

How does short- and long-term PM2.5 exposure affect depression? A cohort study from 2014-2018 China Labor-force Dynamics Survey

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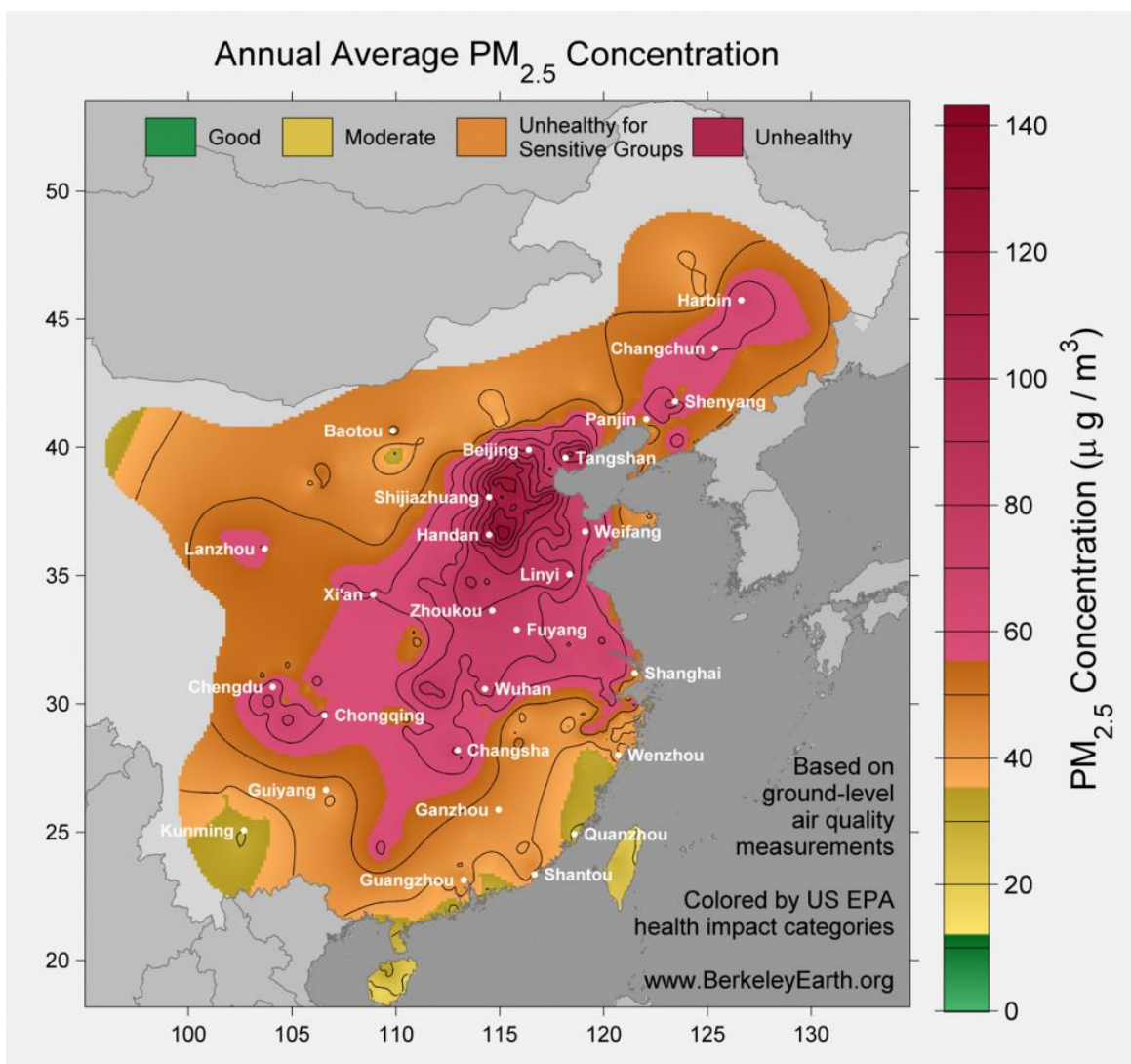


