

### Supplementary materials

**Table S1.** Baseline characteristics, observational period, and outcome incidences of 17,573 male students stratified by breakfast frequency.

**Table S2.** Baseline characteristics, observational period, and incidence of outcomes of 17,573 male students stratified by lunch frequency.

**Table S3.** Baseline characteristics, observational period, and outcome incidences of 8860 female students stratified by breakfast frequency.

**Table S4.** Baseline characteristics, observational period, and outcome incidences of 8860 female students stratified by lunch frequency.

**Table S5.** Baseline characteristics of 212 male students with baseline dinner frequency of skipping  $\geq$  occasionally who underwent annual health checkup 1 year after admission.

**Table S6.** Baseline characteristics of 288 female students with baseline dinner frequency of skipping  $\geq$  occasionally who underwent annual health checkup 1 year after admission.

**Figure S1.** Annual health checkups during the observational period in students admitted on April (n = 29985) and October (n = 159).

**Figure S2.** Breakfast frequency and the cumulative probabilities of the incidence of weight gain  $\geq$  10% (a, b) and BMI  $\geq$  25 kg/m<sup>2</sup> (c, d) in male (a, c) and female (b, d) students.

**Figure S3.** Lunch frequency and the cumulative probabilities of the incidence of weight gain  $\geq$  10% (a, b) and BMI  $\geq$  25 kg/m<sup>2</sup> (c, d) in male (a, c) and female (b, d) students.

**Table S1.** Baseline characteristics, observational period, and outcome incidences of 17,573 male students stratified by breakfast frequency.

<b>Breakfast frequency</b>	<b>Eating every day</b>	<b>Skipping occasionally</b>	<b>Skipping <math>\geq</math> often</b>	<b>P</b>
Number	14,233	2275	1065	
Baseline characteristics at admission				
Age, 18 years, n (%)	9438 (66.3)	1326 (58.3)	578 (54.3)	< 0.001
19	4413 (31.0)	820 (36.0)	392 (36.8)	
20	263 (1.8)	82 (3.6)	42 (3.9)	
21–60	119 (0.8)	47 (2.1)	53 (5.0)	
Height, cm	171.4 $\pm$ 5.7	171.0 $\pm$ 5.7	171.0 $\pm$ 5.5	0.763
Body weight, kg	63.6 $\pm$ 9.4	62.8 $\pm$ 9.3	62.1 $\pm$ 9.2	< 0.001
BMI, kg/m <sup>2</sup>	21.6 $\pm$ 2.9	21.5 $\pm$ 2.9	21.2 $\pm$ 2.9	< 0.001
< 25.0 kg/m <sup>2</sup> , n (%)	12,657 (88.9)	2033 (89.4)	966 (90.7)	0.181
$\geq$ 25.0	1576 (11.1)	242 (10.6)	99 (9.3)	
Smokers, n (%)	45 (0.3)	35 (1.5)	17 (1.6)	< 0.001
Drinkers, n (%)	1156 (8.1)	317 (13.9)	185 (17.4)	< 0.001
Sleep duration, < 5 hours, n (%)	424 (3.0)	71 (3.1)	52 (4.9)	< 0.001
5–6	4558 (32.0)	714 (31.4)	332 (31.2)	
6–7	6951 (48.8)	1071 (47.1)	451 (42.3)	
7–8	2019 (14.2)	327 (14.4)	175 (16.4)	
$\geq$ 8	281 (2.0)	92 (4.0)	55 (5.2)	
Lunch, Eating every day, n (%)	13,639 (95.8)	1956 (86.0)	853 (80.1)	< 0.001
Skipping $\geq$ occasionally	594 (4.2)	319 (14.0)	212 (19.9)	
Dinner, Eating every day, n (%)	14,115 (99.2)	2170 (95.4)	1022 (96.0)	< 0.001
Skipping $\geq$ occasionally	118 (0.8)	105 (4.6)	43 (4.0)	
Dinner time, before 7 PM, n (%)	2708 (19.0)	387 (17.0)	160 (15.0)	< 0.001
7–9 PM	9310 (65.4)	1487 (65.4)	656 (61.6)	
9–11 PM	2093 (14.7)	371 (16.3)	217 (20.4)	
after 11 PM	122 (0.9)	30 (1.3)	32 (3.0)	
Observational period and outcome incidences				
Observational period (years)	3.0 $\pm$ 0.9	3.0 $\pm$ 0.9	2.9 $\pm$ 1.0	0.020
Weight gain $\geq$ 10%, n (%)	1512 (10.6)	242 (10.6)	142 (13.3)	0.022
IR per 1000 PY (95% CI)	35.5 (33.7, 37.3)	35.8 (31.6, 40.6)	45.6 (38.7, 53.8)	
BMI $\geq$ 25 kg/m <sup>2</sup> , n (%)	534 (4.2)	97 (4.8)	40 (4.1)	0.508
IR per 1000 PY (95% CI)	13.8 (12.7, 15.1)	15.9 (13.0, 19.3)	13.9 (10.2, 19.0)	

