

**Supplementary Appendix**

Supplement to: **White rice intake and incident diabetes: A study of 132,373 participants in  
21 countries**

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**Table S1: PURE food frequency validation studies**

Country	Validated	Reference dietary method	Reference
Argentina	Yes	Multiple dietary recalls	Dehghan et al. PLoS One. 2012;7(5):e37958
Brazil	Yes	Multiple dietary recalls	Under preparation
Canada	Yes	Multiple dietary recalls	Kelemen L et al. J Am Diet Assoc. 2003 103(9):1178-84
Chile	Yes	Multiple dietary recalls	Dehghan et al. Public Health Nutr. 2013;16 (10):1782-8.
China	Yes	Multiple dietary recalls	Zhao WH et al. Biomedical and environmental sciences. 2010; 23(suppl.), 1-38.
Colombia	Yes	Multiple dietary recalls	Dehghan et al. J Nutr Educ Behav. 2012;44(6):609-13.
Iran	Yes	Multiple dietary recalls	Under preparation
India	Yes	Multiple dietary recalls	Iqbal R et al. Public Health Nutr. 2009; 12(1):12-18  Bharati A et al. Asia Pac J Clin Nutr 2008; 14(1):178-185.  Mahajan R et al. The National Medical Journal of India vol. 26, no. 5, 2013
Malaysia	Yes	Multiple dietary recalls	Book chapter
Palestine	Yes	Multiple dietary recalls	Under preparation
Poland	Yes	Multiple dietary recalls	Dehghan et al. J Hum Nutr Diet. 2012; 25(3):225-32
Sweden	Yes	Multiple dietary recalls	Khani B et al. J Nutr. 2004, 134:1541-1545
South Africa	Yes	Multiple dietary recalls	MacIntyre UE et al. Public health nutr. 2000; 4(1), 63-71
Turkey	Yes	Multiple dietary recalls	Gunes eat al. J Pak Med Assoc. 2015; 65(7):756-63.
UAE	Yes	Multiple dietary recalls	Dehghan et al. Nutr J. 2005;4:18
Kuwait/UAE	Yes	Multiple dietary recalls	Dehghan et al. Saudi Med J 2009; Vol30(1)
Zimbabwe	No	FFQ development	Development of FFQ Merchant et al. Nutr J. 2005;4:37

**Table S2-A: De-attenuated Correlation Coefficients of Nutrient Intake**

Country	Vegetables	Fruits	Dairy	Whole Grains	Refined grains	White meat	Red meat	Processed foods
Brazil	0.55	0.52	0.63	0.35	0.73	0.21	0.34	0.27
Chile	0.77	0.66	0.55	0.71	0.63	NR	NR	NR
China	0.42	0.40	0.68	0.80	0.87	0.69	0.58	NR
Iran	0.46	0.54	0.52	NR	0.54			NR
Sweden	0.58	0.59	0.62	0.61	0.49	0.66	0.56	0.65
South Africa	0.41	0.38	0.14	0.56	0.25	0.35	NR	NR
Turkey	0.29	0.29	0.39	NR	0.57	NR	0.48	NR

NR: not reported

**Table S2-B: De-attenuated correlation coefficients of Food Intake (g/d)**

Country	Energy/kcal	CHO/g	Fat/g	Protein/g	SFA/mg	PUFA/mg	Cholesterol/mg
Argentina	0.53	0.57	0.50	0.53	0.52	0.48	0.57
Canada	NR	0.60	0.62	0.57	0.65	0.48	0.73
Chile	NR	0.62	0.81	0.10	0.66	0.41	NR
China	0.65	0.61	0.63	0.63	0.73	0.61	0.57
Colombia	0.57	0.77	0.43	0.51	0.30	0.52	NR
Iran	0.62	0.58	0.51	0.57	0.45	0.42	NR
India	0.52	0.59	0.54	0.52	NR	NR	NR
Palestine	Under preparation						
Poland	0.56	0.60	0.61	0.53	0.63	0.48	0.76
South Africa	0.31	0.31	0.25	0.30	NR	NR	NR
Turkey	0.65	0.63	0.63	0.49	NR	0.36	0.34
UAE/Kuwait	0.72	0.74	0.69	0.70	0.62	0.64	0.81
Zimbabwe	0.99	0.99	0.97	0.94	NR	NR	NR

NR: not reported

**Table S2-C: Correlation between serum triglycerides and white rice intake (n=132,373)**

	White rice intake (grams/day)				p-trend
	<150g/d	150-300g/d	300-450g/d	>450g/d	
	<b>N=71,914</b>	<b>N= 16,976</b>	<b>N= 14,010</b>	<b>N= 29,473</b>	
Triglycerides (mmol/l)	0.004 (0.01)	0.007 (0.01)	0.05 (0.01)	0.06 (0.02)	0.008