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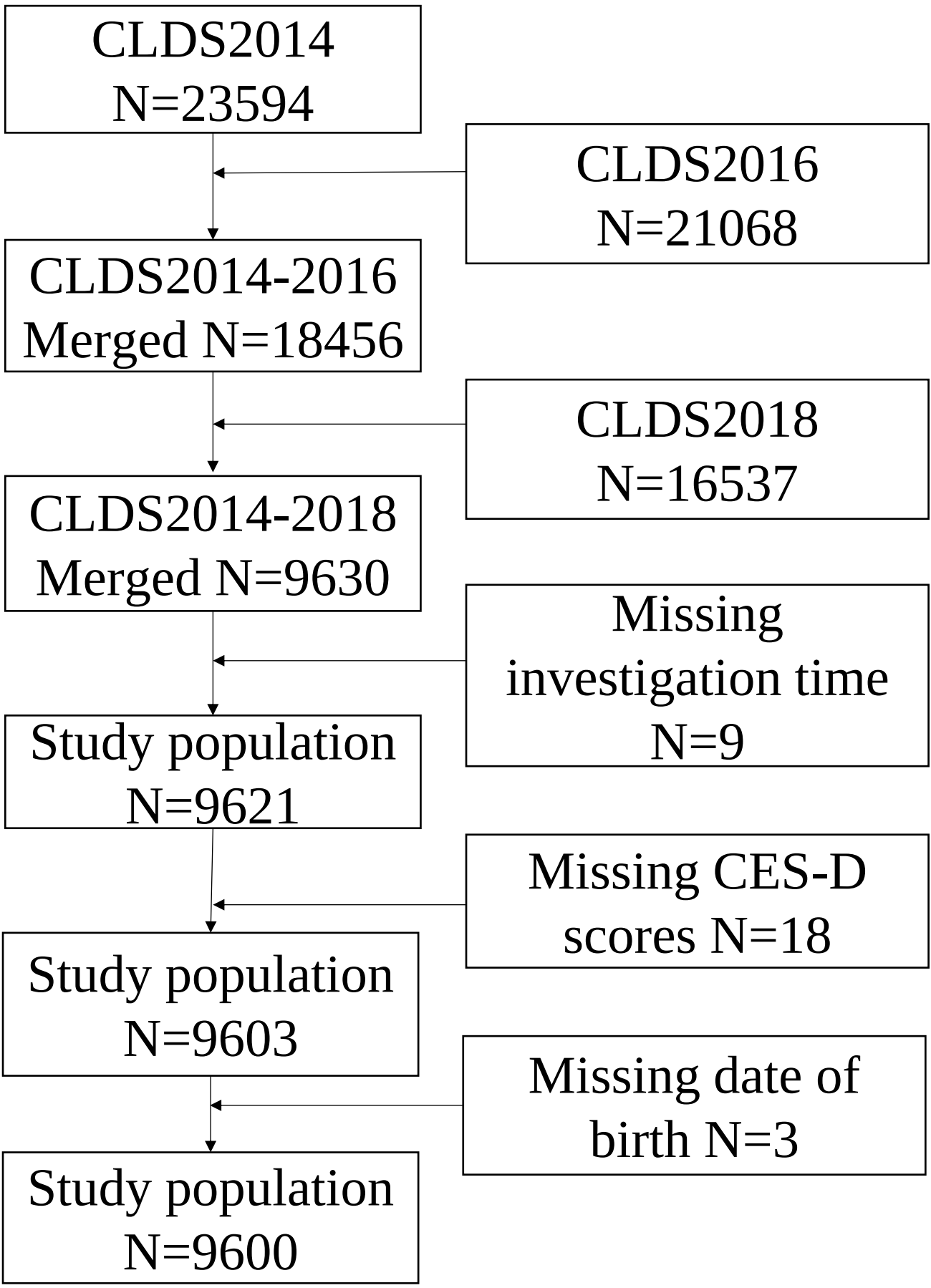
