# **Supplement Materials**

# Highlighting the importance of healthy sleep patterns in the risk of

## adult asthma under the combined effects of genetic susceptibility: a

### large-scale prospective cohort study of 455,405 participants

Running title: Healthy sleep pattern and asthma

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#### **Supplement Text:**

#### Questions and the options of the 5 sleep traits.

- Chronotype was assessed using the question: 'Do you consider yourself to be (a) definitely a "morning" person, (b) more a "morning" than "evening" person, (c) 'more an "evening" than "morning" person', or (d) definitely an "evening" person'.
- Sleep duration was recorded by asking 'About how many hours sleep do you get in every 24 h? (include naps)'. Sleep duration was further categorized as short (<7 h/day), normal (7–8 h/ day), and long (>\_9 h/day) in this research.
- Insomnia was obtained by the question 'Do you have trouble falling asleep at night or do you wake up in the middle of the night?' with responses of (a) never/rarely, (b) sometimes, or (c) usually.
- Snoring was collected by the question 'Does your partner or a close relative or friend complain about your snoring?' with responses of (i) yes or (ii) no.
- 5) Daytime sleepiness was coded based on the question 'How likely are you to doze off or fall asleep during the daytime when you don't mean to? (e.g. when working, reading or driving)' with responses of (a) never/rarely, (b) sometimes, (c) often, or (d) all of the time.

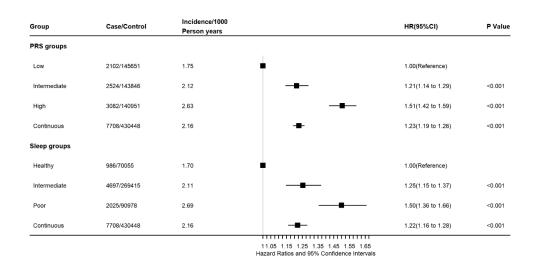


Figure S1. Multivariable-adjusted HRs (95%CIs) for asthma risk by polygenic

risk score (PRS) and sleep patterns in 5-year lag analysis.

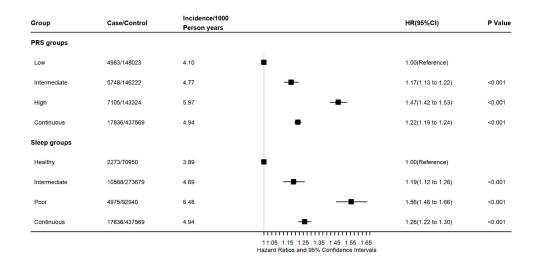


Figure S2. Multivariable-adjusted HRs (95%CIs) for asthma risk by polygenic

risk score (PRS) and sleep patterns in basic covariates adjustment analysis.

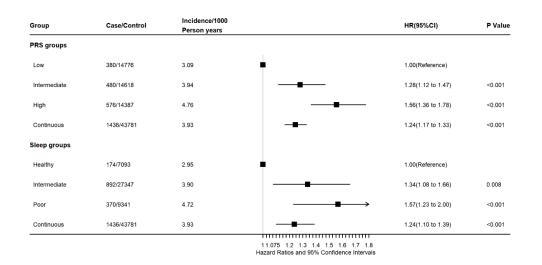


Figure S3. Multivariable-adjusted HRs (95%CIs) for asthma risk by polygenic

risk score (PRS) and sleep patterns in repeated measurement participants.

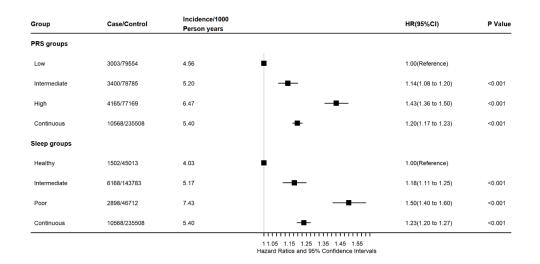


Figure S4. Multivariable-adjusted HRs (95%CIs) for asthma risk by polygenic risk score (PRS) and sleep patterns in females.

