Author, year	Country	Study design	Number of patients	Study population	Study variables	Outcome variables
AIR POLLUTION						
Neonatal outcomes						
Arroyo et al., 2016[1]	Spain	Cross-sectional	298,705 births	Neonates	Mean daily $PM_{2.5}$, NO_2 and O_3 (µg/m3), maximum and minimum daily temperatures (°C)	LBW (<2500 g), premature birth (<37 weeks of gestation), and late fetal death (<24 h of life)
Pedersen et al. 2016[2]	Several European cohorts	Cross-sectional	34,923 singleton births in 1994–2008	Neonates	Annual average concentrations of elemental constituents of $PM_{2.5}$ and PM_{10} at maternal home addresses during pregnancy	Birth weight
Rasking et al. 2024[3]	Belgium	Prospective cohort	1484	Mother–neonate pairs	Black carbon and $PM_{2.5}$ levels of the mother's residential address(es)	Cord blood cystatin C as measurement of neonatal kidney function
Ren et al. 2023[4]	Global	Retrospective cohort	Global data per 100.000 individuals	Neonates	$PM_{2.5}$	Age-standardized mortality rate; neonatal preterm birth; neonatal encephalopathy due to birth asphyxia and trauma; neonatal sepsis and other neonatal infections; HDNJ: hemolytic disease and other neonatal jaundice
Rittner et al. 2020[5]	Sweden	Retrospective analysis	1,247,993 individuals	All individuals of Scania > 5 years of age	$PM_{2.5}$ concentration of a 100 × 100 m cell in which a patient’s centroid of their residence was located	Birthweight and premature deaths
Respiratory infections						

Álvaro-Meca et al., 2022[6]	Spain	Bidirectional case-crossover study	30.445	Children <2 years	Temperature, relative humidity, NO_2, SO_2, O_3 and PM_{10}-levels	Hospital admissions for acute viral LRTIs
Bono et al., 2016[7]	Italy	Prospective cohort	20512 (excl 1281 asthma)	Children aged 0-18 years	Temperature, relative humidity, cumulative daily precipitations, NO_2, $PM_{2.5}$, O_3, and aeroallergens	ED-admissions for respiratory diseases
Carlsen et al., 2016[8]	Sweden	Prospective cohort	95	Children aged 11-12 years	$PM_{2.5}$, $PM_{2.5-10}$, O_3, NO_2, NO_x, NO	Airway inflammation ($FENO_{50}$)
Carugno et al., 2018[9]	Italy	Retrospective time-series study	2814	Children aged 0-18 years	PM_{10}	Hospitalization due to RSV-bronchiolitis
Pablo-Romero et al., 2015[10]	Spain	Retrospective cohort	2043 (excluding 87 asthma patients)	Children < 14 years	$PM_{2.5}$, temperature, relative humidity	Hospital admissions for respiratory diseases
Dimakopoulou et al., 2020[11]	Greece	Panel study	186	Children aged 10-11 years	O_3, PM_{10}, time spent outdoors (obtained through time activity diaries)	Long-term effects on lung function (spirometry) and FeNO levels.
Gallo et al., 2023[12]	Italy	Retrospective database	2215	Children < 1 years	$Pm_{2.5}$, PM_{10}, NO_2	Bronchiolitis severity
Guillien et al., 2024[13]	UK, France, Spain, Lithuania, Norway and Greece	Prospective cohort	1033	Children aged 6-12 years	$Pm_{2.5\text{-}10}$, NO_2, greenness, building density, VOCS	Lung function, ISAAC questionnaires, rhinitis
Kanellopoulos et al., 2021[14]	Greece	Retrospective analysis of prospectively collected data	4017 (excl 208 asthma)	Children aged 0-18 years	$PM_{2.5}$	ED visits for respiratory related issues
Karakatsani et al., 2017[15]	Greece	Panel study	188	Children aged 10-11 years	O_3 exposure	Respiratory symptoms, Lung Function
Milani et al., 2022[16]	Italy	Prospective cohort	110	Children < 1 year	The daily PM_{10} and $PM_{2.5}$ exposure in the 29 preceding days of measurement	Bronchiolitis severity score