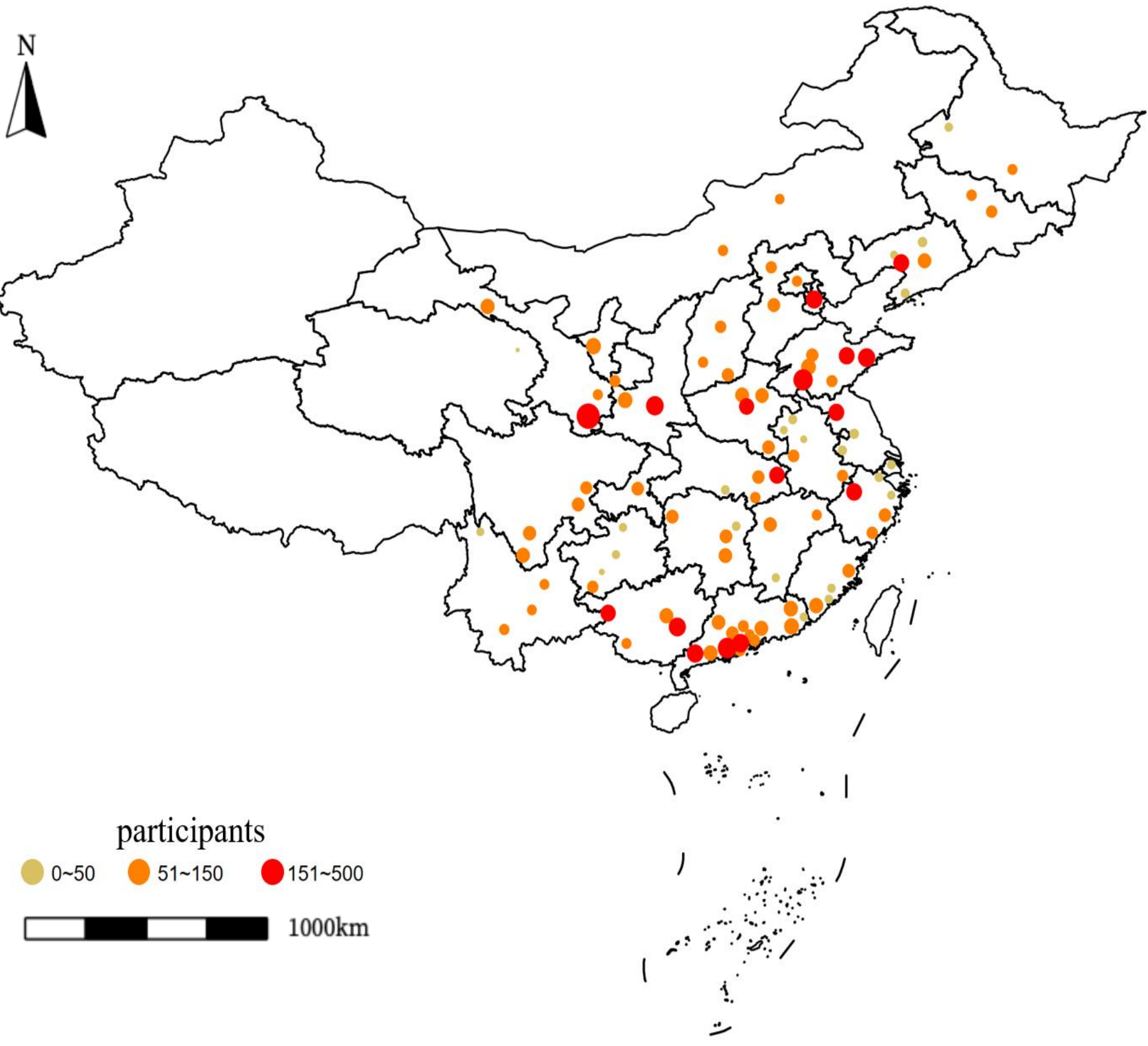
◆ Introduction

