Supplementary material

Pollution Characteristics of Different Components of $PM_{2.5}$ in Taiyuan during 2017-2020 Wintertime and Their Toxicity Effects on HepG2 Cells

Table S1 Primers sequences

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Fig. S1. Changes in $PM_{2.5}$ pollutant concentration from 2017 to 2020

Fig. S2. Toxic effects of different concentrations of $PM_{2.5}$ exposure on HepG2 cells from 2017 to 2020 (A) WSP (B) OP (n=4, compared with control group, *p<0.05, **p<0.01)

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Fig. S4. Effects of different concentrations of $PM_{2.5}$ on IL-6 levels in HepG2 cells from 2017 to 2020 (A) WSP (B) OP (n=4, compared with the control group, *p<0.05, **p<0.01; Compared between years, #p<0.05, ##p<0.01)

Fig. S5. Effects of different concentrations of $PM_{2.5}$ on TNF-α levels in HepG2 cells from 2017 to 2020 (A) WSP (B) OP (n=4, compared with the control group, *p<0.05, **p<0.01; Compared between years, #p<0.05, ##p<0.01)

Fig. S6. Effects of different concentrations of $PM_{2.5}$ on intracellular ROS levels of HepG2 from 2017 to 2020 (A) WSP (B) OP (n=4, compared with the control group, *p<0.05, **p<0.01; Compared between years, #p<0.05, ##p<0.01)

Fig. S7. Effects of different concentrations of $PM_{2.5}$ on SOD content in HepG2 cells from 2017 to 2020 (A) WSP (B) OP (n=4, compared with the control group, *p<0.05, **p<0.01; Compared between years, #p<0.05, ##p<0.01)

Fig. S8. Effects of different concentrations of $PM_{2.5}$ on MDA content in HepG2 cells from 2017 to 2020 (A) WSP (B) OP (n=4, compared with the control group, *p<0.05, **p<0.01; Compared between years, #p<0.05, ##p<0.01)

Fig. S9. Effects of different concentrations of $PM_{2.5}$ on TG content in HepG2 cells from 2017 to 2020 (A) WSP (B) OP(n=4, compared with the control group, *p<0.05, **p<0.01; Compared between years, #p<0.05, ##p<0.01)

Fig. S10. Effects of different concentrations of $PM_{2.5}$ on FFA content in HepG2 cells from 2017 to 2020 (A) WSP (B) OP (n=4, compared with the control group, *p<0.05, **p<0.01; Compared between years, #p<0.05, ##p<0.01)

Fig. S11. Effects of different concentrations of $PM_{2.5}$ and its extracts on lipid metabolism in HepG2 cells in 2018 (A) WP (B) OP (C) WSP (n=4, compared with control group, *p<0.05, **p<0.01)

Fig. S12. Effects of different concentrations of $PM_{2.5}$ and its extracts on lipid metabolism in HepG2 cells in 2019 (A) WP (B) OP (C) WSP (n=4, compared with control group, *p<0.05, **p<0.01)

Fig. S13. Effects of different concentrations of $PM_{2.5}$ and its extracts on lipid metabolism in HepG2 cells in 2020 (A) WP (B) OP (C) WSP (n=4, compared with control group, *p<0.05, **p<0.01)

Table S1 Primers sequences

Genes	Accession No.	Sequence	
Srebp-1c	NM_001321096.3	Forward primer	5′-ACACAGCAACCAGAAACTCAAG-3′
Products	153bp	Reverse primer	5′-AGTGTGTCCTCCACCTCAGTCT-3
Scd1	NM_005063.5	Forward primer	5′-CTGCTTACTTGGTGAGGGTGC-3′
Products	110bp	Reverse primer	5′-TTCTTGCCCTTGCTTCTTCC-3′
PPARα	NM_005036.6	Forward primer	5′- ATGGTGGACACGGAAAGCC-3′
Products	124bp	Reverse primer	5′-CGATGGATTGCGAAATCTCTTGG-3′
Cpt1α	NM_001876.4	Forward primer	5′-TCCAGTTGGCTTATCGTGGTG-3′
Products	98bp	Reverse primer	5′-TCCAGAGTCCGATTGATTTTTGC-3′
Acox1	NM_007292.6	Forward primer	5′-ACTCGCAGCCAGCGTTATG-3′
Products	84bp	Reverse primer	5′-AGGGTCAGCGATGCCAAAC-3′
FASN	NM_004104.4	Forward primer	5′-CTCAGCCGCCATCTACAACATCG-3′
Products	129bp	Reverse primer	5′- GCCAGCGTCTTCCACACTATGC-3′
ACC1	NM_198838.2	Forward primer	5′- GGTAATGCGGTATGGAAGTCG-3
Products	195bp	Reverse primer	5′- GCCTGAAACATGATCTGTGCTG-3′
FATP2	NM_003645.4	Forward primer	5′- TACTCTTGCCTTGCGGACTAA-3′
Products	100bp	Reverse primer	5′- CCGAAGCAGTTCACCGATATAC-3′
FATP5	NM_012254.3	Forward primer	5′- CATGGCGTGACAGTGATCCT-3′
Products	121bp	Reverse primer	5′- CAGCCCGTAGTCCATTGCC-3′
CD36	NM_001127443.2	Forward primer	5′-CTTTGGCTTAATGAGACTGGGAC -3′
Products	134bp	Reverse primer	5′- GCAACAAACATCACCACACCA -3′

APOB	NM_000384.3	Forward primer	5′-AGACAGCATCTTCGTGTTTCAA-3′
Products	123bp	Reverse primer	5′-ATCATTTAGTTTCAGCCCAGGA-3′
FABP1	NM_001443.3	Forward primer	5′-GTGGGATGGGAAGGAAAG-3′
Products	92bp	Reverse primer	5′-TCCGAGTACAGGTGACATTG-3
MTTP	NM_001300785.2	Forward primer	5′-AGCTCACGTACTCCACTGAAG-3′
Products	107bp	Reverse primer	5′-CCTCCATAGTAAGGCCACATCC-3′
GAPDH	NM_002046.7	Forward primer	5′-GGAAGGACTCATGACCACAGT-3′
Products	85bp	Reverse primer	5′-GCCATCATGCCACAGTTTC-3′

Table S2 Source analysis of characteristic ratios of individual PAH concentrations

PAH characteristic ratios	Scope	Source
FLA/(FLA + PYR)	＜0.4	Oil burning
	0.4-0.5	Fossil fuel burning
	＞0.5	Coal and biomass burning
ANT/(ANT + PHE)	＜0.1	Oil burning
	＞0.1	Coal burning
BaA/(BaA + CHR)	0.2-0.35	Coal burning
	＞0.35	Motor vehicle emissions
IcdP/(IcdP + BghiP)	＜0.2	Oil burning
	0.2-0.5	Oil burning
	＞0.5	Coal and biomass burning

