.6 ± 4.2	1.8 ± 4.9	1.8 ± 4.0	1.9 ± 4.9	1.6 ± 4.2
Sitting, hours/day ¹	6.9 ± 3.7	6.5 ± 3.6	6.5 ± 3.7	6.8 ± 3.7	6.6 ± 3.7	6.7 ± 3.6
Sleep, hours/day ¹	7.0 ± 1.2	7.0 ± 1.1	7.0 ± 1.2	7.0 ± 1.1	7.0 ± 1.2	7.0 ± 1.1
Total energy intake, kcal/day ¹	1,791.7 ± 565.0	1,643.8 ± 592.9	1,733.7 ± 596.3	1,630.0 ± 574.5	1,724.6 ± 599.5	1,632.9 ± 575.7
Total fibre, g/day ^{1,2}	13.0 ± 5.6	14.9 ± 6.4	10.6 ± 4.6	17.4 ± 6.3	11.7 ± 5.4	15.8 ± 6.5
Grain products, g/day ^{1,2}	676.2 ± 246.3	492.7 ± 202.3	655.1 ± 249.7	485.8 ± 201.4	657.1 ± 253.3	489.7 ± 198.1
Legumes, g/day ^{1,2}	3.0 ± 4.9	4.2 ± 5.7	3.1 ± 5.0	3.7 ± 5.5	3.1 ± 5.1	3.8 ± 5.3
Soy food, g/day ^{1,2}	51.1 ± 38.0	223.4 ± 110.8	107.7 ± 95.1	133.5 ± 108.3	97.1 ± 88.8	147.9 ± 113.7
Nuts and seeds, g/day ^{1,2}	2.9 ± 4.7	3.0 ± 4.5	2.7 ± 4.4	3.0 ± 4.4	2.7 ± 4.3	3.0 ± 4.6
Fruits, g/day ^{1,2}	200.4 ± 175.4	243.1 ± 188.5	70.6 ± 61.7	413.5 ± 181.9	172.5 ± 159.3	264.7 ± 198.4
Vegetables, g/day ^{1,2}	105.1 ± 60.1	137.1 ± 75.1	101.3 ± 58.9	134.2 ± 75.2	64.4 ± 30.9	185.9 ± 68.4

Q = quadrant; ¹Mean ±SD; ²Fibre food sources are shown in energy adjusted units using the residual method.

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Supplementary Table 3. Hazard ratio (95% confidence interval) of total knee replacement according to sources of fibre intake, stratified by sex and body mass index: The Singapore Chinese Health Study (1993-2017)

	Sex				BMI			
	Men		Women		< 23 kg/m ²		≥ 23 kg/m ²	
	Cases	HR (95% CI)	Cases	HR (95% CI)	Cases	HR (95% CI)	Cases	HR (95% CI)
Total fibre								
Q1	154	1.00	374	1.00	132	1.00	396	1.00
Q2	113	1.11 (0.85, 1.46)	399	1.04 (0.90, 1.19)	174	1.06 (0.84, 1.34)	538	1.03 (0.91, 1.18)
Q3	111	1.16 (0.85, 1.58)	656	1.04 (0.89, 1.22)	204	1.14 (0.91, 1.43)	563	1.05 (0.92, 1.19)
Q4	125	1.16 (0.81, 1.65)	684	1.07 (0.89, 1.28)	218	1.14 (0.91, 1.42)	591	1.10 (0.97, 1.26)
<i>p</i> for trend ¹		0.12		0.20		0.25		0.14
<i>p</i> for interaction				0.32				0.81
Legumes								
Q1	197	1.00	441	1.00	174	1.00	464	1.00
Q2	106	1.01 (0.79, 1.30)	648	0.97 (0.85, 1.10)	192	0.91 (0.73, 1.13)	562	1.00 (0.87, 1.14)
Q3	85	0.83 (0.63, 1.08)	671	0.95 (0.83, 1.08)	170	0.77 (0.62, 0.97)	586	1.01 (0.89, 1.16)
Q4	115	0.91 (0.72, 1.16)	553	0.84 (0.74, 0.96)	192	0.82 (0.66, 1.02)	476	0.85 (0.74, 0.97)
<i>p</i> for trend ¹		0.34		0.005		0.14		0.01
<i>p</i> for interaction				0.53				0.57

¹Linear trend was tested by assigning to participants the median value of the quartile and assessing this as a continuous variable.