**Table S3: Baseline characteristics of study participants by geographic region (n=132,373)**

	<b>Overall (n=132,373)</b>	<b>North America &amp; Europe (n= 14,552)</b>	<b>South America (n=21,442)</b>	<b>Africa (n=5,881)</b>	<b>Middle East (n=11,756)</b>	<b>South East Asia (n=10,596)</b>	<b>China (n=41,727)</b>	<b>South Asia (n=26,419)</b>
Age (years)	50.0 (9.9)	53.1 (9.2)	50.9 (9.7)	49.5 (10.6)	47.6 (9.1)	51.1 (9.8)	50.6 (9.7)	47.6 (10.1)
Body mass index (kg/m <sup>2</sup> )	25.5 (5.2)	27.1 (4.9)	27.8 (5.3)	26.0 (7.1)	28.8 (5.5)	25.6 (4.9)	24.5 (3.6)	22.7 (4.9)
Men (%)	41.5	44.3	38.5	30.8	45.6	40.5	41.5	43.3
Urban (%)	52.0	70.4	56.6	47.9	59.7	45.7	47.3	45.7
Physical inactivity (%)	17.4	5.9	13.2	20.0	26.8	29.0	15.5	21.2
Current smoker (%)	11.5	36.5	22.3	4.8	9.1	8.0	4.6	3.9
<b>Diet</b>								
Energy intake, Kcal	2020 (1562-2611)	2149 (1648-2754)	2110 (1641-2665)	1838 (1320-2572)	2217 (1732-2823)	2432 (1740-3178)	1900 (1501-2379)	1938 (1507-2557)
Fiber intake (g/day)	19.1 (11.3-29.5)	26.1 (18.6-36.4)	23.6 (17.4-31.2)	26.1 (17.6-41.0)	30.5 (22.6-41.2)	8.9 (5.2-13.1)	19.9 (12.7-29.5)	10.1 (6.7-15.1)
%E from carbohydrate	60.9 (53.0-69.9)	52.1 (46.8-57.9)	58.2 (49.9-65.9)	60.0 (53.0-69.5)	54.2 (49.4-58.8)	54.6 (49.0-60.1)	68.3 (61.0-74.5)	64.6 (57.8-75.7)
%E from fat	24.0 (16.2-30.3)	30.4 (26.5-34.3)	24.8 (19.3-30.5)	25.0 (18.0-31.7)	29.8 (26.2-33.8)	28.9 (24.7-33.0)	16.3 (11.7-22.3)	23.5 (13.1-29.6)
%E from protein	15.0 (12.6-17.4)	16.5 (14.9-18.3)	17.0 (14.9-19.5)	13.4 (11.6-15.5)	16.6 (14.9-18.2)	16.6 (14.5-18.8)	14.9 (13.2-16.9)	11.3 (10.1-12.7)

South Asia includes India, Pakistan and Bangladesh.

South East Asia includes Malaysia, Philippines

Values are median (IQR) unless stated otherwise

**Table S4: Baseline characteristics of study participants – overall, South Asia, Rest of the world and China**

	<b>Overall (n=132,373)</b>	<b>South Asia (N=26,419)</b>	<b>Rest of the world (N=64,227)</b>	<b>China (n=41,727)</b>
Age (years)	50.0 (9.9)	47.6 (10.1)	50.7 (9.8)	50.6 (9.7)
Body mass index (kg/m <sup>2</sup> )	25.5 (5.2)	22.7 (4.9)	27.4 (5.5)	24.5 (3.6)
Waist hip ratio	0.87 (0.08)	0.86 (0.09)	0.88 (0.08)	0.86 (0.07)
Men (n, %)	54,902 (41.5)	11,441 (43.3)	26,141 (40.7)	17,320 (41.5)
Urban (n, %)	68,860 (52)	12,060 (45.7)	37,063 (57.7)	19,737 (47.3)
Physical inactivity (%)	21,471 (21)	4,935 (21.2)	10,178 (17.3)	6,358 (15.5)
<b>Diet<sup>s</sup></b>				
Energy intake, Kcal	2020 (1562-2611)	2091 (823)	2283 (873)	1976 (666)
Fiber intake (g/day)	19.1 (11.3-29.5)	12.4 (6.7-15.0)	26 (14.9-33.3)	22.4 (12.7-29.5)
%E from carbohydrate	60.9 (53.0-69.9)	66 (57.7-75.7)	56 (48.9-61.8)	67 (61-64.5)
%E from fat	24.0 (16.2-30.3)	22.1 (13.1-29.6)	27.8 (23.0-32.8)	17.6 (11.7-22.3)
%E from protein	15.0 (12.6-17.4)	11.5 (10.1-12.7)	16.7 (14.5-18.6)	15.2 (13.2-16.9)

South Asia includes India, Pakistan and Bangladesh

Rest of the world includes South East Asia, Middle East, South America, North America/Europe and Africa.