Ratajczak et al., 2021[17]	Poland	Prospective cohort	?	Children aged 3–12 years	Daily changes in PM_{10} and $PM_{2.5}$	The number of children reporting URTS and their severity.
Shabani Isenaj et al., 2022[18]	Kosovo	Retrospective data base	1838 hospital admission records and 7372 ambulatory visits	Children aged 0–18 years	$PM_{2.5}$	Ambulatory and ER visits due to respiratory symptoms
Van Brusselen et al., 2024[19]	Belgium	Prospective cohort	118 cases and 79 controls	Children < 2 years	Predicted values of $PM_{2.5}$, PM_{10}, BC and NO_2 exposure, at the home address, and daycare address of the participant 1 to 5 days prior to hospitalization	Hospitalization for bronchiolitis
Atopic conditions						
Altzibar et al., 2014[20]	Spain	Observational study	28.477	Adults, but also children <15 years	Weekly average exposure to CO, PM_{10}, $PM_{2.5}$, NO_2 and O_3, temperature, relative humidity	ED visits and hospitalizations for asthma exacerbations
Amazouz et al., 2021[21]	France	Prospective birth cohort study	1063	Children at age 8 years old	Daily total pollen concentration, daily allergenic risk indices for specific pollen taxa, daily concentrations of PM_{10}, NO_2 and O_3 up to 4 days before the day of measurement	Lung function, FeNO
Ashworth et al., 2021[22]	England	Observational study	Not given	Adults, but also children <18 years	Daily PM_{10}, $PM_{2.5}$, NO_2 and O_3	Respiratory consultations for asthma and URTIs
Bouazza et al., 2018[23]	France	Observational study	47.107	Children <18 years	Daily mean exposure to concentration of PM_{10}, $PM_{2.5}$, NO_2 and O_3	ED visits for asthma exacerbations
Gehring et al., 2015[24]	Germany, Sweden, The Netherlands	Prospective birth cohort study	14.126	Children up to age 14-16 years	Annual average concentrations of PM_{10}, $PM_{2.5}$, NO_2, PM_{coarse}, and $PM_{2.5}$ absorbance at home address level	Incidence of asthma and rhino conjunctivitis

Gehring et al., 2015[25]	Netherlands	Prospective cohort	3702	Children aged 0-12 years	$PM_{2.5}$ and $_{10}$ and specific compounds such as copper, iron, potassium.	Asthma and allergy
Kouis et al., 2024[26]	Cyprus, Greece	Randomized controlled trial	182	Children aged 6-11 years with asthma	Interventions targeting exposure to outside concentrations of PM_{10} (one control group, one outdoor intervention group and one combined intervention group)	Asthma symptom control (c-ACT), lung function, FeNO
Lepeule et al. 2023[27]	France	Prospective longitudinal cohort	391	Infants 2 months of age	NO_2, $PM_{2.5}$ measured by wearables by mothers	Lung function in newborns
Mejias et al., 2019[28]	Spain	Observational retrospective study	2609	Children <16 years	Daily pollution data of NO_2, PM_{10} and O_3 at a monitoring station close to the hospital	ED visits for an asthma exacerbation
Mazenq et al., 2017[29]	France	Nested case-control study (1:15)	68.897	Children between 3-18 years of age	PM_{10}, $PM_{2.5}$ and meteorological conditions linked to postal code	Risk of asthma emergency visits
Melen et al., 2020[30]	Germany, Sweden, The Netherlands	Prospective birth cohort study	6.163	Children up to age 16 years	Individual residential outdoor levels of PM_{10}, $PM_{2.5}$, $PM_{2.5}$ absorbance, NO_2 and NO_x	Serum IgE sensitization to allergen extracts
Milanzi et al., 2018[31]	The Netherlands	Prospective birth cohort study	1.636	Children up to age 16 years	Annual average concentrations of PM_{10}, $PM_{2.5}$, NO_2, PM_{coarse}, and $PM_{2.5}$ absorbance at home address level	Lung function
Patlán-Hernández et al., 2024[32]	France	Prospective mother-child cohort	2.440	Children at 6- and 12-years of age	Exposure during pregnancy to $PM_{2.5}$ and NO_2 at the residential address	Incidence of asthma, rhinitis, eczema
Paunescu et al., 2019[33]	France, Spain	Prospective birth cohort	305	10-year-old children with and without persistent wheezing and/ or asthma attacks	Personal 24-hour measurements of exposure to BC and UFP	Lung function, FeNO
Pedersen et al., 2023[34]	Denmark	Nationwide prospective birth cohort	1.060.154	Children aged 0-19 years	Monthly mean concentrations of O_3, NO_2, NO_3^-, NO_x, PM_{10}, $PM_{2.5}$, SO_2, SO_4^-, NH_3, NH_4^+,	Incidence of asthma