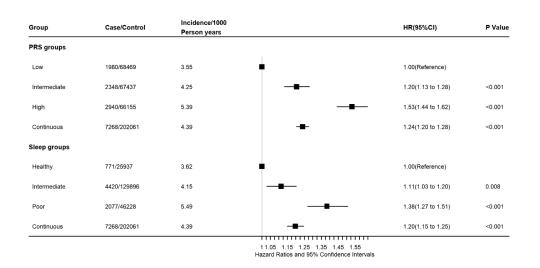


Figure S5. Multivariable-adjusted HRs (95%CIs) for asthma risk by polygenic

risk score (PRS) and sleep patterns in males.

Group	Case/Control	Incidence/1000 Person years	HR(95%CI)	P Value
Low Genetic Risk				
Healthy Sleep	251/23452	1.30	1.00(Reference)	
Intermediate sleep	1295/90992	1.73		0.003
Poor sleep	556/31207	2.16	1.67(1.38 to 2.02)	<0.001
Intermediate Genetic Risk				
Healthy Sleep	337/23637	1.73	1.24(1.01 to 1.53)	0.041
Intermediate sleep	1504/89976	2.02		<0.001
Poor sleep	683/30233	2.73	1.83(1.52 to 2.21)	<0.001
High Genetic Risk				
Healthy Sleep	398/22966	2.09	1.60(1.31 to 1.95)	<0.001
Intermediate sleep	1898/88447	2.58	1.93(1.63 to 2.28)	<0.001
Poor sleep	786/29538	3.20	→ 2.25(1.87 to 2.70)	<0.001
			1 1.5 2 2.5 Hazard Ratios and 95% Confidence Intervals	

Figure S6. The joint association of genetic risk and sleep pattern with asthma in 5-year lag analysis.

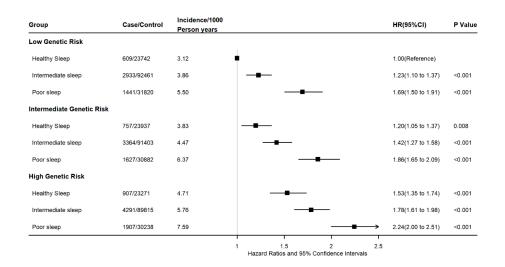


Figure S7. The joint association of genetic risk and sleep pattern with asthma in basic covariates adjustment analysis.

Group	Case/Control	Incidence/1000 Person years		HR(95%CI)	P Valu
Low Genetic Risk					
Healthy Sleep	38/2363	1.94	•	1.00(Reference)	
Intermediate sleep	236/9249	3.07		1.60(1.03 to 2.47)	0.035
Poor sleep	106/3164	4.00	<b>-</b> >	1.93(1.20 to 3.12)	0.007
Intermediate Genetic Risk					
Healthy Sleep	64/2417	3.19	<∎>	1.51(0.91 to 2.52)	0.114
Intermediate sleep	293/9079	3.87	<b>-</b>	1.85(1.20 to 2.84)	0.005
Poor sleep	123/3122	4.70	<b>_</b> >	2.15(1.34 to 3.45)	0.001
High Genetic Risk					
Healthy Sleep	72/2313	3.73	<b>_</b> >	1.72(1.03 to 2.86)	0.037
Intermediate sleep	363/9019	4.78	<b>_</b> >	2.21(1.44 to 3.38)	<0.001
Poor sleep	141/3055	5.49		2.54(1.60 to 4.04)	<0.001
			1 1.5 2 2.5 Hazard Ratios and 95% Confidence Intervals		

Figure S8. The joint association of genetic risk and sleep pattern with asthma in repeated measurement participants.

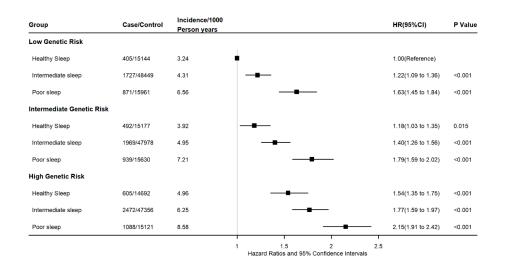


Figure S9. The joint association of genetic risk and sleep pattern with asthma in

females.