<sup>s</sup>Values are median (IQR) unless stated otherwise

**Table S5 A: Association between white rice intake and incident diabetes – stratified by family history**

	White rice intake (grams/day)			
	<150g/d	≥150 to <300g/d	≥300 to <450g/d	≥450g/d
<b>No family history (n=95,666)</b>	<b>N=54,640</b>	<b>N=12,601</b>	<b>N=10,026</b>	<b>N=18,399</b>
Diabetes events (%)	1822 (3.3)	520 (4.1)	358 (3.6)	717 (3.9)
Minimally adjusted model	1.00	1.12 (1.00-1.26)	1.24 (1.07-1.43)	1.16 (1.00-1.36)
Fully adjusted model adjusted for age, sex, BMI, WHR, physical activity, education, location, smoking, energy intake, refined grain and whole grain, fruits and vegetables and study center as random effect	1.00	1.14 (1.00-1.30)	1.32 (1.13-1.55)	1.30 (1.07-1.56)
<b>Positive family history (n=24,662)</b>	<b>N=15,269</b>	<b>N=3,608</b>	<b>N=2,847</b>	<b>N= 2,938</b>
Diabetes events (%)	1,059 (6.9)	360 (10.0)	209 (7.3)	298 (10.1)
Minimally adjusted model	1.00	1.10 (0.94-1.28)	1.18 (0.97-1.43)	1.19 (0.95-1.50)
Fully adjusted model adjusted for age, sex, BMI, WHR, physical activity, education, location, smoking, energy intake, refined grain and whole grain, fruits and vegetables and study center as random effect	1.00	1.11 (0.94-1.31)	1.14 (0.92-1.42)	1.10 (0.83-1.46)

p-for interaction = 0.22

**Table S5 B: Association between white rice intake and incident diabetes – stratified by physical activity**

	White rice intake (grams/day)			
	<150g/d	≥150 to <300g/d	≥300 to <450g/d	≥450g/d
<b>Physically inactive (n=21,471)</b>	<b>11,409</b>	<b>2,845</b>	<b>2,035</b>	<b>5,182</b>
Diabetes events (%)	500 (4.4)	158 (5.6)	99 (4.9)	323 (6.2)
Minimally adjusted model	1.00	1.13 (0.92-1.39)	1.24 (0.96-1.60)	1.39 (1.08-1.79)
Model adjusted for age, sex, bmi, whr, family history, education, location, smoking, energy intake, refined grain and whole grain, fruits and vegetables and study center as random effect	1.00	1.18 (0.93-1.51)	1.38 (1.02-1.86)	1.50 (1.08-2.09)
<b>Physically active (n=101,764)</b>	<b>54,154</b>	<b>13,261</b>	<b>11,307</b>	<b>23,042</b>
Diabetes events (%)	2240 (4.1)	731 (5.5)	504 (4.5)	1189 (5.2)

Minimally adjusted for age, sex and study center as random effect	1.00	1.12 (1.01-1.25)	1.20 (1.05-1.36)	1.11 (0.96-1.27)
Model adjusted for age, sex, bmi, whr, family history, education, location, smoking, energy intake, refined grain and whole grain, fruits and vegetables	1.00	1.11 (0.99-1.24)	1.21 (1.05-1.40)	1.16 (0.97-1.38)

p-for interaction = 0.47

Physically inactive = <600 MET × min per week and <150 min per week of moderate intensity physical activity.

Physically active = >600 MET × min per week of moderate intensity physical activity.