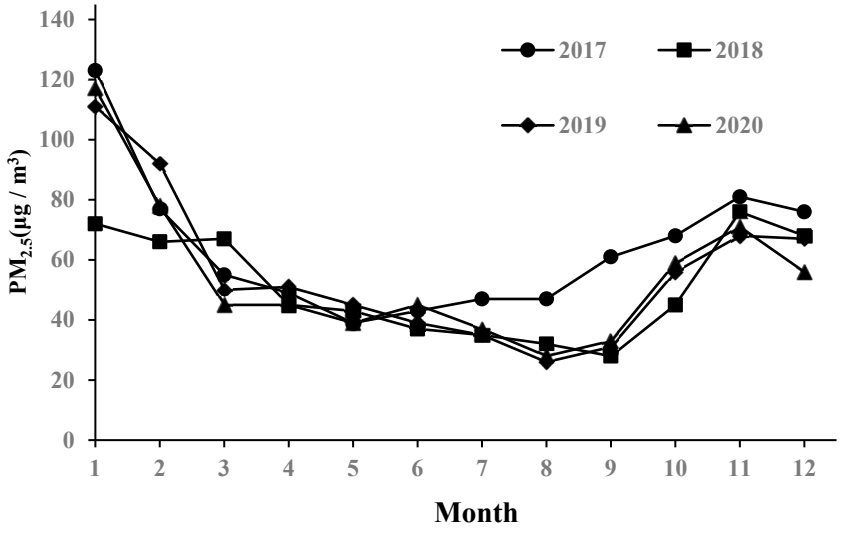


Fig. S1 Changes in $PM_{2.5}$ pollutant concentration from 2017 to 2020

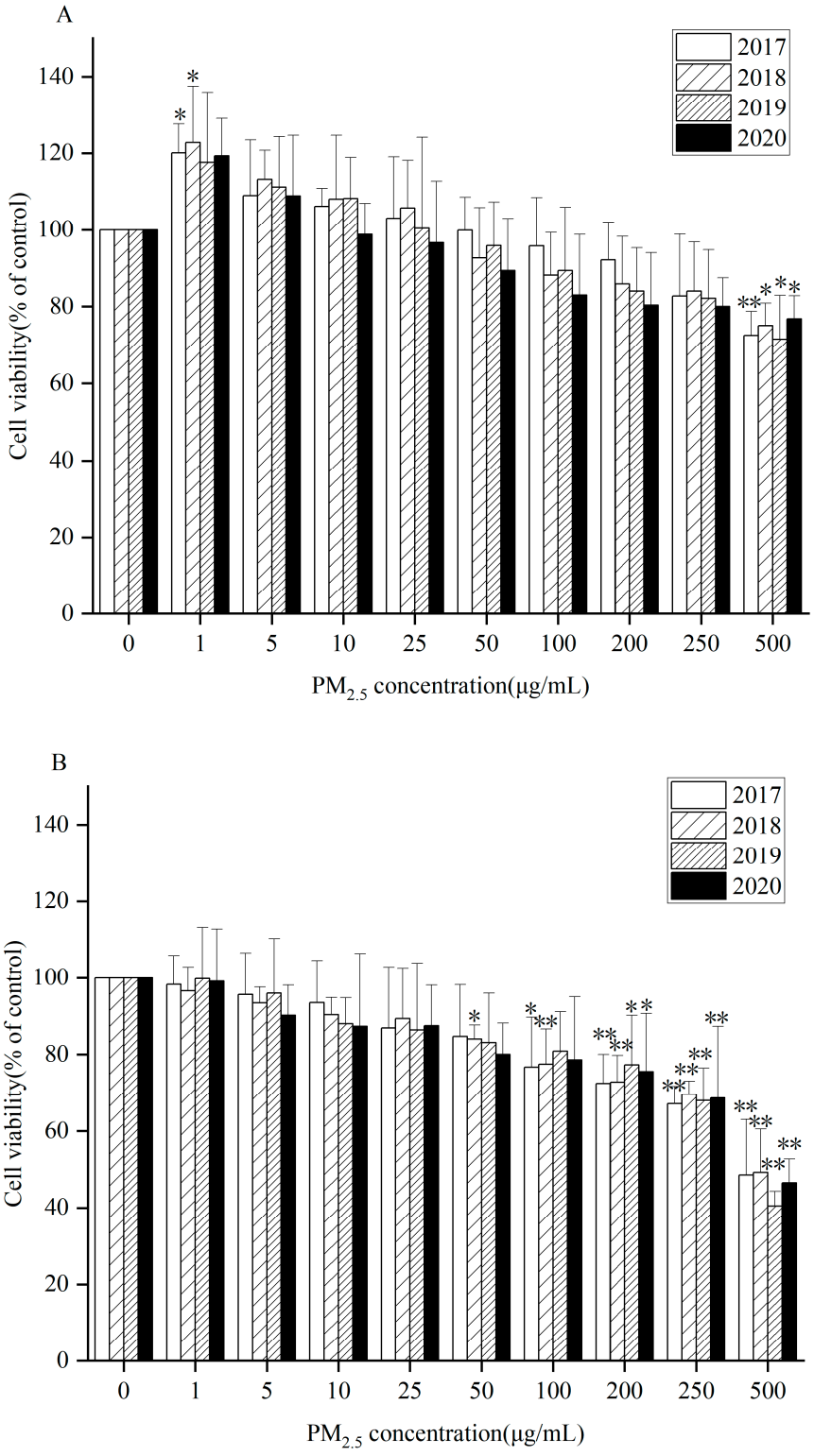


Fig. S2 Toxic effects of different concentrations of $PM_{2.5}$ exposure on HepG2 cells from 2017 to 2020

(A) WSP (B) OP

(n=4, compared with control group, *p<0.05, **p<0.01)

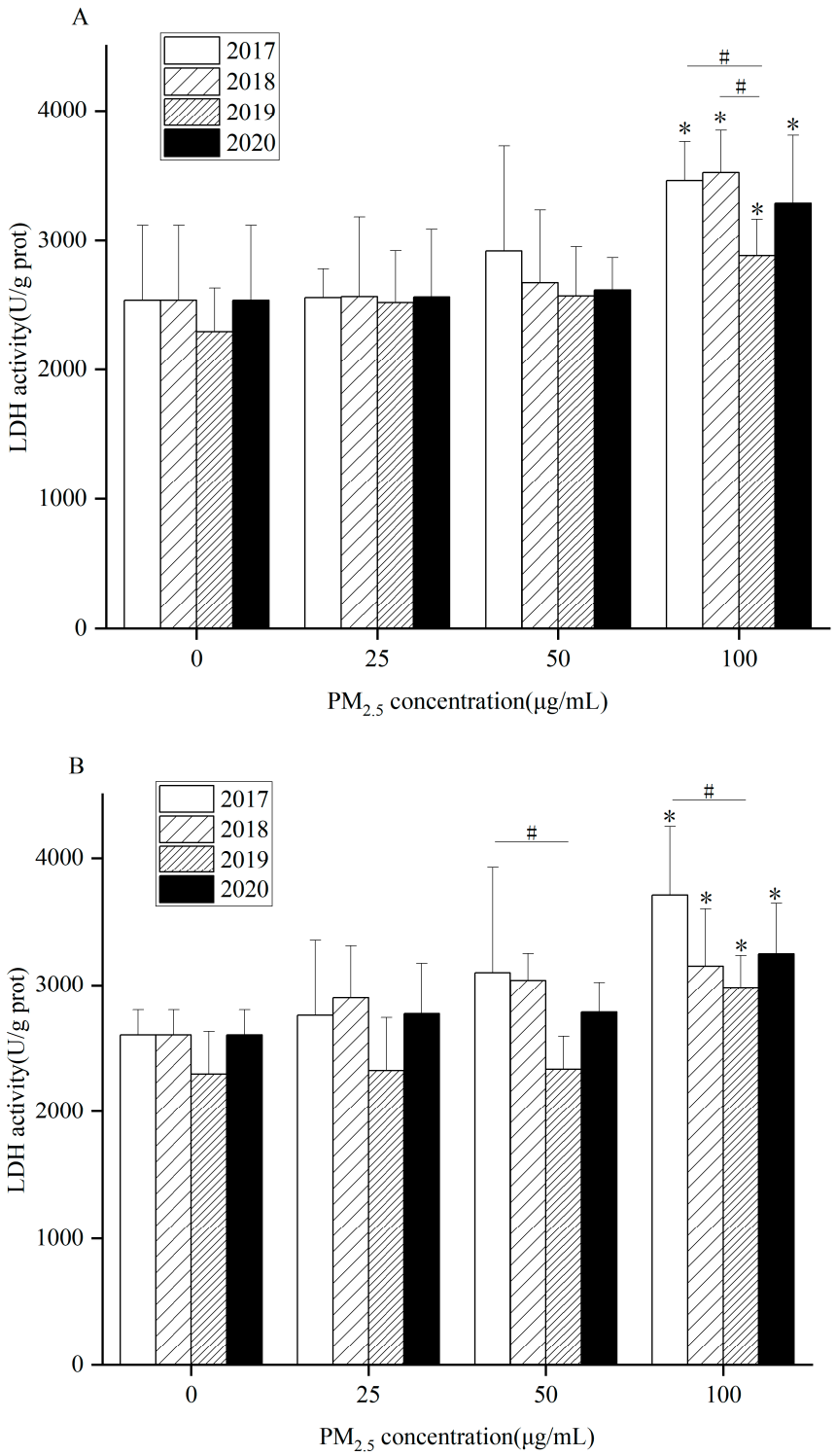


Fig. S3 Effects of different concentrations of $PM_{2.5}$ exposure on LDH release from HepG2 cells during 2017-2020 (A) WSP (B) OP