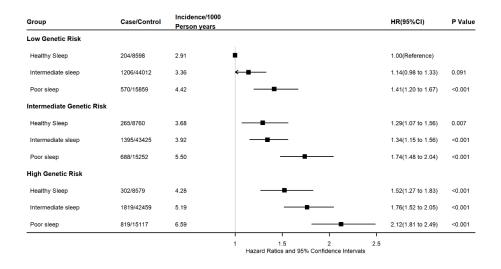


Figure S10. The joint association of genetic risk and sleep pattern with asthma in

males.

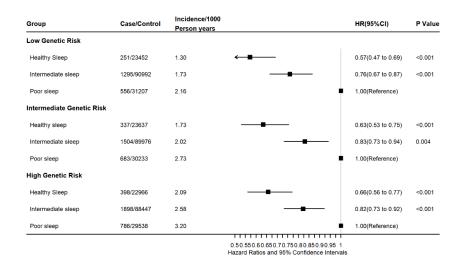


Figure S11. The associations between sleep pattern and risk of asthma by polygenic risk score (PRS) category in 5-year lag analysis.

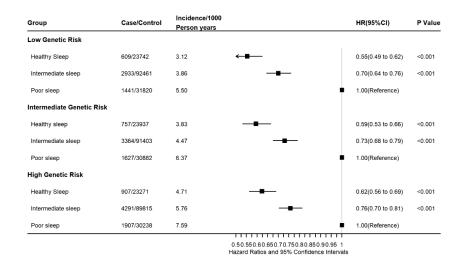


Figure S12. The associations between sleep pattern and risk of asthma by polygenic risk score (PRS) category in basic covariates adjustment analysis.

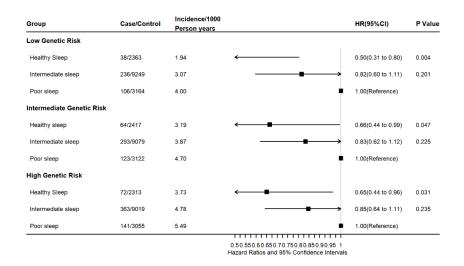


Figure S13. The associations between sleep pattern and risk of asthma by polygenic risk score (PRS) category in repeated measurement participants.

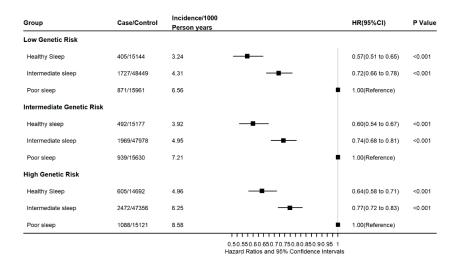


Figure S14. The associations between sleep pattern and risk of asthma by polygenic risk score (PRS) category in females.

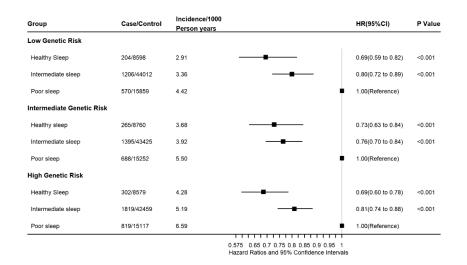


Figure S15. The associations between sleep pattern and risk of asthma by polygenic risk score (PRS) in males.

HR(95%CI)		P Value	% of participants at risk	PAR%
0.74(0.70 to 0.78)	•	<0.001	66.28	19.15
0.82(0.77 to 0.88)		<0.001	26.23	5.39
0.96(0.90 to 1.02)		- 0.180	43.93	1.83
0.80(0.75 to 0.85)	<b></b>	<0.001	27.51	6.58
0.91(0.86 to 0.97)	8	0.004	41.39	3.82
0.84(0.78 to 0.90)	_∎	<0.001	23.42	4.41
0.76(0.70 to 0.83)	-	<0.001	83.79	20.68
	0.74(0.70 to 0.78) 0.82(0.77 to 0.88) 0.96(0.90 to 1.02) 0.80(0.75 to 0.85) 0.91(0.86 to 0.97) 0.84(0.78 to 0.90)	0.74(0.70 to 0.78)	0.74(0.70 to 0.78) <0.001	P Value at risk   0.74(0.70 to 0.78)    0.82(0.77 to 0.88)    0.82(0.77 to 0.88)    0.96(0.90 to 1.02) 0.180   0.80(0.75 to 0.85)    0.91(0.86 to 0.97) 0.004   0.91(0.78 to 0.90)

#### Figure S16. Multivariable-adjusted HRs (95%CIs) and PAR% for asthma risk by

low-risk factors in 5-year lag analysis.