**Table S5 C: Association between white rice intake and incident diabetes - stratified by BMI**

	White rice intake (grams/day)			
	<150g/d	≥150 to <300g/d	≥300 to <450g/d	≥450g/d
<b>BMI &lt;25 (n=62,446)</b>	<b>29,161</b>	<b>7,275</b>	<b>6,826</b>	<b>19,184</b>
Diabetes events (%)	459 (1.6)	190 (2.6)	137 (2.0)	779 (4.1)
Minimally adjusted for age, sex and study center as random effect	1.00	1.27 (1.04-1.54)	1.21 (0.95-1.53)	1.37 (1.10-1.71)
Model adjusted for age, sex, WHR, family history, physical activity, education, location, smoking, energy intake, refined grain and whole grain, fruits and vegetables and study center as random effect	1.00	1.12 (0.90-1.41)	1.20 (0.91-1.58)	1.25 (0.93-1.68)
<b>BMI &gt;25 (n=62,733)</b>	<b>38,531</b>	<b>8,713</b>	<b>6,615</b>	<b>8,874</b>
Diabetes events (%)	2378 (6.2)	686 (7.9)	468 (7.1)	775 (8.7)
Minimally adjusted for age, sex and study center as random effect	1.00	1.07 (0.96-1.19)	1.20 (1.05-1.37)	1.26 (1.09-1.45)
Model adjusted for age, sex, WHR, family history, physical activity, education, location, smoking, energy intake, refined grain and whole grain, fruits and vegetables and study center as random effect	1.00	1.11 (1.00-1.25)	1.25 (1.08-1.44)	1.19 (0.99-1.44)

P for interaction = 0.006



**Table S5 D: Association between white rice intake and incident diabetes - stratified by WHR**

	White rice intake (grams/day)			
	<150g/d	≥150 to <300g/d	≥300 to <450g/d	≥450g/d
<b>Low WHR (&lt;0.90 in men, &lt;0.80 in women) (N=46,625)</b>	<b>23,019</b>	<b>5,651</b>	<b>4,424</b>	<b>13,531</b>
Diabetes events (%)	365 (1.6)	139 (2.5)	98 (2.2)	401 (3.0)
Minimally adjusted for age, sex and study centre	1.00	1.22 (0.97-1.53)	1.27 (0.96-1.67)	1.18 (0.90-1.54)
Model adjusted for age, sex, BMI, family history, physical activity, education, location, smoking, energy intake, refined grain and whole grain, fruits and vegetables and study center as random effect	1.00	1.19 (0.92-1.55)	1.46 (1.07-1.99)	1.52 (1.09-2.12)
<b>High WHR (&gt;0.90 in men, &gt;0.80 in women) (N=78,822)</b>	<b>44,710</b>	<b>10,383</b>	<b>9,070</b>	<b>14,659</b>
Diabetes events (%)	2447 (5.5)	732 (7.1)	506 (5.6)	1152 (7.9)
Minimally adjusted for age, sex and study centre	1.00	1.08 (0.97-1.20)	1.16 (1.02-1.31)	1.22 (1.07-1.40)
Model adjusted for age, sex, BMI, family history, physical activity, education, location, smoking, energy intake, refined grain and whole grain, fruits and vegetables and study center as random effect	1.00	1.11 (0.99-1.24)	1.22 (1.06-1.41)	1.17 (0.98-1.40)

p-for interaction = 0.46

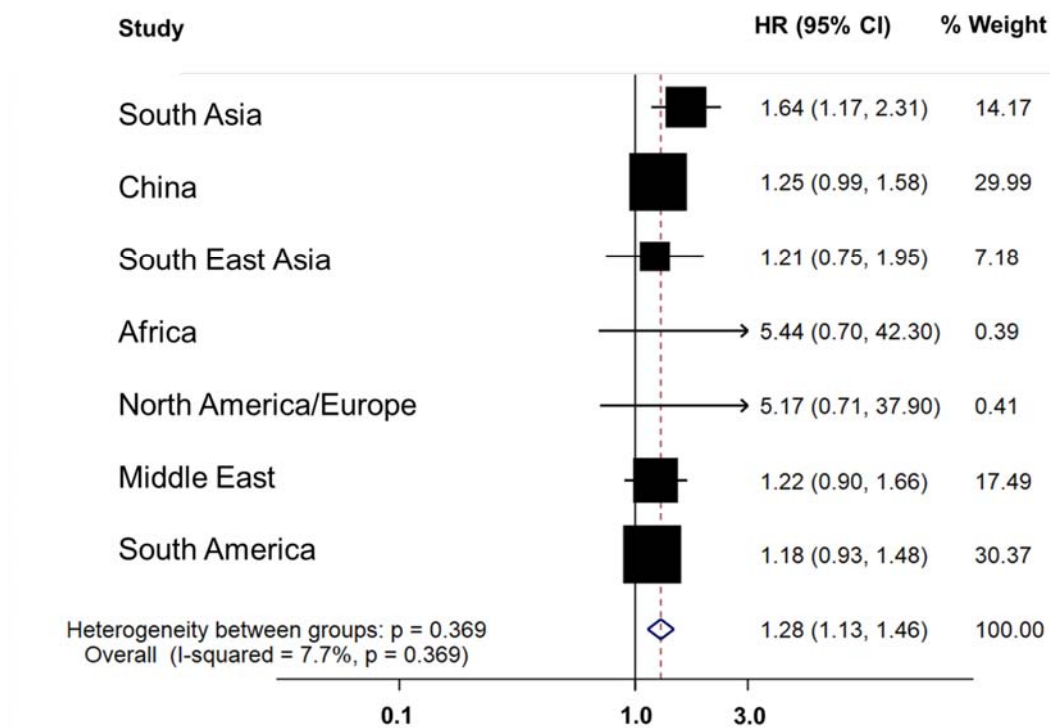
**Table S6: Association of white rice intake with incident diabetes – in different world regions**