Models adjusted for age at interview, years of interview, total energy intake, gender, dialect, education level, BMI, smoking, sitting duration, sleep duration, physical activity, history of hypertension, diabetes, heart attack, stroke, and other fibre sources (except the variable of total fibre).

BMI, body mass index; HR, hazard ratio; CI, confidence interval

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Supplementary Table 4. Hazard ratios (95% confidence intervals) for risk of total knee replacement according to intake of fibre, excluding participants with imputed BMI: The Singapore Chinese Health Study (1993-2017).

Quartiles of energy-adjusted food intake	Q1	Q2	Q3	Q4	<i>p</i> for trend ¹
Total fibre					
Cases/ person-years	431/ 225,009	593/ 233,131	664/ 242,189	704/ 251,627	
Multivariate Model	1.00	1.06 (0.94, 1.21)	1.10 (0.97, 1.25)	1.10 (0.97, 1.24)	0.15
Grain products²					
Cases/ person, years	662/ 257,857	685/ 237,642	563/ 229,482	482/ 226,975	
Multivariate Model	1.00	1.10 (0.99, 1.23)	0.95 (0.84, 1.07)	0.94 (0.82, 1.08)	0.17
Legumes					
Cases/ person, years	543/ 240,133	636/ 231,312	639/ 234,243	574/ 246,268	
Multivariate Model	1.00	0.99 (0.87, 1.11)	0.96 (0.85, 1.09)	0.88 (0.78, 1.00)	0.03
Nuts and seeds					
Cases/ person, years	571/ 242,077	586/ 232,250	666/ 231,361	568/ 245,237	
Multivariate Model	1.00	0.87 (0.77, 0.99)	0.98 (0.86, 1.11)	0.90 (0.79, 1.01)	0.24
Soy food					
Cases/ person, years	479/ 234,558	606/ 231,547	660/ 236,972	647/ 248,879	
Multivariate Model	1.00	1.11 (0.98, 1.26)	1.10 (0.97, 1.25)	0.99 (0.87, 1.12)	0.43
Fruits					
Cases/ person, years	468/ 219,430	571/ 229,769	648/ 244,351	705/ 258,408	
Multivariate Model	1.00	1.02 (0.9, 1.16)	1.08 (0.95, 1.22)	1.08 (0.95, 1.23)	0.19
Vegetables					
Cases/ person-years	459/ 226,795	574/ 230,643	644/ 239,311	715/ 255,208	
Multivariate Model	1.00	1.02 (0.90, 1.16)	0.99 (0.88, 1.13)	0.98 (0.86, 1.11)	0.59

¹Linear trend was tested by assigning to participants the median value of the quartile and assessing this as a continuous variable.

Models adjusted for age at interview, years of interview, total energy intake, gender, dialect, education level, BMI, smoking, sitting duration, sleep duration, physical activity, history of hypertension, diabetes, heart attack, stroke, and other fibre sources (except the variable of total fibre).

BMI, body mass index.

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Supplementary Table 5. Hazard ratios (95% confidence intervals) for risk of total knee replacement according to intake of fibre, excluding participants with extreme energy intake: The Singapore Chinese Health Study (1993-2017).

