Supplementary Materials for

The joint effects of physical activity and air pollution on type 2 diabetes in Chinese adults

Linjun Ao[1*], Junmin Zhou[1*], Mingming Han[2], Hong Li[3], Yajie Li[4], Yongyue Pan[5], Jiayi Chen[1], Xiaofen Xie[1], Ye Jiang[1], Jing Wei[6], Gongbo Chen[7], Shanshan Li[8], Yuming Guo[8], Feng Hong[9], Zhifeng Li[10], Xiong Xiao[¶1], Xing Zhao[1] on behalf of the China Multi-Ethnic Cohort (CMEC) collaborative group

[¶] Corresponding authors. xiaoxiong.scu@scu.edu.cn

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Supplementary Text

Proof

$$f_{T,V}\{(t,v)|r(t,v,X),Y(t,v)\} = f_{T,V}\{(t,v)|r(t,v,X)\}$$

$f_{T,V}\{(t,v)|r(t,v,X),Y(t,v)\}$

$=\int f_{T,V}\{(t,v)|x,r(t,v,X),Y(t,v)\}dF_X\left(x\middle|r(t,v,X),Y(t,v)\right)$

$=\int f_{T,V}\{(t,v)|x\}dF_X\left(x\middle|r(t,v,X),Y(t,v)\right)$

$=\int r(t,v,x)dF_X\left(x\middle|r(t,v,X),Y(t,v)\right)$

$= r(t,v,X)$

$f_{T,V}\{(t,v)|r(t,v,X)\}$

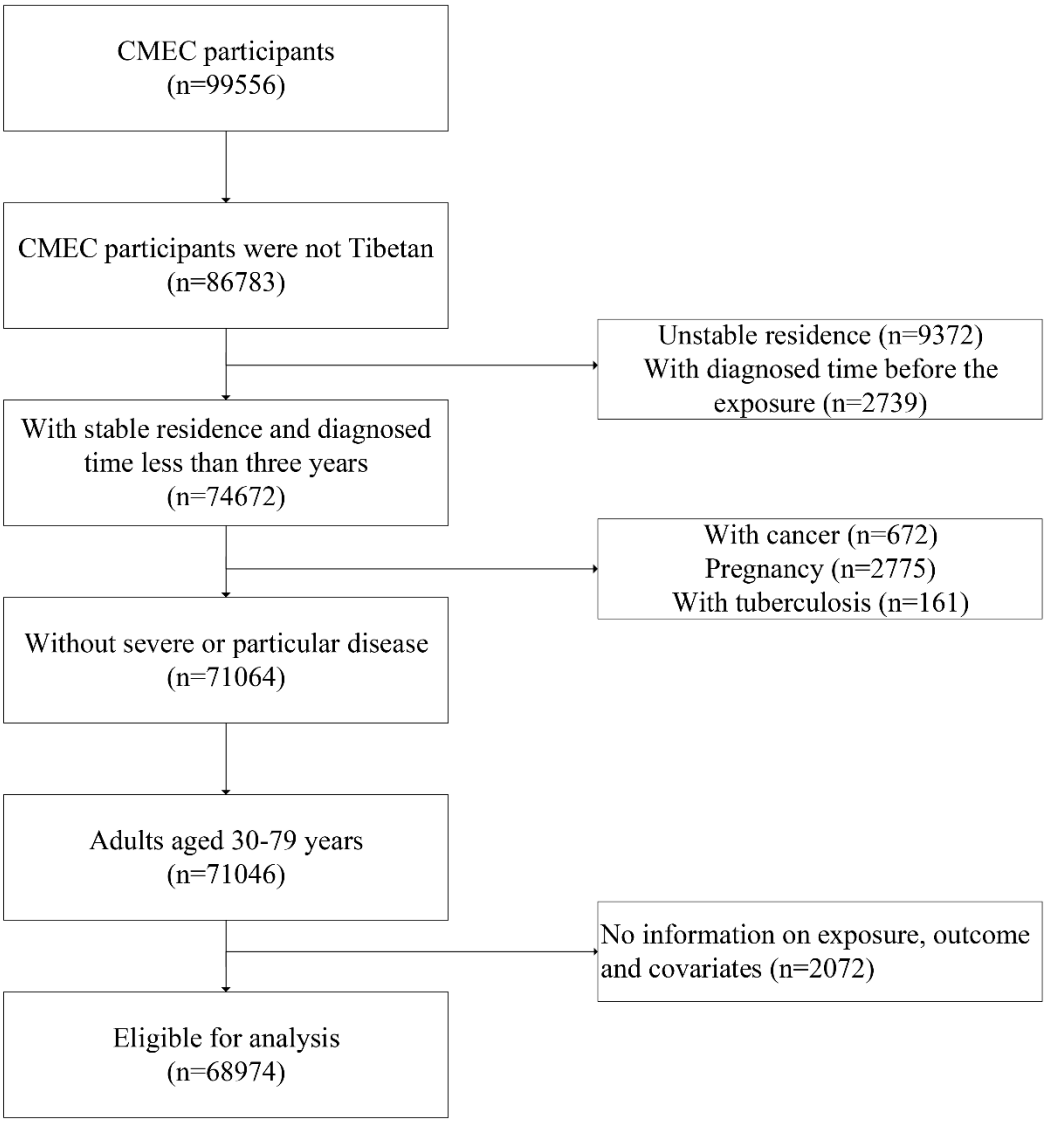
$=\int f_{T,V}\{(t,v)|x,r(t,v,X)\}dF_X\left(x\middle|r(t,v,X)\right)$