Mean  $\pm$  standard deviation; BMI, body mass index; CI, confidence interval, IR, incidence rate; PY, person-year.

**Table S2.** Baseline characteristics, observational period, and incidence of outcomes of 17,573 male students stratified by lunch frequency.

<b>Lunch frequency</b>	<b>Eating every day</b>	<b>Skipping <math>\geq</math> occasionally</b>	<b>P</b>
Number	16,448	1125	
Baseline characteristics at admission			
Age, 18 years, n (%)	10,772 (65.5)	570 (50.7)	< 0.001
19	5171 (31.4)	454 (40.4)	
20	325 (2.0)	62 (5.5)	
21–60	180 (1.1)	39 (3.5)	
Height, cm	171.3 $\pm$ 5.7	171.0 $\pm$ 5.7	0.763
Body weight, kg	63.4 $\pm$ 9.4	63.7 $\pm$ 10.0	0.324
BMI, kg/m <sup>2</sup>	21.6 $\pm$ 2.9	21.7 $\pm$ 3.1	0.078
< 25.0 kg/m <sup>2</sup> , n (%)	14,682 (89.3)	974 (86.6)	0.005
$\geq$ 25.0	1766 (10.7)	151 (13.4)	
Smokers, n (%)	70 (0.4)	27 (2.4)	< 0.001
Drinkers, n (%)	1463 (8.9)	195 (17.3)	< 0.001
Sleep duration, < 5 hours, n (%)	484 (2.9)	63 (5.6)	< 0.001
5–6	5207 (31.7)	397 (35.3)	
6–7	8010 (48.7)	463 (41.2)	
7–8	2369 (14.4)	152 (13.5)	
$\geq$ 8	378 (2.3)	50 (4.4)	
Breakfast, Eating every day, n (%)	13,639 (82.9)	594 (52.8)	< 0.001
Skipping occasionally	1956 (11.9)	319 (28.4)	
Skipping $\geq$ often	853 (5.2)	212 (18.8)	
Dinner, Eating every day, n (%)	16,327 (99.3)	980 (87.1)	< 0.001
Skipping $\geq$ occasionally	121 (0.7)	145 (12.9)	
Dinner time, before 7 PM, n (%)	3078 (18.7)	177 (15.7)	< 0.001
7–9 PM	10,747 (65.3)	706 (62.8)	
9–11 PM	2466 (15.0)	215 (19.1)	
after 11 PM	157 (1.0)	27 (2.4)	
Observational period and outcome incidences			
Observational period (years)	3.0 $\pm$ 0.9	3.0 $\pm$ 0.9	0.904
Weight gain $\geq$ 10%, n (%)	1760 (10.7)	136 (12.1)	0.146
IR per 1000 PY (95% CI)	35.8 (34.2, 37.5)	40.5 (34.2, 47.9)	
BMI $\geq$ 25 kg/m <sup>2</sup> , n (%)	621 (4.2)	50 (5.1)	0.177
IR per 1000 PY (95% CI)	13.9 (12.9, 15.0)	17.0 (12.9, 22.5)	

Mean  $\pm$  standard deviation; BMI, body mass index; CI, confidence interval, IR, incidence rate; PY, person-year.

**Table S3.** Baseline characteristics, observational period, and outcome incidences of 8860 female students stratified by breakfast frequency.