					secondary inorganic aerosols (sum of NO_3^-, SO_4^- and NH_4^+), elemental carbon, organic carbon, sea salt	
Puklova et al., 2019[35]	Czech Republic	Cross-sectional study	7.239	Children at 5, 9, 13 and 17 years	Exposure to PM_{10} and NO_2 at the residential address	Prevalence of respiratory allergic diseases
Ranzi et al., 2014[36]	Italy	Prospective cohort study	69	Asthmatic children aged 6-7 years	Individual exposure at address level of PM_{10}	Respiratory symptoms
Spyratos et al., 2015[37]	Greece	Prospective cohort study	1425	Children aged 10-12 years	Concentrations of PM_{10} as well as SO_2	Asthma, Rhinitis, Allergy
Usemann et al., 2019[38]	Switzerland	Prospective birth cohort	232	Children at 6 years	Individual level PM_{10}, O_3 and NO_2 during pregnancy until 6 years	Lung function
Velická et al., 2015[39]	Czech Republic	Prospective cohort study	147	Children aged 6-18 years old with mild to moderate persistent asthma	Daily exposure based on time spent at home and school NO_2, PM_{10} and SO_2	Respiratory symptoms
Veremchuk et al., 2015[40]	Russia	Prospective cohort study	Not given	Children and adolescents	Aerosol suspension of PM, NO_2, SO_2, CO, NH_3 and CH_2O in snow and air, climatic factors	ED visits for asthma exacerbations
Wang et al., 2024[41]	England	Time-stratified case-crossover study	111.766	Children between 0-14 years	Daily NO_2 levels at the residential address with land use data and chemical transport estimates	Emergency hospital admissions for asthma
Yu et al., 2023[42]	Sweden	Prospective birth cohort	1.509	Children and adolescents between 8, 16 and 24 years old	Exposure to $PM_{2.5}$, PM_{10}, BC and NO_x at residential addresses	Lung function
Yu et al., 2024[43]	Sweden	Prospective birth cohort	2.371	Children and adolescents between 8-24 years old	Change in individual-level exposure to $PM_{2.5}$, PM_{10}, BC and NO_x at residential addresses	Incidence of asthma
Zhao et al., 2019[44]	Germany	Prospective birth cohort	2.921	10-year-old and 15-year-old children	Maximum 8 our averages of O_3 and daily average	FeNO

					concentrations of NO_2 and PM_{10} at monitoring stations	
Zhao et al., 2021[45]	Germany	Prospective birth cohort	915	Children up until 15 years of age	Annual average concentrations of NO_2, $PM_{2.5}$, PM_{10}, PM_{coarse} and $PM_{absorbance}$ in the first year of life	Lung function
Zhao et al., 2021[46]	Germany	Prospective birth cohort	2.224	15-year-old children	Air pollutant exposure of $PM_{2.5}$, PM_{10}, $PM_{2.5}$ absorbance, PM_{coarse} and NO_2 at 6, 10 and 15 years	Lung function
Neurological and cognitive conditions						
Antonsen et al. (2020)[47]	Denmark	Cohort	2189	Children up until 10 years	Annual average concentrations of NO_2, $PM_{2.5}$, PM_{10}	Schizophrenia
Baranyi et al. (2023)[48]	Scotland	Cohort	2,734	Age 11-86	$PM_{2.5}$ exposure	Cognitive ability and mortality
Binter et al. (2022)[49]	Netherlands	Cohort	3515	Children between 9-12 years	Outdoor air pollutants (NO_2, $PM_{2.5}$, and $PM_{2.5}$ absorbance)	Brain development; white matter, brain volume
Chen et al. (2024)[50]	Spain	Cohort	1416	Children up until 7 years	$PM_{2.5}$	ADHD
Horsdal et al. (2019)[51]	Denmark	Case-cohort	3531	Children up until 10 years	NO_2	Schizophrenia
Kusters et al. (2022)[52]	Netherlands	Cohort	5170	Children up until adolescence	Cu, OC, Fe, OP of PM, and PM_{coarse}	Cognitive function and behavioral problems
Kusters et al. (2024)[53]	Netherlands	Cohort	4108	Children 10-14 years old	$PM_{2.5}$, PM_{10}, PM_{coarse}, NO_x, OPDTT	White matter microstructure development
Lertxundi et al. 2019[54]	Spain	Prospective longitudinal cohort	1119	Mother-child pairs Children 4-6 years	NO_2, $PM_{2.5}$ measured at postal code during pregnancy	Infants' neuropsychological development
Lubczyńnska et al. (2020)[55]	Netherlands	Cohort	2954	Children 9-12 years old	Prenatal exposure to $PM_{2.5}$, elemental Si, NO_x, elemental Zn and OP of PM	White matter microstructure development