$=\int f_{T,V}\{(t,v)|x\}dF_X\left(x\middle|r(t,v,X)\right)$

$=\int r(t,v,x)dF_X\left(x\middle|r(t,v,X)\right)$

$= r(t,v,X)$

S1 Fig. Flow diagram of participants' enrolment



S2 Fig. Causal Inference Workflow

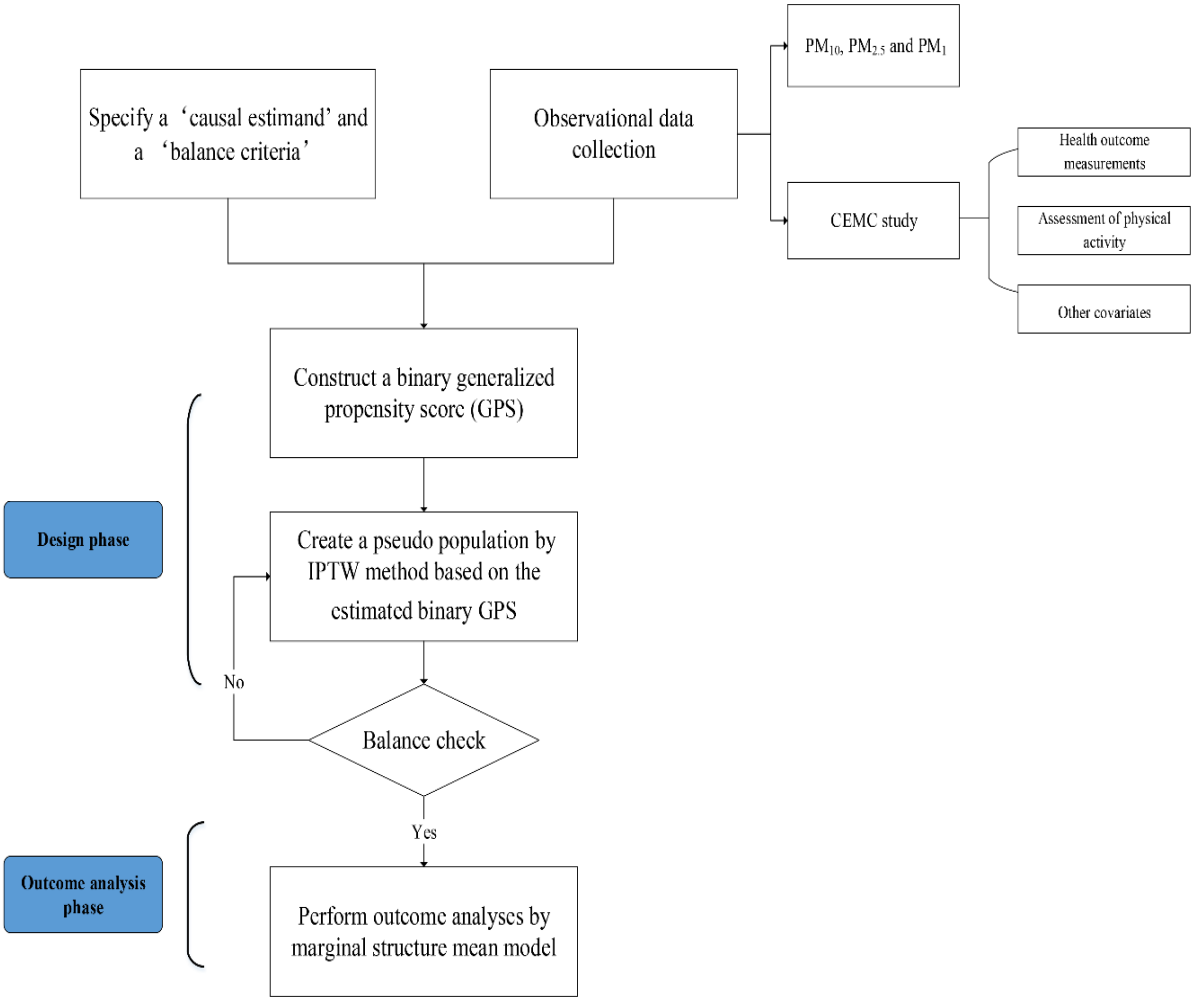


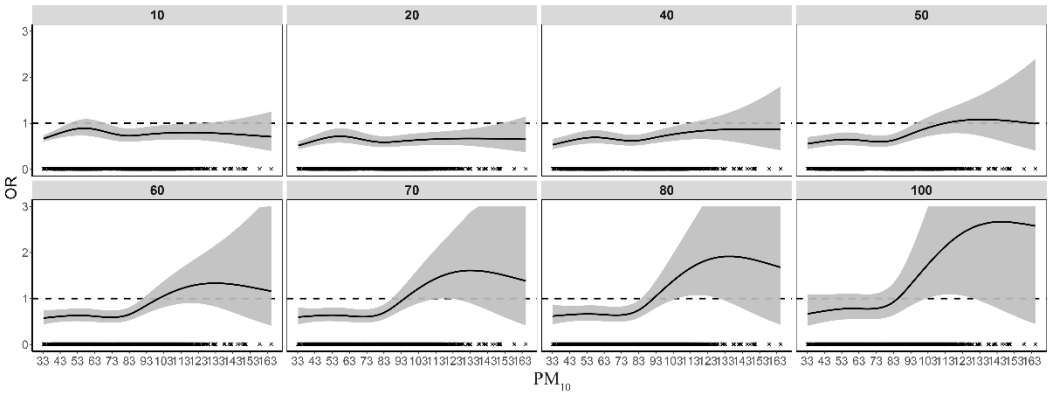
Figure S2: Causal Inference Workflow. A workflow for causal inference approaches using the estimated bi-dimensional GPS to design and analyze observational data. The design and analysis phases are kept separate, and the technical details about each phase are discussed in Methods section.