<b>Breakfast frequency</b>	<b>Eating every day</b>	<b>Skipping occasionally</b>	<b>Skipping <math>\geq</math> often</b>	<b>P</b>
Number	7793	782	285	
<b>Baseline characteristics at admission</b>				
Age, 18 years, n (%)	5832 (74.8)	536 (68.5)	169 (59.3)	< 0.001
19	1784 (22.9)	192 (24.6)	76 (26.7)	
20	111 (1.4)	28 (3.6)	21 (7.4)	
21–60	66 (0.8)	26 (3.3)	19 (6.7)	
Height, cm	158.4 $\pm$ 5.2	158.2 $\pm$ 5.1	158.7 $\pm$ 5.6	0.250
Body weight, kg	51.6 $\pm$ 6.8	51.0 $\pm$ 6.9	51.5 $\pm$ 7.0	0.088
BMI, kg/m <sup>2</sup>	20.5 $\pm$ 2.4	20.4 $\pm$ 2.5	20.4 $\pm$ 2.4	0.137
< 25.0 kg/m <sup>2</sup> , n (%)	7450 (95.6)	740 (94.6)	275 (96.5)	0.334
$\geq$ 25.0	343 (4.4)	42 (5.4)	10 (3.5)	
Smokers, n (%)	7 (0.1)	4 (0.5)	2 (0.7)	0.001
Drinkers, n (%)	309 (4.0)	67 (8.6)	42 (14.7)	< 0.001
Sleep duration, < 5 hours, n (%)	212 (2.7)	35 (4.5)	17 (6.0)	< 0.001
5–6	2790 (35.8)	276 (35.3)	93 (32.6)	
6–7	3753 (48.2)	341 (43.6)	115 (40.4)	
7–8	951 (12.2)	112 (14.3)	46 (16.1)	
$\geq$ 8	87 (1.1)	18 (2.3)	14 (4.9)	
Lunch, Eating every day, n (%)	7546 (96.8)	679 (86.8)	226 (79.3)	< 0.001
Skipping $\geq$ occasionally	247 (3.2)	103 (13.2)	59 (20.7)	
Dinner, Eating every day, n (%)	7538 (96.7)	707 (90.4)	257 (90.2)	< 0.001
Skipping $\geq$ occasionally	255 (3.3)	75 (9.6)	28 (9.8)	
Dinner time, before 7 PM, n (%)	2100 (26.9)	137 (17.5)	51 (17.9)	< 0.001
7–9 PM	4917 (63.1)	519 (66.4)	175 (61.4)	
9–11 PM	746 (9.6)	121 (15.5)	53 (18.6)	
after 11 PM	30 (0.4)	5 (0.6)	6 (2.1)	
<b>Observational period and outcome incidences</b>				
Observational period (years)	3.0 $\pm$ 1.0	2.9 $\pm$ 1.0	2.9 $\pm$ 1.1	0.064
Weight gain $\geq$ 10%, n (%)	1338 (17.2)	138 (17.6)	42 (14.7)	0.519
IR per 1000 PY (95% CI)	58.1 (55.0, 61.3)	61.4 (51.9, 72.5)	50.4 (37.3, 68.3)	
BMI $\geq$ 25 kg/m <sup>2</sup> , n (%)	236 (3.2)	17 (2.3)	13 (4.7)	0.134
IR per 1000 PY (95% CI)	10.0 (8.8, 11.4)	7.5 (4.7, 12.1)	15.3 (8.9, 26.4)	

Mean  $\pm$  standard deviation; BMI, body mass index; CI, confidence interval, IR, incidence rate; PY, person-year.

**Table S4.** Baseline characteristics, observational period, and outcome incidences of 8860 female students stratified by lunch frequency.