- Depression has become a severe public health problem in China and worldwide
- the adverse mental health effects of air pollution (especially PM_{2.5}) are of increasing concern
- epidemiological results on the relationship between PM_{2.5} exposure and depression remain inconsistent
- empirical evidence for the co-governance of depression and air pollution is limited

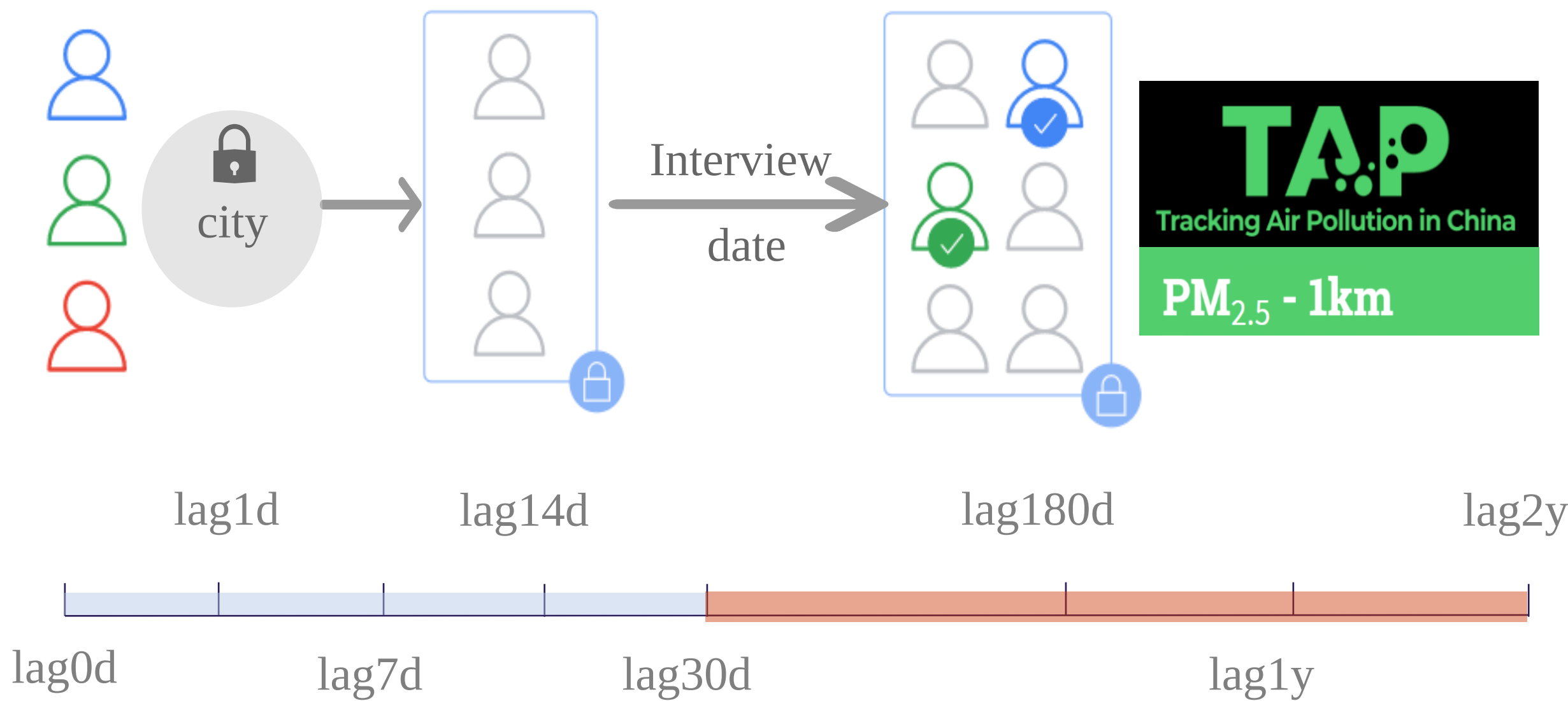
this study arms to investigate the single and overlapping effects of short- and long-term PM_{2.5} exposure on individual depression using a large national sample of the China population