Table S1. The characteristics of the study participants with different levels of physical activity.

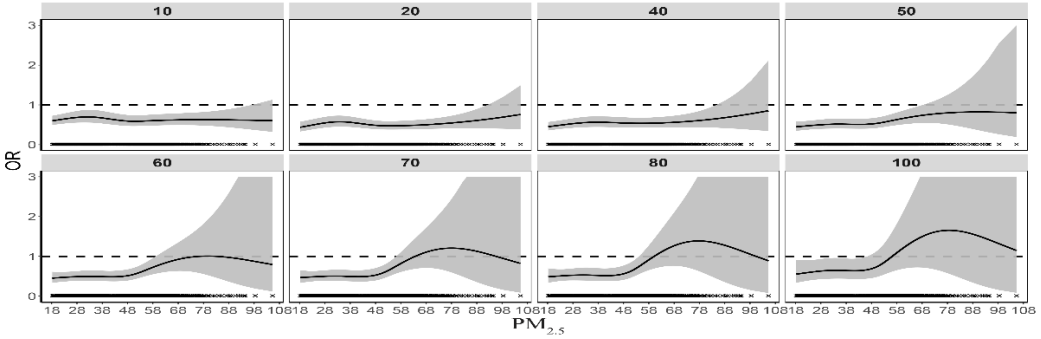
	[0, 12.78]	(12.78, 23.30]	(23.30, 38.50]	(38.50, 142]	*P*
n	17241	17250	17239	17244	
Age, mean (SD)	57.44 (11.85)	50.33 (11.41)	49.90 (10.47)	50.12 (9.50)	<0.001
Type 2 diabetes, n (%) : yes	1805 (10.5)	1231 (7.1)	1184 (6.9)	1123 (6.5)	<0.001
PM_{10}(μg/m^3) , mean (SD)	77.79 (24.01)	77.41 (23.88)	71.20 (23.43)	63.31 (21.23)	<0.001
$PM_{2.5}$(μg/m^3) , mean (SD)	45.78 (15.96)	45.59 (15.94)	41.35 (15.75)	35.96 (14.45)	<0.001
PM_1(μg/m^3) , mean (SD)	29.83 (6.63)	29.80 (6.67)	27.98 (6.57)	25.71 (5.95)	<0.001