<b>Lunch frequency</b>	<b>Eating every day</b>	<b>Skipping <math>\geq</math> occasionally</b>	<b>P</b>
Number	8451	409	
Baseline characteristics at admission			
Age, 18 years, n (%)	6283 (74.3)	254 (62.1)	< 0.001
19	1933 (22.9)	119 (29.1)	
20	140 (1.7)	20 (4.9)	
21-60	95 (1.1)	16 (3.9)	
Height, cm	158.4 $\pm$ 5.2	158.2 $\pm$ 5.6	0.250
Body weight, kg	51.5 $\pm$ 6.8	51.7 $\pm$ 6.9	0.483
BMI, kg/m <sup>2</sup>	20.5 $\pm$ 2.4	20.7 $\pm$ 2.4	0.221
< 25.0 kg/m <sup>2</sup> , n (%)	8078 (95.6)	387 (94.6)	0.356
$\geq$ 25.0	373 (4.4)	22 (5.4)	
Smokers, n (%)	11 (0.1)	2 (0.5)	0.064
Drinkers, n (%)	370 (4.4)	48 (11.7)	< 0.001
Sleep duration, < 5 hours, n (%)	241 (2.9)	23 (5.6)	< 0.001
5-6	3011 (35.6)	148 (36.2)	
6-7	4045 (47.9)	164 (40.1)	
7-8	1045 (12.4)	64 (15.6)	
$\geq$ 8	109 (1.3)	10 (2.4)	
Breakfast, Eating every day, n (%)	7546 (89.3)	247 (60.4)	< 0.001
Skipping occasionally	679 (8.0)	103 (25.2)	
Skipping $\geq$ often	226 (2.7)	59 (14.4)	
Dinner, Eating every day, n (%)	8178 (96.8)	324 (79.2)	< 0.001
Skipping $\geq$ occasionally	273 (3.2)	85 (20.8)	
Dinner time, before 7 PM, n (%)	2204 (26.1)	84 (20.5)	0.006
7-9 PM	5347 (63.3)	264 (64.5)	
9-11 PM	863 (10.2)	57 (13.9)	
after 11 PM	37 (0.4)	4 (1.0)	
Observational period and outcome incidences			
Observational period (years)	2.9 $\pm$ 1.0	2.9 $\pm$ 1.0	0.412
Weight gain $\geq$ 10%, n (%)	1452 (17.2)	66 (16.1)	0.583
IR per 1000 PY (95% CI)	58.2 (55.3, 61.3)	55.5 (43.6, 70.6)	
BMI $\geq$ 25 kg/m <sup>2</sup> , n (%)	250 (3.1)	16 (4.1)	0.253
IR per 1000 PY (95% CI)	9.8 (8.7, 11.1)	13.6 (8.4, 22.3)	

Mean  $\pm$  standard deviation; BMI, body mass index; CI, confidence interval, IR, incidence rate; PY, person-year.

**Table S5.** Baseline characteristics of 212 male students with baseline dinner frequency of skipping  $\geq$  occasionally who underwent an annual health checkup 1 year after admission.

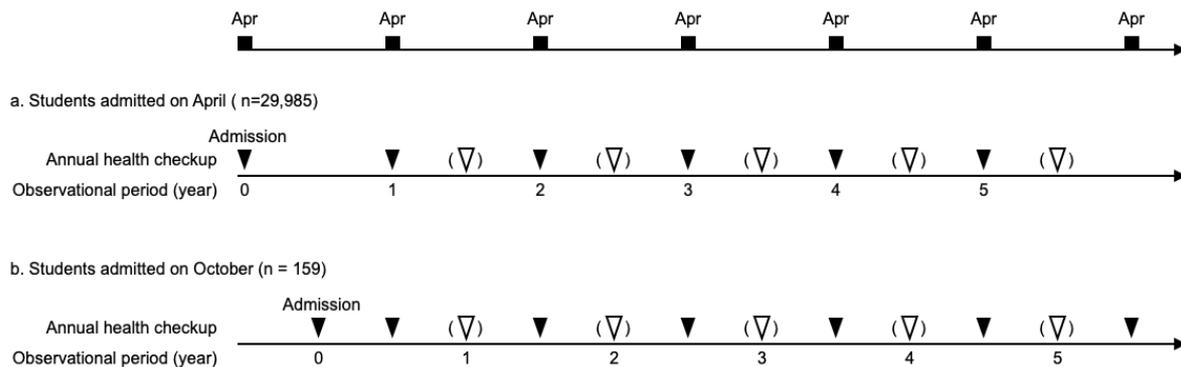
<b>Dinner frequency 1 year after admission</b>	<b>Eating every day</b>	<b>Skipping <math>\geq</math> occasionally</b>	<b>P</b>
Number	164	48	
Baseline characteristics at admission			
Age, 18 years, n (%)	64 (39.0)	23 (47.9)	0.330
19	79 (48.2)	19 (39.6)	
20	14 (8.5)	2 (4.2)	
21-60	7 (4.3)	4 (8.3)	
Height, cm	171.0 $\pm$ 5.6	170.7 $\pm$ 6.1	0.770
Body weight, kg	66.2 $\pm$ 10.8	72.1 $\pm$ 18.8	0.007
BMI, kg/m <sup>2</sup>	22.6 $\pm$ 3.5	24.6 $\pm$ 5.8	0.004
< 25.0 kg/m <sup>2</sup> , n (%)	133 (81.1)	31 (64.6)	0.016
$\geq$ 25.0	31 (18.9)	17 (35.4)	
Smokers, n (%)	3 (1.8)	4 (8.3)	0.027
Drinkers, n (%)	41 (25.0)	6 (12.5)	0.067
Sleep duration, < 5 hours, n (%)	10 (6.1)	5 (10.4)	0.624
5-6	64 (39.0)	20 (41.7)	
6-7	65 (39.6)	14 (29.2)	
7-8	21 (12.8)	7 (14.6)	
$\geq$ 8	4 (2.4)	2 (4.2)	
Breakfast, Eating every day, n (%)	74 (45.1)	23 (47.9)	0.174
Skipping occasionally	58 (35.4)	21 (43.8)	
Skipping $\geq$ often	32 (19.5)	4 (8.3)	
Lunch, Eating every day, n (%)	78 (47.6)	24 (50.0)	0.766
Skipping $\geq$ occasionally	86 (52.4)	24 (50.0)	
Dinner time, before 7 PM, n (%)	32 (19.5)	12 (25.0)	0.594
7-9 PM	88 (53.7)	27 (56.3)	
9-11 PM	35 (21.3)	8 (16.7)	
after 11 PM	9 (5.5)	1 (2.1)	