Quartiles of energy-adjusted food intake	Q1	Q2	Q3	Q4	<i>p</i> for trend ¹
Total fibre					
Cases/ person-years	522/ 270,496	692/ 274,670	760/ 281,302	793/ 283,978	
Multivariate Model	1.00	1.05 (0.94, 1.18)	1.09 (0.97, 1.22)	1.10 (0.98, 1.23)	0.12
Grain products ²					
Cases/ person-years	724/ 283,040	794/ 279,209	670/ 275,194	579/ 273,002	
Multivariate Model	1.00	1.09 (0.99, 1.22)	0.95 (0.85, 1.07)	0.94 (0.83, 1.07)	0.14
Legumes					
Cases/ person-years	630/ 276,506	750/ 277,344	734/ 272,247	653/ 284,348	
Multivariate Model	1.00	0.98 (0.87, 1.10)	0.95 (0.85, 1.07)	0.86 (0.76, 0.96)	0.003
Nuts and seeds					
Cases/ person-years	679/ 281,219	686/ 280,684	761/ 273,265	641/ 275,277	
Multivariate Model	1.00	0.84 (0.75, 0.94)	0.93 (0.82, 1.05)	0.88 (0.78, 0.99)	0.21
Soy food					
Cases/ person-years	560/ 273,524	716/ 276,143	741/ 277,329	750/ 283,448	
Multivariate Model	1.00	1.10 (0.98, 1.24)	1.06 (0.94, 1.19)	1.00 (0.89, 1.13)	0.56
Fruits					
Cases/ person-years	572/ 266,985	661/ 273,097	754/ 282,450	780/ 287,913	
Multivariate Model	1.00	1.00 (0.89, 1.12)	1.08 (0.96, 1.21)	1.07 (0.95, 1.21)	0.15
Vegetables					
Cases/ person-years	535/ 267,954	665/ 275,083	748/ 281,792	819/ 285,616	
Multivariate Model	1.00	1.01 (0.90, 1.13)	1.00 (0.89, 1.13)	1.02 (0.90, 1.15)	0.77

¹ Linear trend was tested by assigning to participants the median value of the quartile and assessing this as a continuous variable.

Models adjusted for age at interview, years of interview, total energy intake, gender, dialect, education level, BMI, smoking, sitting duration, sleep duration, physical activity, history of hypertension, diabetes, heart attack, stroke, and other fibre sources (except the variable of total fibre).

BMI, body mass index; HR, hazard ratio; CI, confidence interval

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Supplementary Table 6. Hazard ratios (95% confidence intervals) for risk of total knee replacement according to intake of fibre, excluding participants with less than 5 years of follow-up: The Singapore Chinese Health Study (1993-2010).

Quartiles of energy-adjusted food intake	Q1	Q2	Q3	Q4	<i>p</i> for trend ¹
Total fibre					
Cases/ person-years	458/ 198,483	625/ 203,853	674/ 207,684	726/ 211,123	
Multivariate Model	1.00	1.08 (0.95, 1.22)	1.10 (0.97, 1.24)	1.13 (1.00, 1.28)	0.05
Grain products²					
Cases/ person-years	665/ 212,228	712/ 207,143	600/ 203,500	506/ 198,272	
Multivariate Model	1.00	1.12 (1.00, 1.25)	0.99 (0.87, 1.11)	0.98 (0.86, 1.12)	0.45
Legumes					
Cases/ person-years	577/ 203,399	642/ 201,719	669/ 203,959	595/ 212,065	
Multivariate Model	1.00	0.93 (0.83, 1.05)	0.94 (0.83, 1.06)	0.83 (0.74, 0.94)	0.003
Nuts and seeds					
Cases/ person-years	622/ 207,648	607/ 204,643	654/ 202,737	600/ 206,115	
Multivariate Model	1.00	0.83 (0.73, 0.93)	0.88 (0.77, 0.99)	0.89 (0.79, 1.00)	0.27
Soy food					
Cases/ person-years	481/ 200,208	643/ 202,594	671/ 207,054	688/ 211,287	
Multivariate Model	1.00	1.17 (1.03, 1.32)	1.11 (0.98, 1.26)	1.06 (0.94, 1.21)	0.92
Fruits					
Cases/ person-years	500/ 193,986	587/ 202,494	665/ 209,593	731/ 215,069	
Multivariate Model	1.00	0.99 (0.88-1.12)	1.07 (0.94-1.2)	1.11 (0.98-1.26)	0.04
Vegetables					
Cases/ person-years	468/ 195,841	603/ 203,717	663/ 208,830	749/ 212,754	
Multivariate Model	1.00	1.05 (0.92, 1.19)	1.01 (0.89, 1.14)	1.05 (0.92, 1.19)	0.58

¹ Linear trend was tested by assigning to participants the median value of the quartile and assessing this as a continuous variable.

Models adjusted for age at interview, years of interview, total energy intake, gender, dialect, education level, BMI, smoking, sitting duration, sleep duration, physical activity, history of hypertension, diabetes, heart attack, stroke, and other fibre sources (except the variable of total fibre).