	White rice intake (grams/day)		
	<150g/d	150-300g/d	>300g/d
<b>South Asia (n=26,419)</b>	<b>N=7,227</b>	<b>N=1,672</b>	<b>N=17,520</b>
Diabetes events N (%)	343 (4.8)	114 (6.8)	1382 (7.9)
Minimally adjusted model	1.00	1.19 (0.93-1.52)	1.22 (0.97-1.53)
Fully adjusted model <sup>^</sup>	1.00	1.27 (0.87-1.87)	1.64 (1.17-2.31)
<b>China (n=41,727)</b>	<b>N=17,889</b>	<b>N=7,300</b>	<b>N=16,538</b>
Diabetes events N (%)	520 (2.9)	231 (3.2)	440 (2.7)
Minimally adjusted model	1.00	1.02 (0.86-1.21)	1.21 (1.00-1.46)
Fully adjusted model <sup>^</sup>	1.00	0.98 (0.81-1.19)	1.25 (0.99-1.58)
<b>South East Asia (n=10,596)</b>	<b>N=3,696</b>	<b>N=2,606</b>	<b>N=4,294</b>
Diabetes events N (%)	<b>75 (2.0)</b>	<b>104 (4.00)</b>	<b>160 (3.7)</b>
Minimally adjusted model	1.00	1.66 (1.21-2.27)	1.98 (1.43-2.75)
Fully adjusted model <sup>^</sup>	1.00	1.26 (0.82-1.95)	1.21 (0.75-1.95)
<b>Middle East (n=8,379)</b>	<b>N=5,076</b>	<b>N=2,725</b>	<b>N=578</b>
Diabetes events N (%)	410 (8.1)	288 (10.6)	70 (12.1)
Minimally adjusted model	1.00	1.08 (0.91-1.28)	1.25 (0.96-1.65)
Fully adjusted model <sup>^</sup>	1.00	1.10 (0.91-1.33)	1.22 (0.90-1.66)
<b>South America (n=21,442)</b>	<b>N=15,161</b>	<b>N=1,808</b>	<b>N=4,473</b>
Diabetes events N (%)	646 (4.3)	157 (8.7)	193 (4.3)
Minimally adjusted model	1.00	1.69 (1.32-2.17)	1.16 (0.93-1.44)
Fully adjusted model <sup>^</sup>	1.00	1.69 (1.31-2.18)	1.18 (0.93-1.48)
<b>North America/Europe (n=17,929)</b>	<b>N=17,598</b>	<b>N=324</b>	<b>N=7</b>
Diabetes events N (%)	872 (4.9)	13 (4.0)	1 (14.3)
Minimally adjusted model	1.00	0.80 (0.46-1.38)	6.68 (0.93-47.79)
Fully adjusted model <sup>^</sup>	1.00	0.87 (0.50-1.52)	5.17 (0.71-37.91)
<b>Africa (n=5,881)</b>	<b>N=5,267</b>	<b>N=541</b>	<b>N=73</b>
Diabetes events N (%)	94 (1.8)	15 (2.8)	1 (1.37)
Minimally adjusted model	1.00	1.53 (0.88-2.66)	0.73 (0.10-5.27)
Fully adjusted model <sup>^</sup>	1.00	1.85 (0.70-4.90)	5.44 (0.70-42.28)

Minimally adjusted for age, sex and study centre as random effect.

Full model adjusted for age, sex, family history of diabetes, education, location, smoking, physical activity, energy intake, whole grains and refined grains, fruits and vegetables, wealth index and study centre as random effect.

**Figure S1 A: Pooled analysis of PURE regions:**



**Figure S1 B – Pooled analysis of PURE regions - Sensitivity Analysis – excluding North America/Europe and Africa**