Lubczyńska, et al. (2020)[56]	Netherlands	Cohort	3133	Children 9-12 years old	NO_x, $PM_{2.5}$, PM_{10} and PM_{coarse}	Brain morphology
Mok et al. (2021)[57]	Denmark	National cohort	32,984	Children until 10 years	$PM_{2.5}$ and NO_2	Mental illness and self-harm
Oudin et al. (2016)[58]	Sweden	Longitudinal cohort	552,221	Children until 18 years	NO_2, PM_{10}, and $PM_{2.5}$	Psychiatric disorders
Oudin et al. (2019)[59]	Sweden	Longitudinal cohort	48,571	Children until 18 years	NO_x	Autism and ADHD
Reuben et al. (2021)[60]	England and Wales	Longitudinal cohort	2039	Children 10-18 years	$PM_{2.5}$ and NO_x	Psychopathology
Ritz et al. (2018)[61]	Denmark	Cohort	15387	9 months before to 9 months after pregnancy	NO_2, SO_2, $PM_{2.5}$ and PM_{10}	Autism spectrum disorder
Roberts et al. (2019)[62]	UK	cohort of twins from the E-Risk Longitudinal Study	284	Children until 18 years	NO, NO_2, NO_x, O_3, O_x, PM_{10}, $PM_{2.5}$, and PM_{coarse}	Mental health problems
Santos et al. 2023[63]	Portugal	Retrospective cohort	217	Children <17 years	O_3, $PM_{2.5}$, PM_{10}, NO_2, SO_2	Autism severity
Diabetes						
Badpa et al., 2022[64]	Germany	Cohort	included 85,251 and 272 diagnosed	Children until 6 years	Daily averages for $PM_{2.5}$, NO_2, O_3, temperature	Type 1 diabetes
Di Ciaula (2015)[65]	Italy	Observational study with time-trend analysis	1501	Children until 14 years	Average PM_{10}, O_3, NO_x and CO levels	Type 1 diabetes
Hrženjak et al., 2020[66]	Slovenia	5-year time-trend study	population between approximately 282,741 and 288,250 people over the period 2013–2017	Children 0-10 years and elderly 60+ years	Daily UFP, $PM_{2.5}$ and PM_{10} concentrations	Primary Health Care Consultations for Diabetes
Tamayo et al., 2016[67]	Germany	Retrospective cohort	771	Children 11-21 years	PM_{10}, NO_2, and O_3-AOT40	Diabetes type 1
HEAT STRESS						

Achebak et al. (2024)[68]	Spain	Cross sectional study	Over 11 million ED emissions	All ages, with a focus on infants <1 years of age	Weather (i.e., temperature and relative humidity), $PM_{2.5}$, PM_{10}, NO_2, and O_3	Emergency department visits
Christodoulou et al. (2024)[69]	France	Time-series observational study	1,198,953	6% children aged 0-15 years	Weather conditions	Conduct disorder, anxiety, mood disorder
Rancière et al. (2024)[70]	France	Cohort study	3359 mothers	Birth	Heat wave experienced by the mothers	Number of neonates with small for gestational age weight
Smith et al. (2016)[71]	UK	Retrospective observational study	1166 during heatwave year	Children aged 0-4 years and 5-14 years	Heat wave period	Emergency department visits for heat illness
WILDFIRES						
Barbosa et al. (2022)[72]	Spain	Retrospective observational study	320 cases in 2016 and 648 in 2017	Children until 18 years	Wildfires	Bronchitis and mortality
Vicedo-Cabrera et al. (2016)[73]	Spain	Cohort study	460	Children until 18 years	Two wildfires	Itchy/watery eyes, sneezing, sore throat, asthma and/or rhinitis

Table E1: Outcomes of the included studies of this review

BC = black carbon; CH2O = formaldehyde; CO = carbon monoxide; Cu = copper; ED = emergency department; Fe = iron; FeNO = fractional exhaled nitric oxide; LBW = low birth weight; LTRIs = lower respiratory tract infections; NO = nitrogen oxide; NO2 = nitric dioxide; NO3- = nitrate; NOx = both nitrogen oxide and nitrogen dioxide; OP = oxidative potential; OC = organic carbon; Ox = ozone and nitrogen dioxide; O3 = ozone; O3-AOT40 = accumulated ozone; PAH = polycyclic aromatic hydrocarbons; PMcoarse = particulate matter with a diameter between 2.5-10 PM2.5 = particulate matter with a diameter ≤2.5 micrometers; PM10 = particulate matter with a diameter ≤10 micrometers; Si = silicon; SNP = single nucleotide polymorphisms; SO2 = sulphur dioxide; UFP = ultrafine particles; U.K. = United Kingdom; URTIs = upper respiratory tract infections; Zn = zinc.

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