Mean  $\pm$  standard deviation; BMI, body mass index

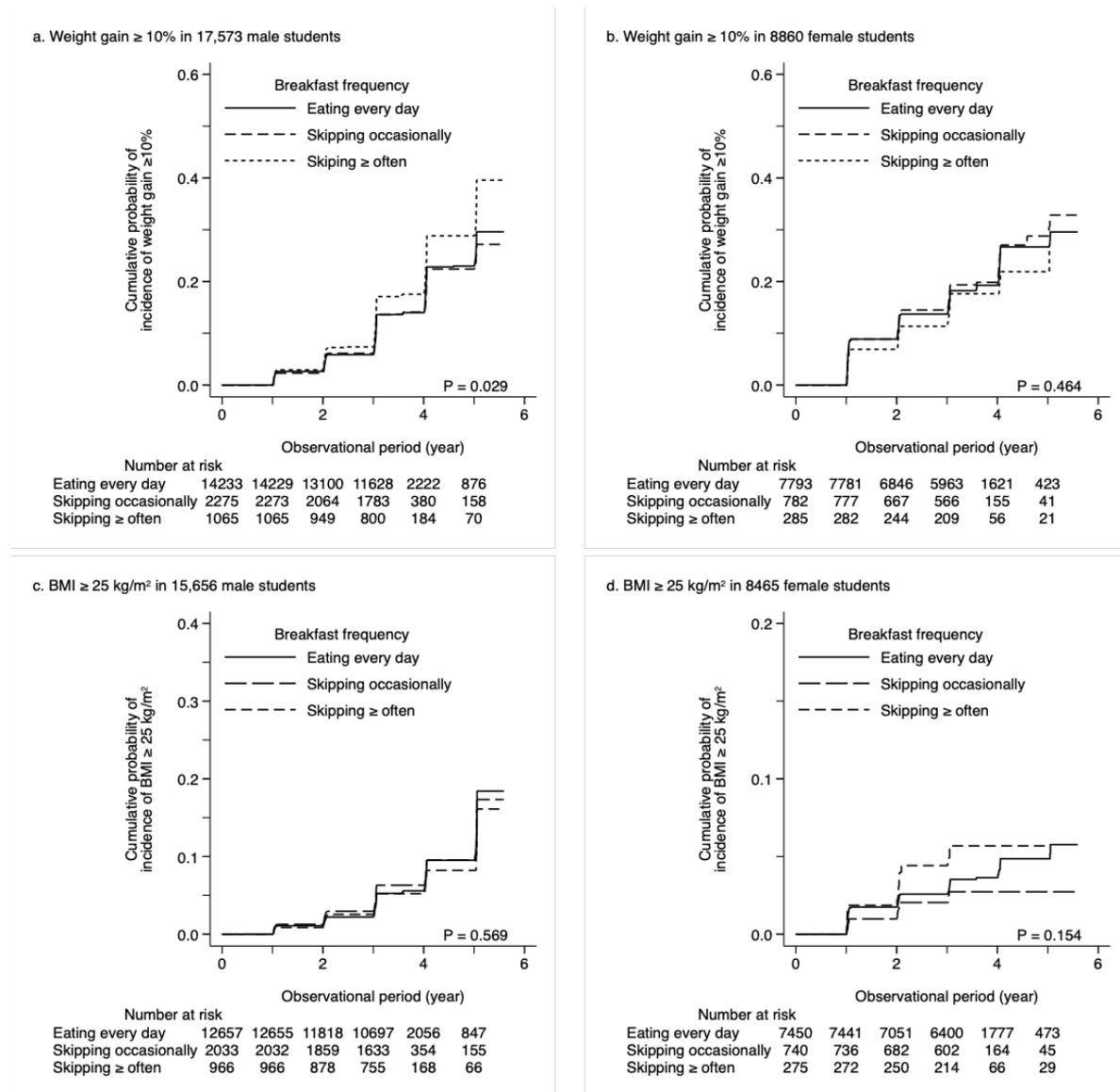
**Table S6.** Baseline characteristics of 287 female students with baseline dinner frequency of skipping  $\geq$  occasionally who underwent an annual health checkup 1 year after admission.