◆ Study population



◆ Ambient PM2.5 exposure assessment



Short-term exposure windows Long-term exposure windows

- Daily average concentrations of PM_{2.5} from *Tracking Air Pollution in China*
- Matched concentrations with different participants by city and interview date

◆ Statistical analysis model: Two-way fixed effects model

$$Depscore_{it} = \alpha + \beta_1 Airpollution_{it} + \beta_2 X_{it} + u_i + \lambda_t + \varepsilon_{it}$$

$Depscore_{it}$: the depression status (measured by 20-item CES-D) of sample i at time t; $Airpollution_{it}$: the mean PM_{2.5} concentration across exposure windows of sample i at time t;

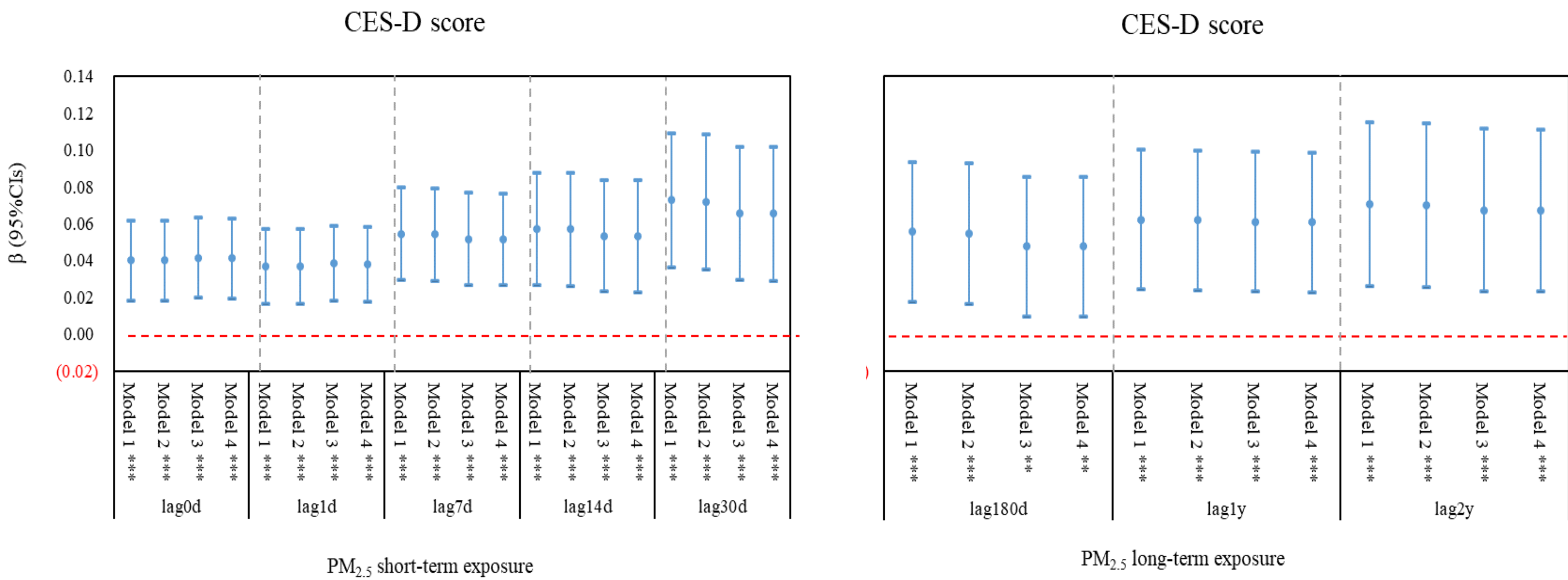
X_{it} : Covariates, i.e., sociodemographic factors, health-related factors and living habits of sample i at time t; β_1 : for every 1 $\mu\text{g}/\text{m}^3$ increment in PM_{2.5} concentration, the change of CES-D score;

u_i : Individual effect of sample i not varying over time; λ_t : Time effects that do not vary with sample i, i.e., year dummy variables; α : constant term; ε_{it} : random disturbance term