(n=4, compared with the control group, *p<0.05, **p<0.01; Compared between years, #p<0.05)

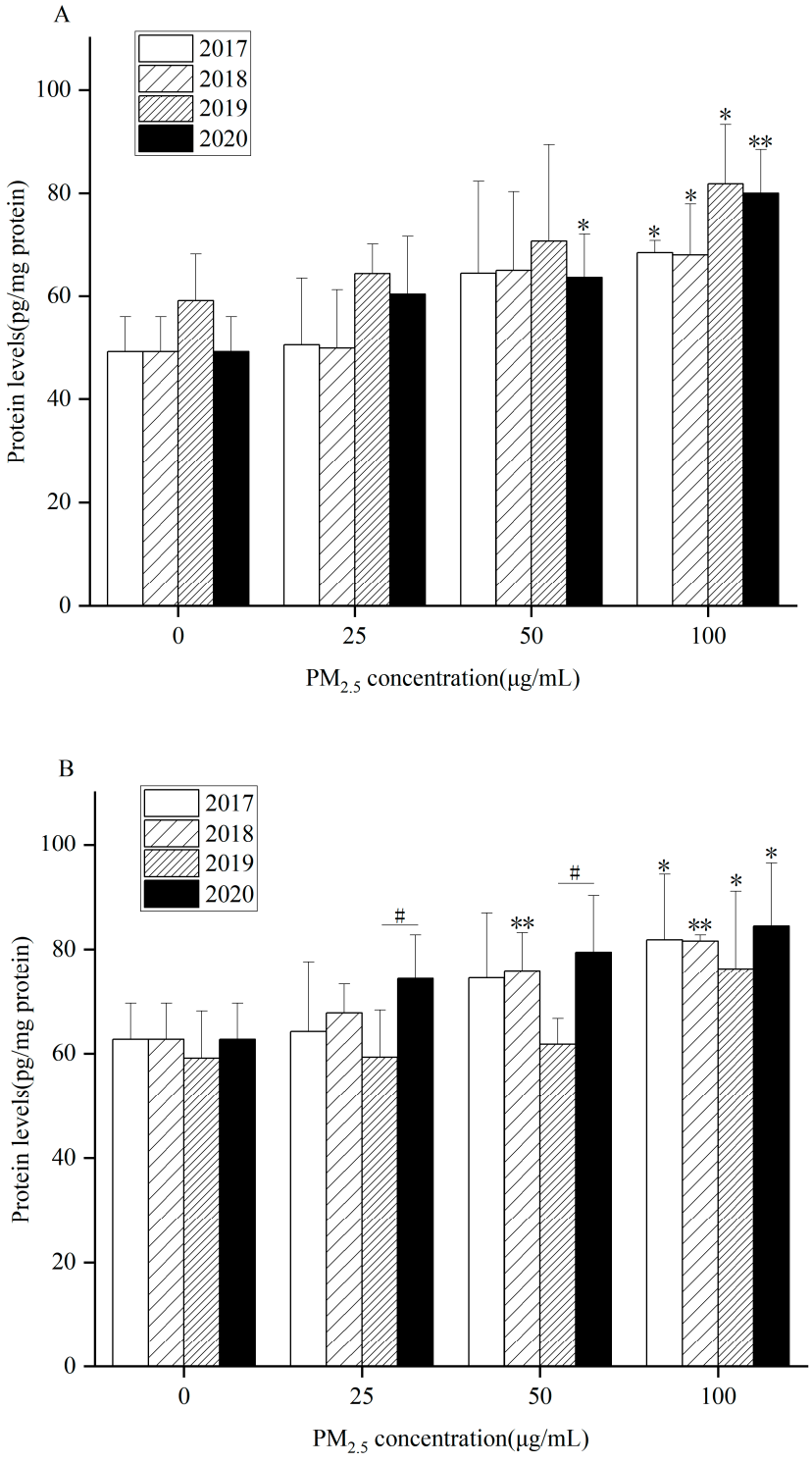


Fig. S4 Effects of different concentrations of $PM_{2.5}$ on IL-6 levels in HepG2 cells from 2017 to 2020

(A) WSP (B) OP

(n=4, compared with the control group, *p<0.05, **p<0.01; Compared between years, #p<0.05)

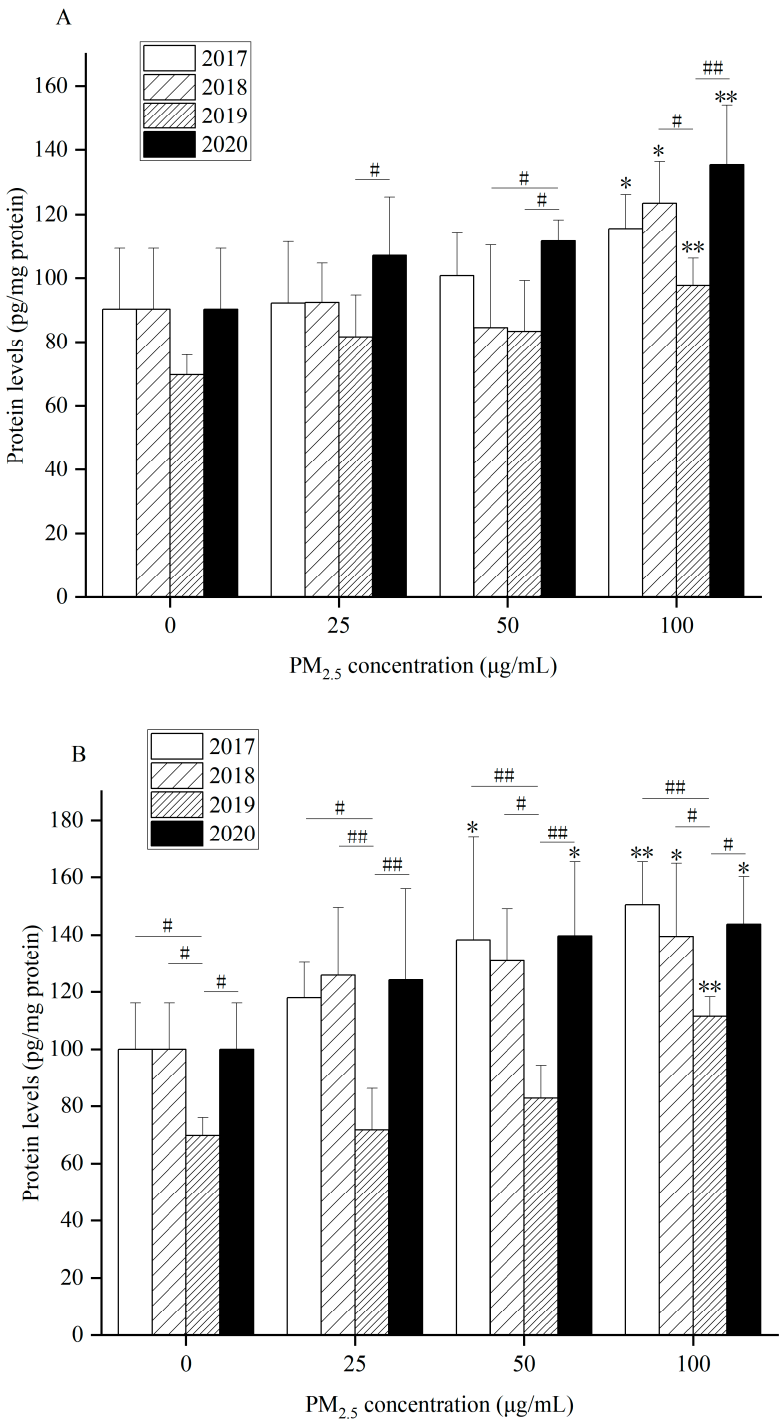


Fig. S5 Effects of different concentrations of $PM_{2.5}$ on TNF-α levels in HepG2 cells from 2017 to 2020