The intervals [0, 12.78], (12.78, 23.30], (23.30, 38.50], (38.50, 142] are based on quartiles of physical activity (MET-h/d).

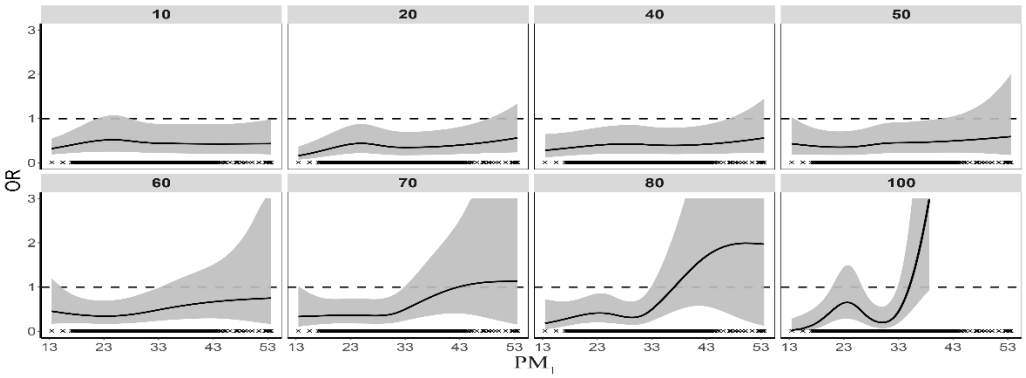
S3-5 Figs: The main analysis results of the relationship between PMs and type 2 diabetes at different levels of PA.



S3 Fig. The exposure-response relationship between PM_{10} and type 2 diabetes at different levels of PA. The OR limit is set to 3 for all subgraphs.

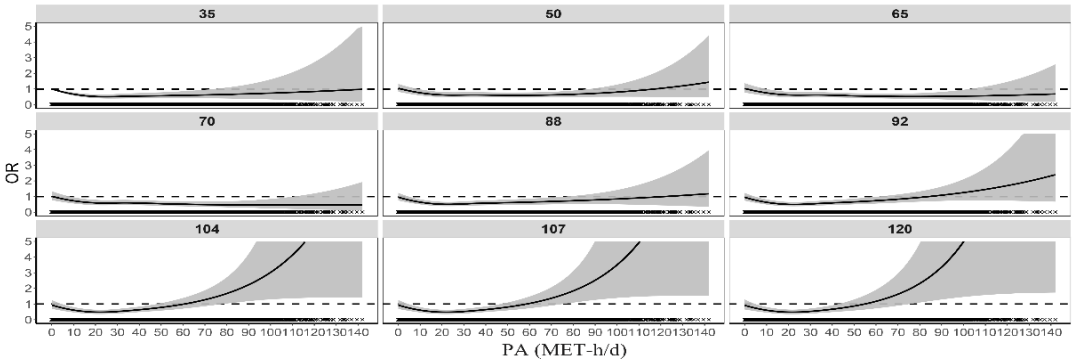


S4 Fig. The exposure-response relationship between $PM_{2.5}$ and type 2 diabetes at different levels of PA. The OR limit is set to 3 for all subgraphs.