<b>Dinner frequency 1 year after admission</b>	<b>Eating every day</b>	<b>Skipping <math>\geq</math> occasionally</b>	<b>P</b>
Number	171	116	
Baseline characteristics at admission			
Age, 18 years, n (%)	100 (58.5)	65 (56.0)	0.971
19	56 (32.7)	41 (35.3)	
20	8 (4.7)	5 (4.3)	
21-60	7 (4.1)	5 (4.3)	
Height, cm	158.6 $\pm$ 5.4	159.0 $\pm$ 4.9	0.446
Body weight, kg	53.1 $\pm$ 7.3	53.2 $\pm$ 7.0	0.887
BMI, kg/m <sup>2</sup>	21.1 $\pm$ 2.6	21.0 $\pm$ 2.3	0.763
< 25.0 kg/m <sup>2</sup> , n (%)	158 (92.4)	107 (92.2)	0.961
$\geq$ 25.0	13 (7.6)	9 (7.8)	
Smokers, n (%)	0 (0.0)	2 (1.7)	0.085
Drinkers, n (%)	19 (11.1)	21 (18.1)	0.093
Sleep duration, < 5 hours, n (%)	9 (5.3)	7 (6.0)	0.494
5-6	63 (36.8)	42 (36.2)	
6-7	66 (38.6)	45 (38.8)	
7-8	31 (18.1)	17 (14.7)	
$\geq$ 8	2 (1.2)	5 (4.3)	
Breakfast, Eating every day, n (%)	117 (68.4)	86 (74.1)	0.140
Skipping occasionally	42 (24.6)	18 (15.5)	
Skipping $\geq$ often	12 (7.0)	12 (10.3)	
Lunch, Eating every day, n (%)	130 (76.0)	92 (79.3)	0.514
Skipping $\geq$ occasionally	41 (24.0)	24 (20.7)	
Dinner time, before 7 PM, n (%)	45 (26.3)	45 (38.8)	0.074
7-9 PM	101 (59.1)	54 (46.6)	
9-11 PM	25 (14.6)	16 (13.8)	
after 11 PM	0 (0.0)	1 (0.9)	