(A) WSP (B) OP (n=4, compared with the control group, *p<0.05, **p<0.01; Compared between years,

#p<0.05, ##p<0.01)

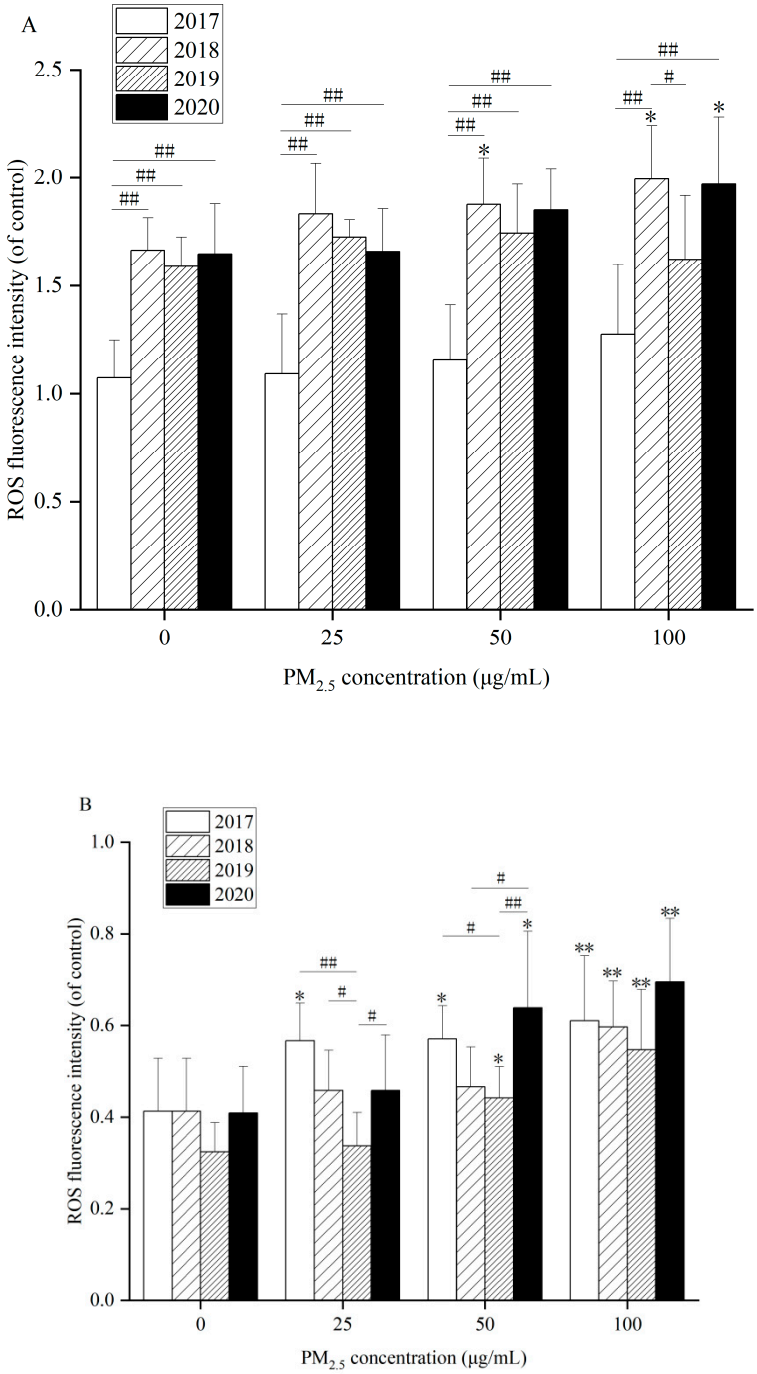
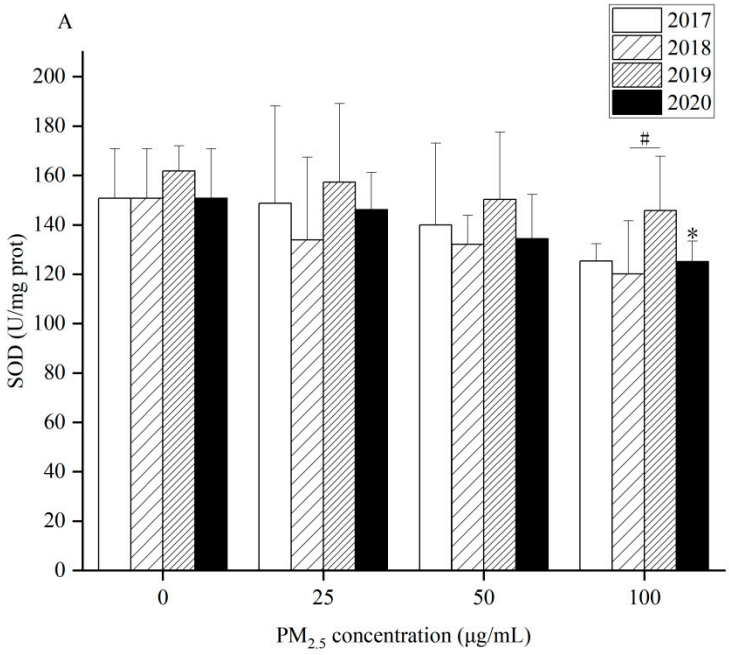


Fig. S6 Effects of different concentrations of $PM_{2.5}$ on intracellular ROS levels of HepG2 from 2017 to 2020 (A) WSP (B) OP

(n=4, compared with the control group, *p<0.05, **p<0.01; Compared between years, #p<0.05,



##p<0.01)

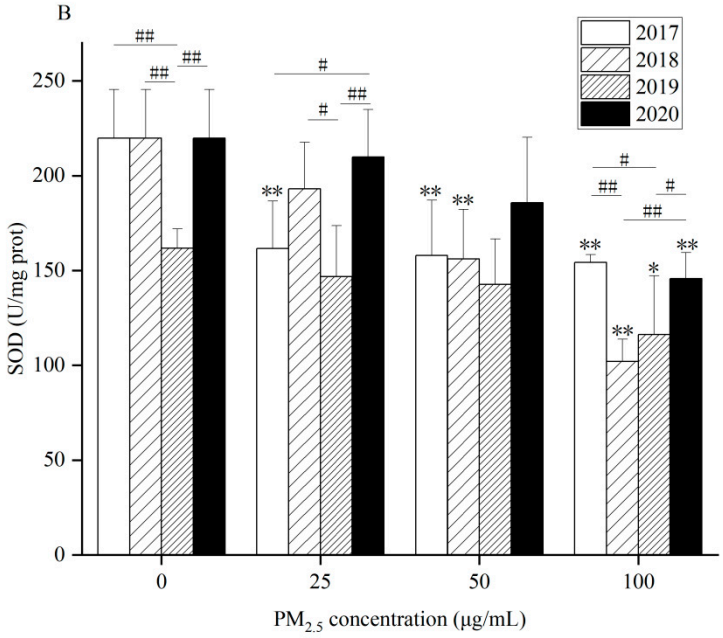


Fig. S7 Effects of different concentrations of $PM_{2.5}$ on SOD content in HepG2 cells from 2017 to 2020

(A) WSP (B) OP (n=4, compared with the control group, *p<0.05, **p<0.01; Compared between years,

#p<0.05, ##p<0.01)