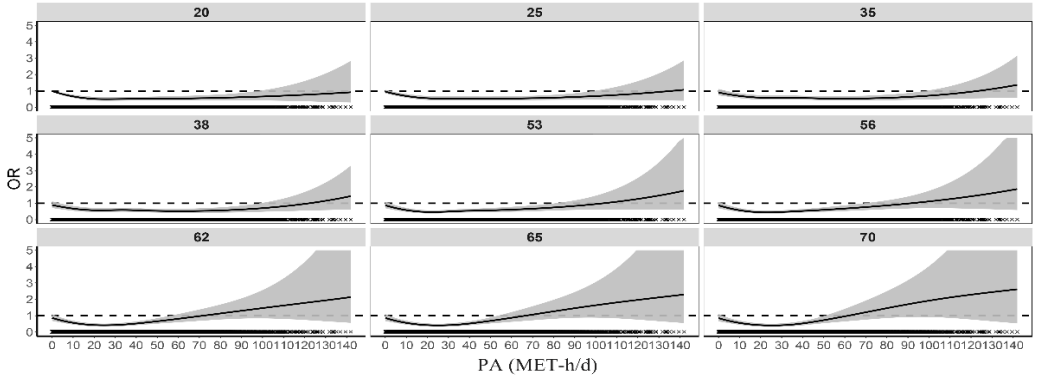


S5 Fig. The exposure-response relationship between PM_1 and type 2 diabetes at different levels of PA. The OR limit is set to 3 for all subgraphs.

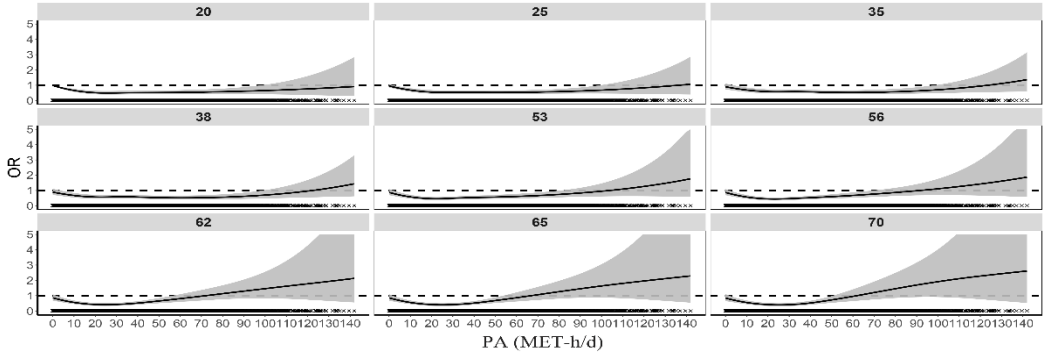
S6-11 Figs: When excluding subjects taking any antidiabetic medication, the relationship between PA and type 2 diabetes at different PMs levels (S6-8 Figs) and the relationship between PMs and type 2 diabetes at different PA levels (S9-11 Figs).



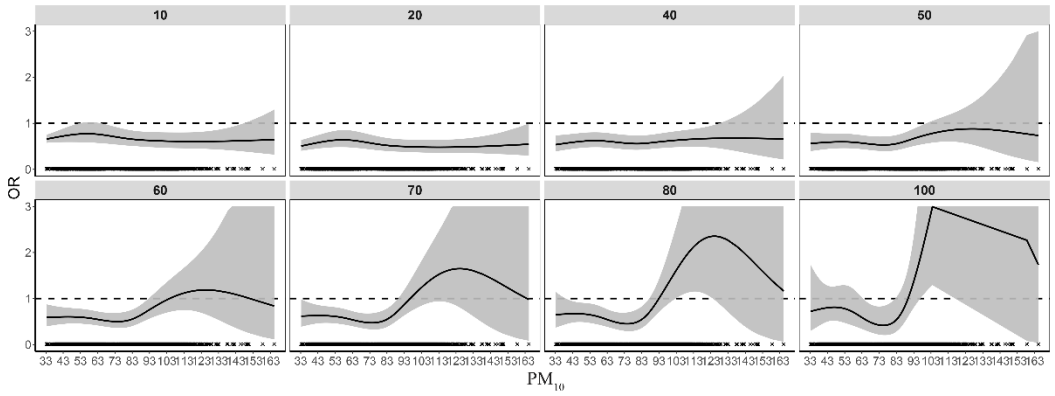
S6 Fig. The exposure-response relationship between PA and type 2 diabetes at different levels of PM_{10}. The OR limit is set to 5 for all subgraphs.