Healthy factors	HR(95%CI)		P Value	% of participants at risk	PAR%
Genetic trait					
Low genetic risk	0.76(0.73 to 0.78)	•	<0.001	66.40	17.54
Sleep traits					
Sleep 7–9 h/day	0.79(0.76 to 0.82)		<0.001	26.45	6.65
Early chronotype	0.93(0.89 to 0.96)		<0.001	43.97	3.40
Never/rarely insomnia	0.75(0.72 to 0.78)		<0.001	27.79	8.56
No self-reported snoring	0.91(0.87 to 0.95)	<b></b>	<0.001	41.49	3.94
No frequent daytime sleepiness	0.85(0.81 to 0.89)	- <b>-</b>	<0.001	23.65	4.02
All healthy sleep factors	0.78(0.74 to 0.83)	-	<0.001	83.92	18.90
		0.725 0.775 0.825 0.875 0.925 0.975 Hazard Ratios and 95% Confidence Interva			

Figure S17. Multivariable-adjusted HRs (95%CIs) and PAR% for asthma risk by

low-risk factors in basic covariates adjustment analysis.

Healthy factors	HR(95%CI)			P Value	% of participants at risk	PAR%
Genetic trait						
Low genetic risk	0.71(0.63 to 0.80)	•		<0.001	66.48	21.70
Sleep traits						
Sleep 7–9 h/day	0.80(0.68 to 0.94)	<b></b>		0.006	22.46	5.42
Early chronotype	0.95(0.83 to 1.10)			0.515	44.80	2.14
Never/rarely insomnia	0.81(0.70 to 0.95)			0.008	24.59	5.30
No self-reported snoring	1.11(0.95 to 1.30)	_		0.198	39.83	-4.06
No frequent daytime sleepiness	0.80(0.67 to 0.95)	<b>—•</b>		0.010	20.38	4.89
All healthy sleep factors	0.72(0.58 to 0.89)			0.002	83.93	24.79
		0.575 0.7 0.8 0.9 1 Hazard Ratios and 95% C	1.075 1.2 1.3			

Figure S18. Multivariable-adjusted HRs (95%CIs) and PAR% for asthma risk by low-risk factors in repeated measurement participants.

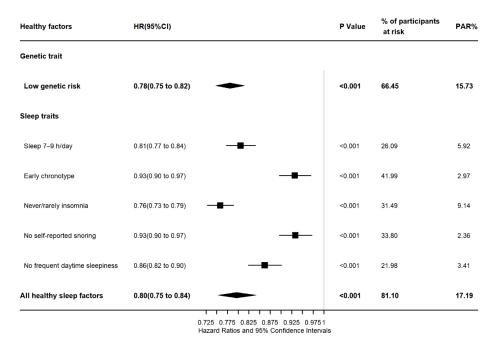


Figure S19. Multivariable-adjusted HRs (95%CIs) and PAR% for asthma risk by

low-risk factors in females.

Healthy factors	HR(95%CI)		P Value	% of participants at risk	PAR%
Genetic trait					
Low genetic risk	0.73(0.69 to 0.77)	•	<0.001	66.35	19.48
Sleep traits					
Sleep 7–9 h/day	0.83(0.79 to 0.88)		<0.001	26.88	5.17
Early chronotype	1.00(0.95 to 1.05)		0.959	46.30	0.06
Never/rarely insomnia	0.78(0.74 to 0.82)		<0.001	23.45	6.35
No self-reported snoring	0.92(0.88 to 0.97)		0.001	50.52	3.99
No frequent daytime sleepiness	0.89(0.84 to 0.94)		<0.001	25.61	3.10
All healthy sleep factors	0.85(0.78 to 0.91)		<0.001	87.24	13.62

Hazard Ratios and 95% Confidence Intervals

#### Figure S20. Multivariable-adjusted HRs (95%CIs) and PAR% for asthma risk by

low-risk factors in males.