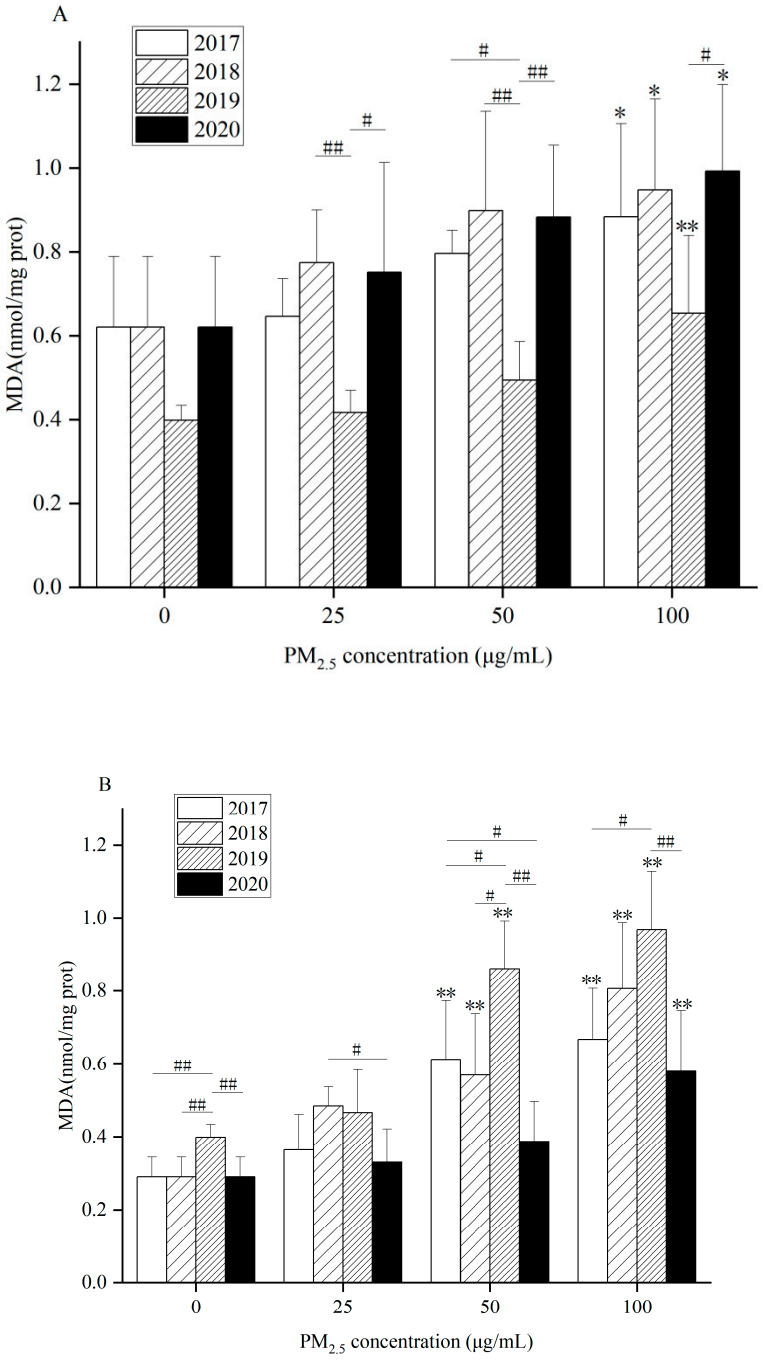
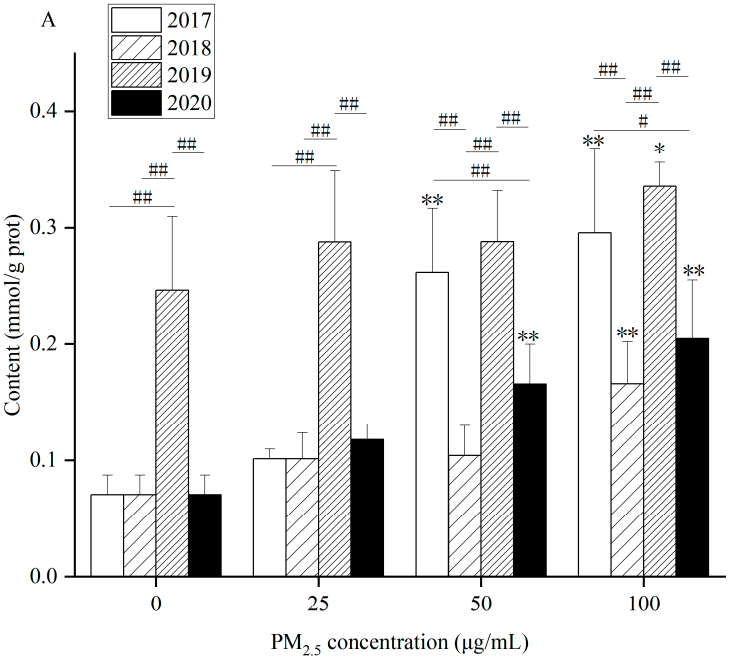


Fig. S8 Effects of different concentrations of $PM_{2.5}$ on MDA content in HepG2 cells from 2017 to 2020 (A) WSP (B) OP

(n=4, compared with the control group, *p<0.05, **p<0.01; Compared between years, #p<0.05,



###p<0.01)

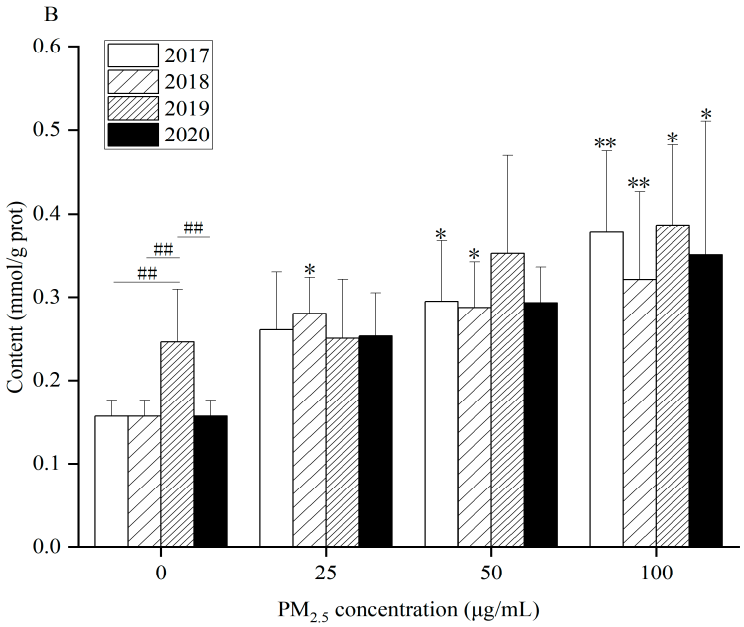


Fig. S9 Effects of different concentrations of $PM_{2.5}$ on TG content in HepG2 cells from 2017 to 2020 (A) WSP (B) OP(n=4, compared with the control group, *p<0.05, **p<0.01; Compared between years, #p<0.05, ##p<0.01)