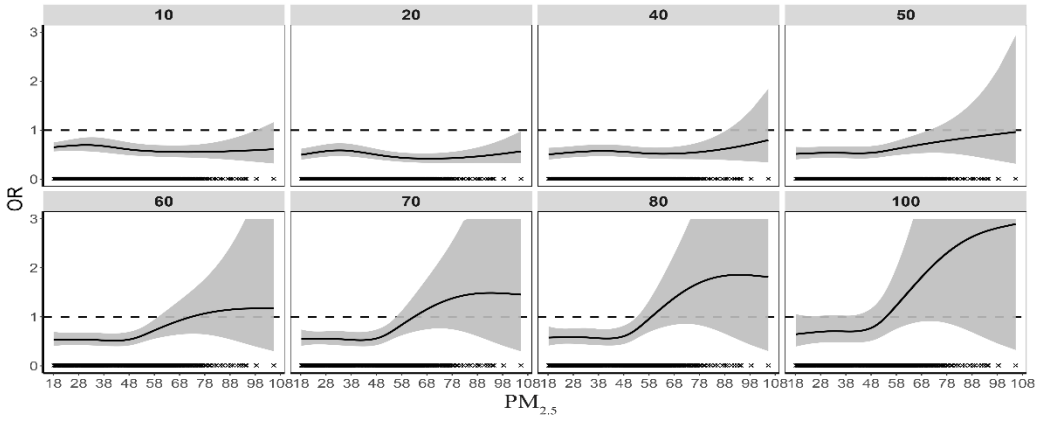
S7 Fig. The exposure-response relationship between PA and type 2 diabetes at different levels of $PM_{2.5}$. The OR limit is set to 5 for all subgraphs.



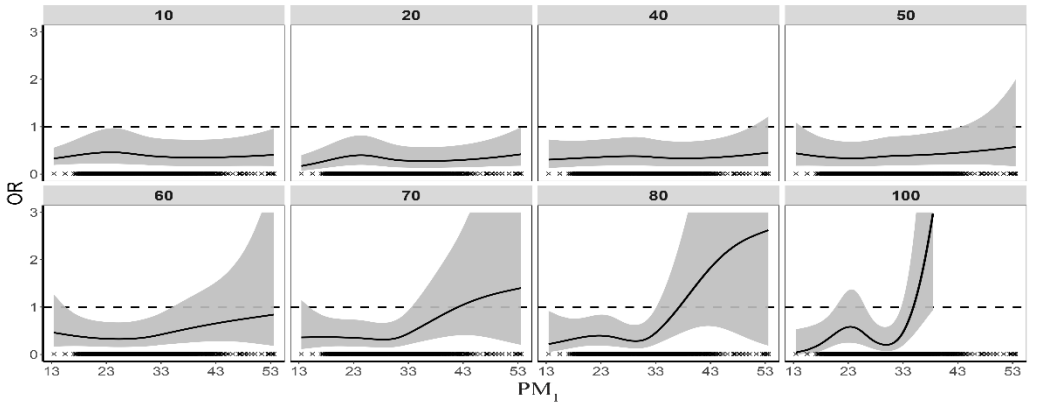
S8 Fig. The exposure-response relationship between PA and type 2 diabetes at different levels of PM_{1}. The OR limit is set to 5 for all subgraphs.



S9 Fig. The exposure-response relationship between PM_{10} and type 2 diabetes at different levels of PA. The OR limit is set to 3 for all subgraphs.

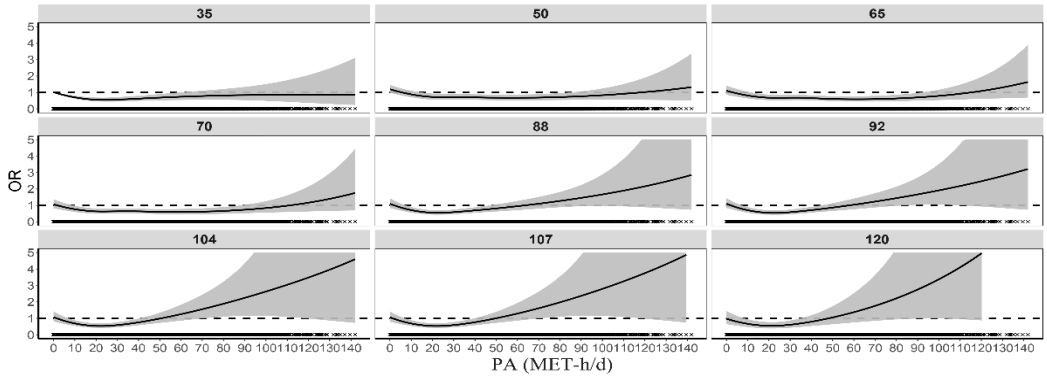


S10 Fig. The exposure-response relationship between $PM_{2.5}$ and type 2 diabetes at different levels of PA. The OR limit is set to 3 for all subgraphs.