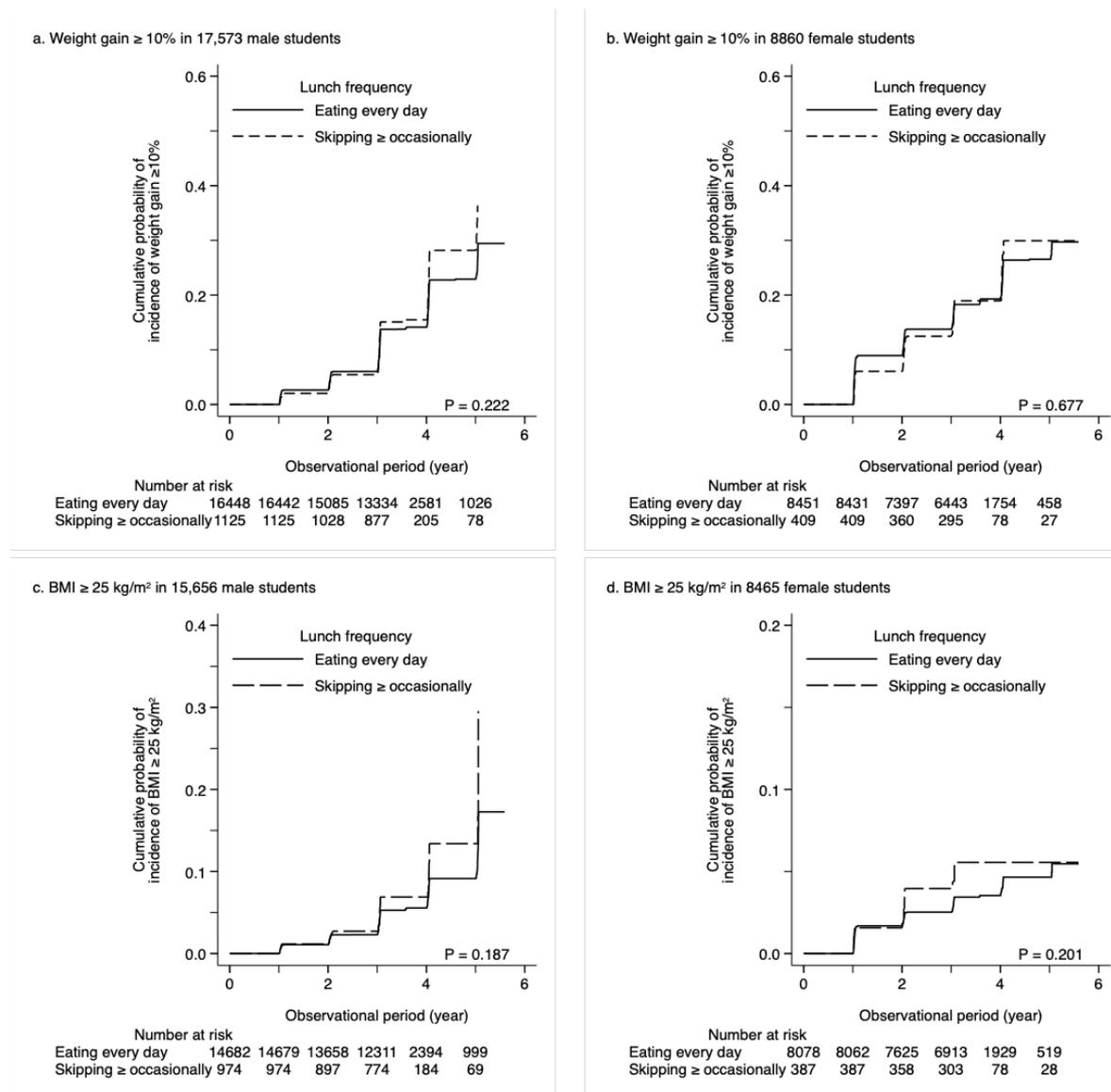
Mean  $\pm$  standard deviation; BMI, body mass index



**Figure S1.** Annual health checkups during the observational period in students admitted on April ( $n = 29,985$ ) and October ( $n = 159$ ). The vast majority of students underwent their annual health checkups every April after admission (black triangle). The university provided alternative health checkups on Octobers (white triangle) for students who could not undergo their health checkups on April.



**Figure S2.** Breakfast frequency and the cumulative probabilities of the incidence of weight gain  $\geq 10\%$  (a, b) and BMI  $\geq 25$  kg/m<sup>2</sup> (c, d) in male (a, c) and female (b, d) students. BMI, body mass index.



**Figure S3.** Lunch frequency and the cumulative probabilities of the incidence of weight gain  $\geq 10\%$  (a, b) and BMI  $\geq 25$  kg/m<sup>2</sup> (c, d) in male (a, c) and female (b, d) students. BMI, body mass index.