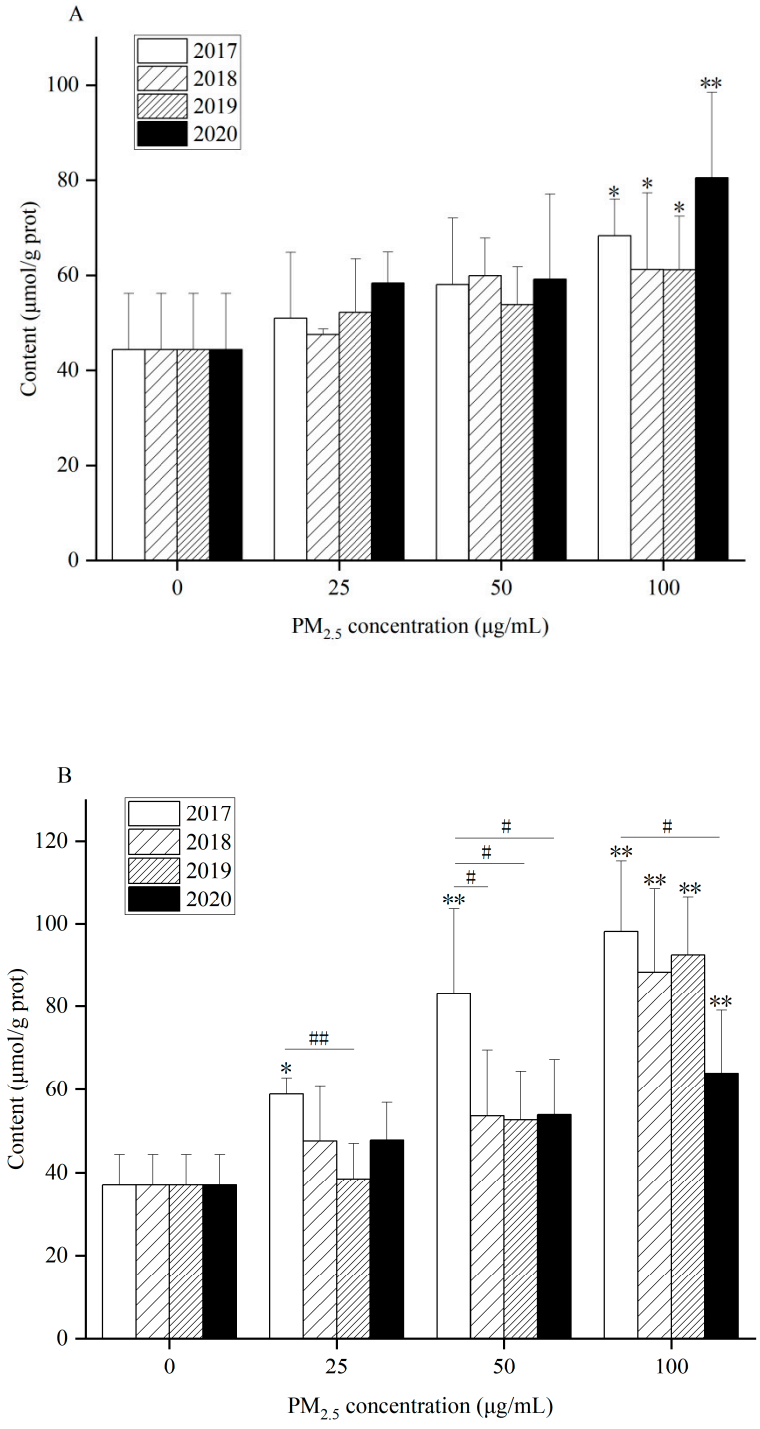
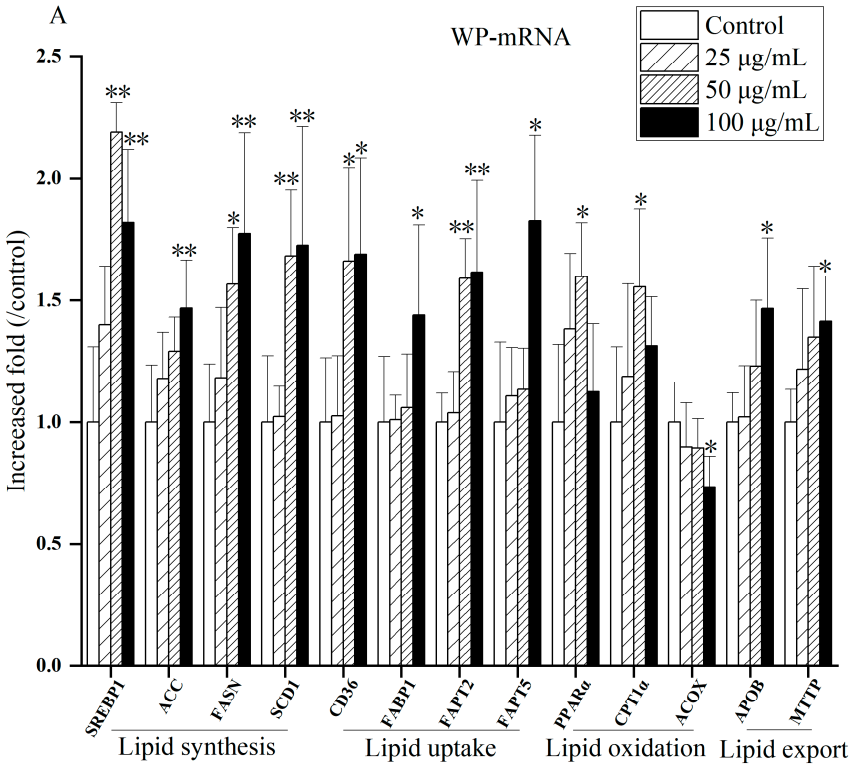
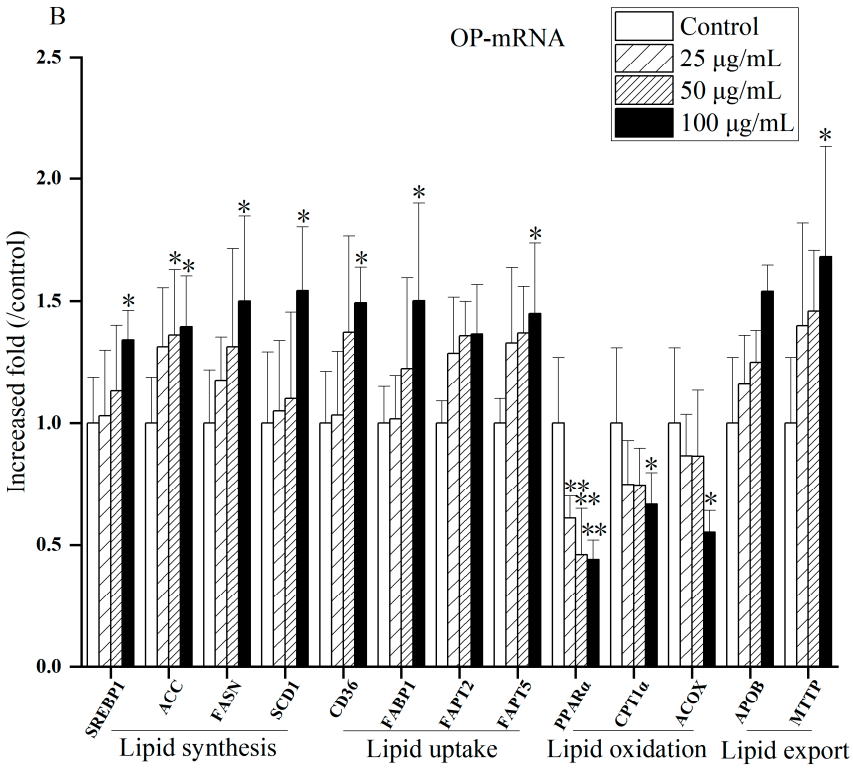


Fig. S10 Effects of different concentrations of $PM_{2.5}$ on FFA content in HepG2 cells from 2017 to 2020

(A) WSP (B) OP

(n=4, compared with the control group, *p<0.05, **p<0.01; Compared between years, #p<0.05, ##p<0.01)


A
WP-mRNA
Control
25 μg/mL
50 μg/mL
100 μg/mL
Increeased fold (/control)
2.5
2.0
1.5
1.0
0.5
0.0
SREBP1
ACC
FASN
SCD1
CD36
FABP1
FAPT2
FAPT5
PPARα
CPT1α
ACOX
APOB
MTTP
Lipid synthesis
Lipid uptake
Lipid oxidation
Lipid export


B
OP-mRNA
Control
25 μg/mL
50 μg/mL
100 μg/mL
Increeased fold (/control)
2.5
2.0
1.5
1.0
0.5
0.0
SREBP1
ACC
FASN
SCD1
CD36
FABP1
FAPT2
FAPT5
PPARα
CPT1α
ACOX
APOB
MTTP
Lipid synthesis
Lipid uptake
Lipid oxidation
Lipid export