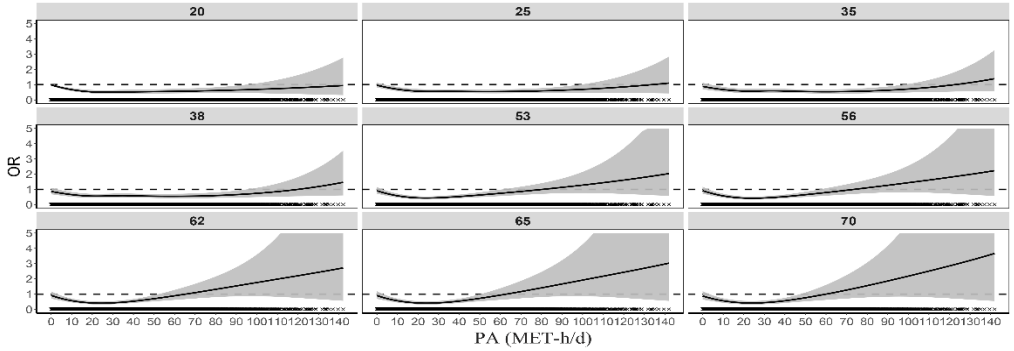


S11 Fig. The exposure-response relationship between PM_{1} and type 2 diabetes at different levels of PA. The OR limit is set to 3 for all subgraphs.

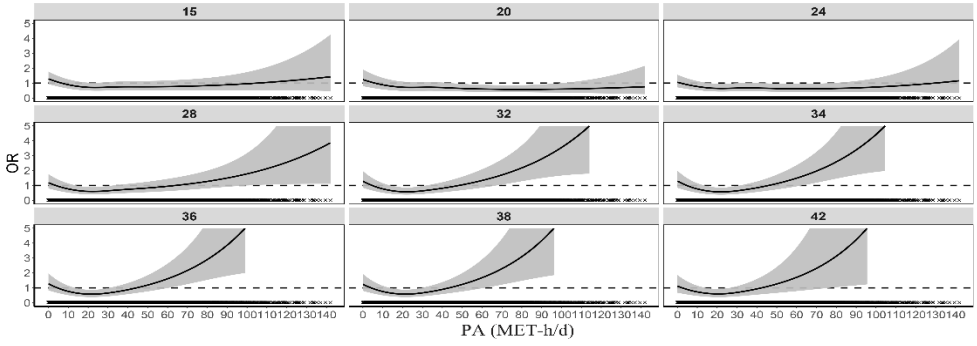
S12-17 Figs: When including 1-year average exposure of PM_{10}, $PM_{2.5}$ and PM_1 instead of 3-year average exposures, the relationship between PA and type 2 diabetes at different levels of PMs (S12-14 Figs), and the relationship between PMs and type 2 diabetes at different levels of PA (S15-17 Figs).



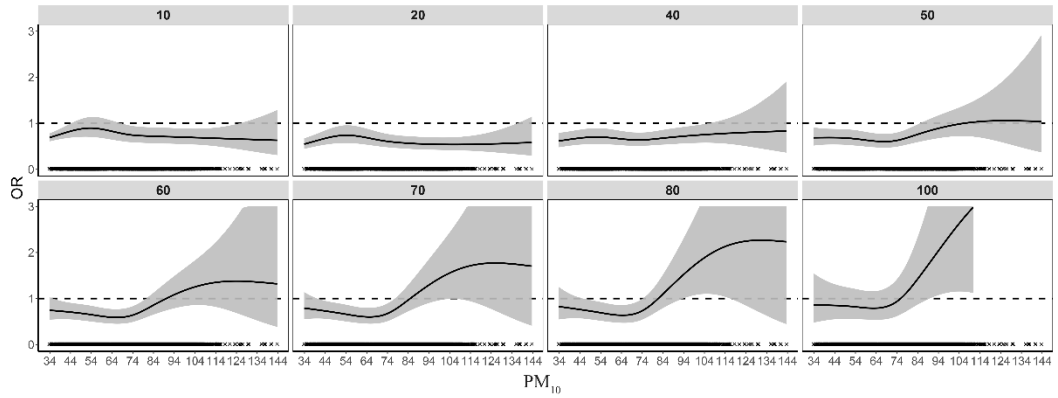
S12 Fig. The exposure-response relationship between PA and type 2 diabetes at different levels of PM_{10}. The OR limit is set to 5 for all subgraphs.