BMI, body mass index; HR, hazard ratio; CI, confidence interval

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Supplementary Table 7. Hazard ratios (95% confidence intervals) for risk of total knee replacement according to intake of fibre, included participants with 5 to 10 years of follow-up: The Singapore Chinese Health Study (1993-2010).

Quartiles of energy-adjusted food intake	Q1	Q2	Q3	Q4	<i>p</i> for trend ¹
Total fibre					
Cases/ person-years	95/ 70,194	158/ 70,760	169/ 71,386	170/ 71,976	
Multivariate Model	1.00	1.08 (0.95, 1.22)	1.10 (0.97, 1.24)	1.13 (1.00, 1.28)	0.08
Grain products²					
Cases/ person-years	133/ 72,610	192/ 71,330	139/ 70,649	128/ 69,726	
Multivariate Model	1.00	1.36 (1.08, 1.72)	0.99 (0.76, 1.28)	1.03 (0.78, 1.37)	0.49
Legumes					
Cases/ person-years	126/ 70,930	176/ 70,163	166/ 70,483	124/ 72,738	
Multivariate Model	1.00	1.09 (0.85, 1.40)	1.01 (0.78, 1.30)	0.83 (0.64, 1.08)	0.06
Nuts and seeds					
Cases/ person-years	143/ 71,457	137/ 70,796	169/ 70,237	143/ 71,825	
Multivariate Model	1.00	0.71 (0.55, 0.92)	0.86 (0.67, 1.12)	0.86 (0.66, 1.11)	0.79
Soy food					
Cases/ person-years	121/ 70,471	168/ 70,507	152/ 71,197	151/ 72,140	
Multivariate Model	1.00	1.19 (0.93, 1.52)	1.03 (0.80, 1.33)	1.01 (0.78, 1.30)	0.61
Fruits					
Cases/ person-years	124/ 69,396	143/ 70,245	160/ 71,785	165/ 72,889	
Multivariate Model	1.00	0.99 (0.77, 1.26)	1.11 (0.87, 1.42)	1.15 (0.89, 1.48)	0.25
Vegetables					
Cases/ person-years	126/ 69,086	128/ 70,580	161/ 71,591	177/ 73,059	
Multivariate Model	1.00	0.79 (0.61, 1.02)	0.91 (0.71, 1.16)	0.95 (0.74, 1.22)	0.75

¹ Linear trend was tested by assigning to participants the median value of the quartile and assessing this as a continuous variable.

Models adjusted for age at interview, years of interview, total energy intake, gender, dialect, education level, body mass index, smoking, sitting duration, sleep duration, physical activity, history of hypertension, diabetes, heart attack, stroke, and other fibre sources (except the variable of total fibre).

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Supplementary Table 8: Hazard ratios (95% confidence intervals) for risk of total knee replacement with intake of fibre with or without adjustment for comorbidities: The Singapore Chinese Health Study (1993-2017).

Quartiles of energy-adjusted food intake	Q1	Q2	Q3	Q4	<i>p</i> for trend ¹
Total fibre					
Cases/ person-years	528/ 275,050	712/ 280,456	767/ 284,394	809/ 287,955	
Multivariate Model	1.00	1.06 (0.95, 1.19)	1.09 (0.97, 1.22)	1.11 (0.99, 1.24)	0.088
Multivariate Model less comorbidities*	1.00	1.06 (0.94, 1.19)	1.08 (0.97, 1.21)	1.11 (0.99, 1.24)	0.097
Legumes					
Cases/ person-years	638/ 280,170	754/ 278,001	756/ 280,407	668/ 289,275	
Multivariate Model	1.00	0.98 (0.87, 1.09)	0.95 (0.84, 1.06)	0.86 (0.76, 0.96)	0.004
Multivariate Model less comorbidities*	1.00	0.98 (0.88, 1.10)	0.96 (0.85, 1.08)	0.88 (0.78, 0.99)	0.014

¹ Linear trend was tested by assigning to participants the median value of the quartile and assessing this as a continuous variable.

* hypertension, diabetes, heart attack, and stroke

Multivariate Models adjusted for age at interview, years of interview, total energy intake, gender, dialect, education level, body mass index, smoking, sitting duration, sleep duration, physical activity, history of hypertension, diabetes, heart attack, stroke, and other fibre sources (except the variable of total fibre).