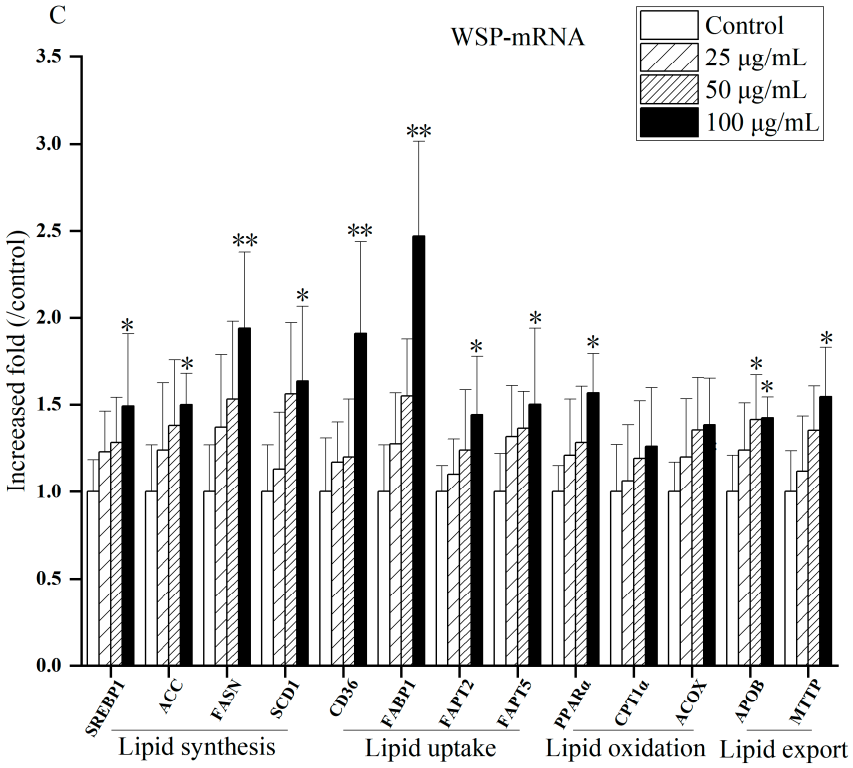
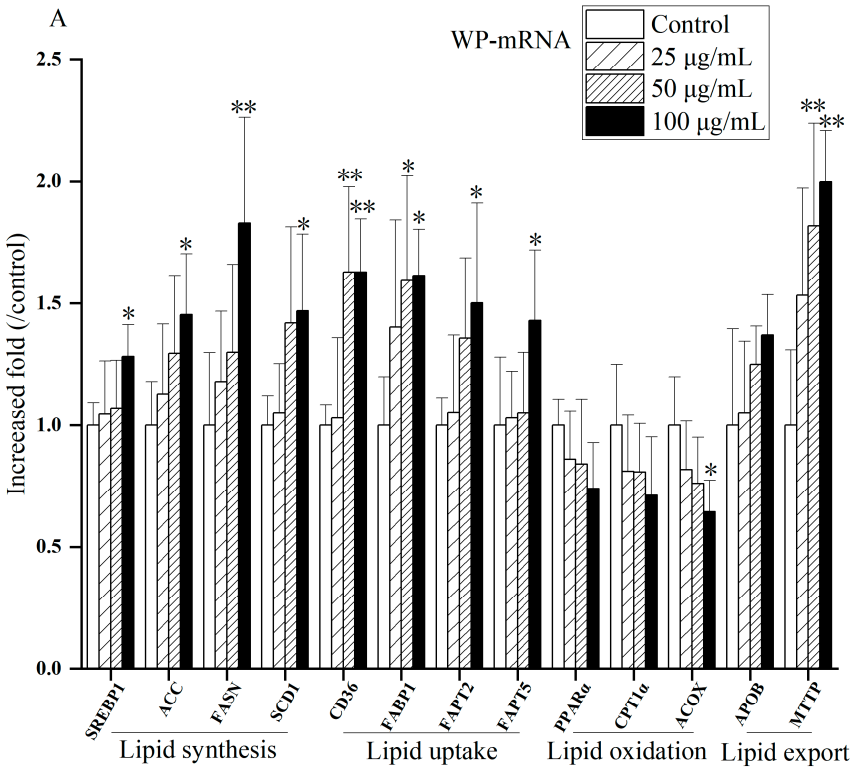
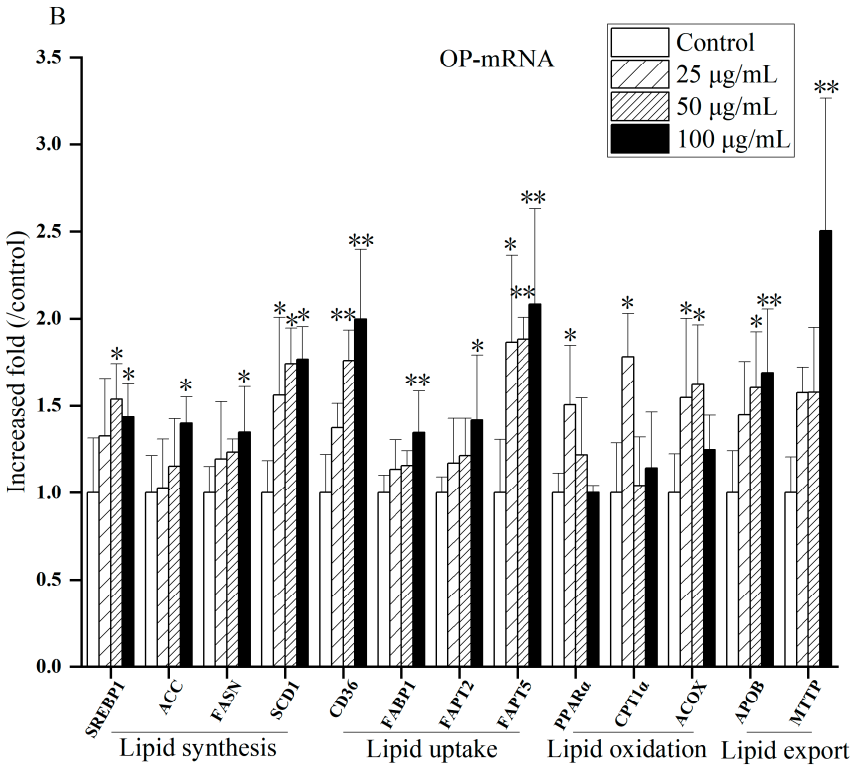


Fig. S11 Effects of different concentrations of $PM_{2.5}$ and its extracts on lipid metabolism in HepG2 cells in 2018 (A) WP (B) OP (C) WSP

(n=4, compared with control group, *p<0.05, **p<0.01)


A
WP-mRNA
Control
25 μg/mL
50 μg/mL
100 μg/mL
Increeased fold (/control)
0.0
0.5
1.0
1.5
2.0
2.5
SREBP1
ACC
FASN
SCD1
CD36
FABP1
FAPT2
FAPT5
PPARα
CPT1α
ACOX
APOB
MTTP
Lipid synthesis
Lipid uptake
Lipid oxidation
Lipid export


B
OP-mRNA
Control
25 μg/mL
50 μg/mL
100 μg/mL
Increeased fold (/control)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
SREBP1
ACC
FASN
SCD1
CD36
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Lipid synthesis
Lipid uptake
Lipid oxidation
Lipid export