◆ Results

variables	N=9600	developed area N=4935	less developed area N=4665
Gender			
male	4308(44.9%)	2186(44.3%)	2122(45.5%)
female	5292(55.1%)	2749(55.7%)	2543(54.5%)
Age			
	48.9(±11.5)	47.9(±11.9)	50.0(±10.9)
Marital status			
married	8588(89.5%)	4313(87.4%)	4275(91.6%)
unmarried	1012(10.5%)	622(12.6%)	390(8.4%)
Education level			
none	1361(14.2%)	480(9.7%)	881(18.9%)
< 9 years	5950(62.0%)	3010(61.0%)	2940(63.0%)
9~16 years	1925(20.1%)	1189(24.1%)	736(15.8%)
≥ 16 years	364(3.8%)	256(5.2%)	108(2.3%)
Residence			
rural	7152(74.5%)	3328(67.4%)	3824(82.0%)
urban	2448(25.5%)	1607(32.6%)	841(18.0%)
Hukou			
rural	7376(76.8%)	3497(70.9%)	3879(83.2%)
non-rural	2224(23.2%)	1438(29.1%)	786(16.8%)
Annual personal income			
<12,000 RMB	3414(35.6%)	1199(24.3%)	2215(47.5%)
≥12,000 RMB	6186(64.4%)	3736(75.7%)	2450(52.5%)
Work status			
employed	8898(92.7%)	4584(92.9%)	4314(92.5%)
unemployed	702(7.3%)	351(7.1%)	351(7.5%)
Self-rated health			
healthy	5071(52.8%)	2860(57.9%)	2211(47.4%)
general	2821(29.4%)	1375(27.9%)	1446(31.0%)
unhealthy	1708(17.8%)	700(14.2%)	1008(21.6%)
BMI (kg/m²)			
	22.9(±3.3)	23.2(±3.4)	22.6(±3.2)
Smoke			
Yes	2345(24.4%)	1114(22.6%)	1231(26.4%)
No	7255(75.6%)	3821(77.4%)	3434(73.6%)
Drink			
Yes	1660(17.3%)	824(16.7%)	836(17.9%)
No	7940(82.7%)	4111(83.3%)	3829(82.1%)
Excise			
Yes	2571(26.8%)	1534(31.1%)	1037(22.2%)
No	7029(73.2%)	3401(68.9%)	3628(77.8%)
Depression			
Yes(CES-D >15)	1761(18.3%)	770(15.6%)	991(21.2%)
No (CES-D ≤15)	7839(81.7%)	4165(84.4%)	3674(78.8%)

➤ Effects short- and long-term PM2.5 exposure on depression



Model 1: crude model;

Model 2: adjusted for sociodemographic factors (gender, age, marital status, education level, residence, hukou, economic zone, annual personal income, and occupation)

Model 3: Moder2 + adjusted for health-related factors (self-rated health and BMI)

Model 4: Model3 + adjusted for living habits (smoke, drink, and excise)

➤ Effects of lag0d PM2.5 concentrations on depression at different long-term exposure levels

2-year mean concentrations of PM2.5	N	Model 1	Model 2	Model 3	Model 4
Low level exposure (<35 $\mu\text{g}/\text{m}^3$)	3,878 (40.4%)	0.0856*** (0.0212 – 0.1500)	0.0850*** (0.0205 – 0.1495)	0.0870*** (0.0235 – 0.1505)	0.0847*** (0.0213 – 0.1481)
High level exposure (≥35 $\mu\text{g}/\text{m}^3$)	5,722 (59.6%)	0.0370*** (0.0122 – 0.0618)	0.0383*** (0.0133 – 0.0632)	0.0408*** (0.0159 – 0.0658)	0.0409*** (0.0160 – 0.0658)

◆ Conclusion

- short- and long-term exposure to PM_{2.5} would significantly increase depression level
- Long-term exposure to PM_{2.5} is more harmful to depression than acute effects
- Individuals' depressive responses to short-term PM_{2.5} exposure varied by “adaptation level”, those with low background exposure were more susceptible to 0-day PM_{2.5} concentration

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