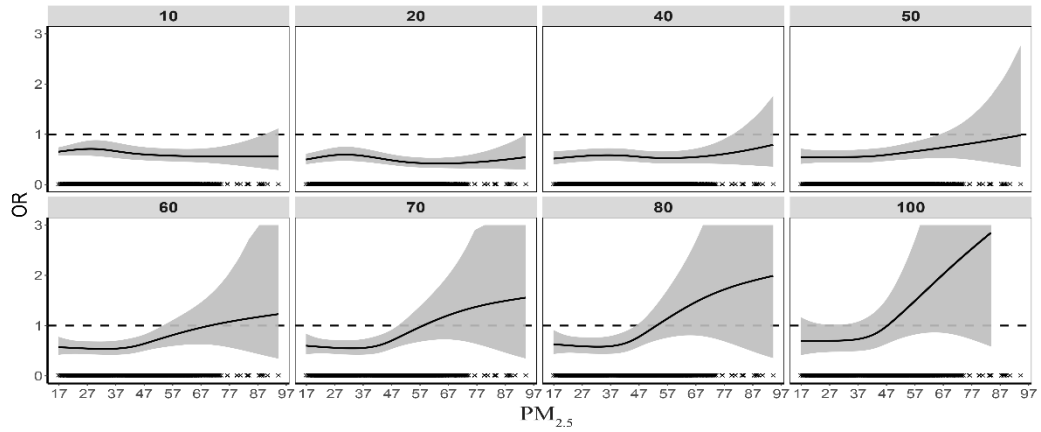
S13 Fig. The exposure-response relationship between PA and type 2 diabetes at different levels of $PM_{2.5}$. The OR limit is set to 5 for all subgraphs.



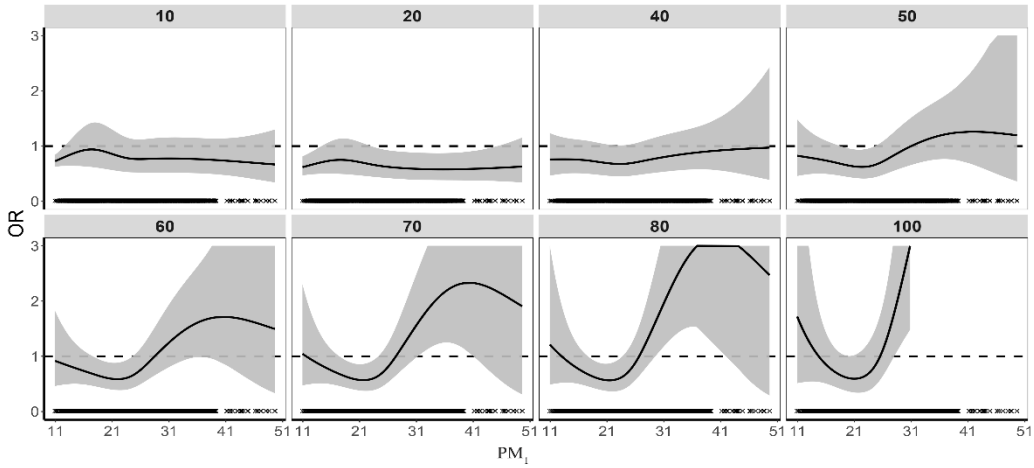
S14 Fig. The exposure-response relationship between PA and type 2 diabetes at different levels of PM_1. The OR limit is set to 5 for all subgraphs.



S15 Fig. The exposure-response relationship between PM_{10} and type 2 diabetes at different levels of PA. The OR limit is set to 3 for all subgraphs.



S16 Fig. The exposure-response relationship between $PM_{2.5}$ and type 2 diabetes at different levels of PA. The OR limit is set to 3 for all subgraphs.



S17 Fig. The exposure-response relationship between PM_1 and type 2 diabetes at different levels of PA. The OR limit is set to 3 for all subgraphs.