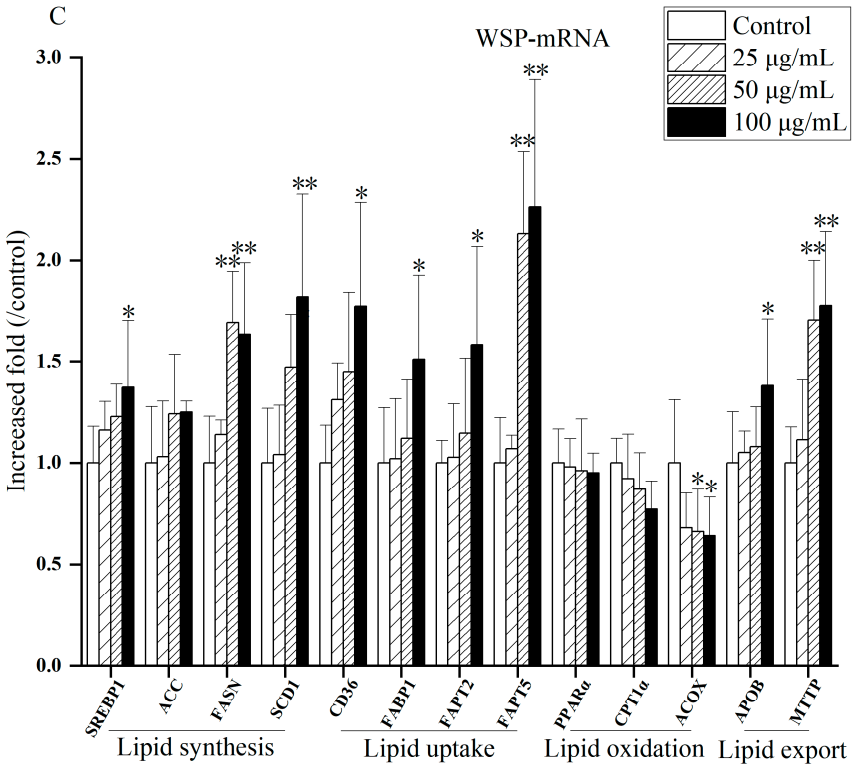
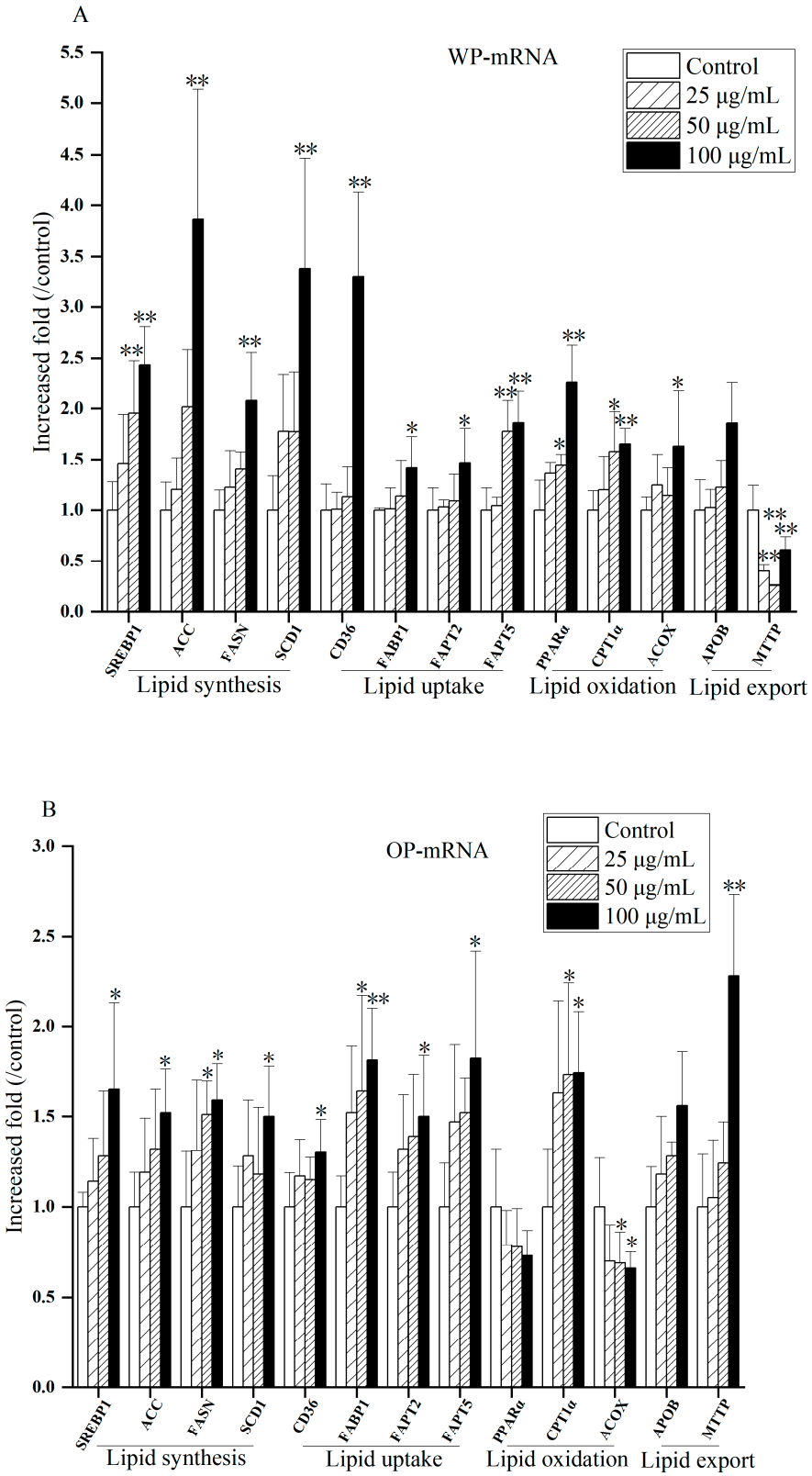


Fig. S12 Effects of different concentrations of $PM_{2.5}$ and its extracts on lipid metabolism in HepG2 cells in 2019 (A) WP (B) OP (C) WSP

(n=4, compared with control group, *p<0.05, **p<0.01)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WP-mRNA
Control
25 μg/mL
50 μg/mL
100 μg/mL
Increeased fold (/control)
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
SREBP1
ACC
FASN
SCD1
CD36
FABP1
FAPT2
FAPT5
PPARα
CPT1α
ACOX
APOB
MTTP
Lipid synthesis
Lipid uptake
Lipid oxidation
Lipid export
B
OP-mRNA
Control
25 μg/mL
50 μg/mL
100 μg/mL
Increeased fold (/control)
3.0
2.5
2.0
1.5
1.0
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0.0
SREBP1
ACC
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Lipid export

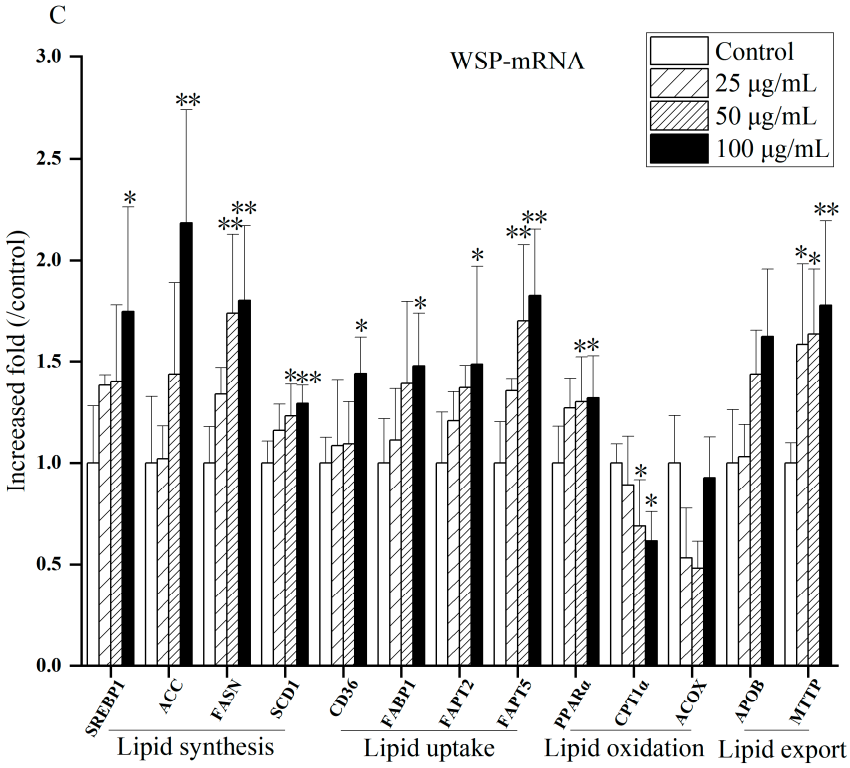

Fig. S13 Effects of different concentrations of $PM_{2.5}$ and its extracts on lipid metabolism in HepG2 cells in 2020 (A) WP (B) OP (C) WSP

(n=4, compared with control group, *p<0.05, **p<0.01)