Review

The impact of prenatal environmental tobacco smoking (ETS) and exposure on Chinese children: A Systematic-Scoping review

Huazhen Ye , Xiaoyu Yang , Fahad Hanna *

Posted Date: 6 July 2023

doi: 10.20944/preprints202307.0391.v1

Keywords: Prenatal environmental smoking, child health, Chinese children, Systematic review, adverse events

Review

The Impact of Prenatal Environmental Tobacco Smoking (ETS) and Exposure on Chinese Children: A Systematic-Scoping Review

Huazhen Ye, Xiaoyu Yang and Fahad Hanna *

Public Health Program, Department of Health and Education, Torrens University Australia
* Correspondence: fahad.hanna@torrens.edu.au

Abstract: Background: There is considerable evidence to support the association between environmental tobacco smoke (ETS) exposure and children's burden of disease. However, literature on the health outcomes of prenatal ETS exposure among Chinese children has not yet been comprehensively reviewed. Objective: This systematic scoping review examines the currently available evidence and identifies gaps for further research on the health consequences of prenatal ETS exposure among Chinese children. Methods: Following the JBI scoping review methodological framework, we conducted a computer-aid search of three electronic databases-- PubMed, EBSCOhost, and ProQuest to include studies from January 2011 to May 2023 that addressed the health outcomes of Chinese children whose mothers were exposed to ETS at any stage of the pregnancy. Further, a methodological quality assessment of the selected articles was conducted, using JBI Critical Appraisal Checklists. **Results:** A total of 30 articles were reviewed, including eleven high-quality studies and nineteen moderate-quality studies. Five main themes, including hypertension, foetal and children's development, behavioural disorders, respiratory outcomes, and other health outcomes. Majority of studies showed positive link between prenatal ETS exposure and increase risk of preterm birth, and moderately, foetal growth restriction. Few studies explored other potential adverse outcome of ETS, including hypertension, respiratory morbidity, lung function and asthma in their children. **Conclusion:** The current available evidence on prenatal ETS exposure in Chinese children has unveiled a wide range of health outcomes, including preterm birth, foetal development, behavioural disorders and much more. However, Chinese studies in this area are still lacking and a gap still exists in relation to the strength of association between prenatal ETS exposure and some health risks. Efficient anti-smoking policies and smoking cessation programs should be developed to promote maternal and child health. Further research is also needed to provide better evidence in this field.

Keywords: prenatal environmental smoking; child health; Chinese children; systematic review; adverse events

1. Background

Environmental tobacco smoke (ETS), also known as second-hand smoke (SHS), contains more than 40 known or suspected carcinogens and various cardiovascular toxicants (WHO, 2000). Early in the second half of the 1980s, evidence from several major international reports, including landmark publications issued by The International Agency for Research on Cancer, Australia's National Health and Medical Research Council, the US Surgeon General, the US National Research Council and the UK's Scientific Committee on Tobacco and Health, showed that exposure to second-hand smoke increased the risk of illness and death in non-smokers, from infancy to adulthood (Greenhalgh et al., 2022). It is now well established that ETS exposure causes adverse health effects in thousands of passive smokers, including respiratory disease, cardiovascular disease, cancer, and mental and behavioural disorders (DiGiacomo et al., 2018; He et al., 2018; Vanker et al., 2017).

 doi:10.20944/preprints202307.0391.v1

Worldwide, about one-third of adult non-smokers and around 40% of children have been exposed to ETS at home, causing significant morbidity and mortality (Öberg et al., 2011). Pregnant women and children are particularly vulnerable to the harmful effects of second-hand smoke as their bodies are undergoing developmental processes and they are more susceptible to the harmful substances in ETS and at particular risk of serious health consequences (Chao et al., 2018; U.S. Department of Health and Human Services [USDHHS], 2014). Moreover, children are also generally unable to control their environment and have a lower ability to detoxify cancer-causing chemicals from smoke (Chao et al., 2018; USDHHS, 2014). With numerous studies conducted to establish a strong association between ETS and adverse health outcomes in children, consistent and increasing evidence showed that exposure to ETS during childhood and prenatally can contribute to adverse physical, psychological, and behavioural outcomes in children such as respiratory tract infections (RTIs), asthma, low birth weight, orofacial clefts, childhood cancer, psychological symptoms, Attention-Deficit/Hyperactivity Disorder (ADHD), and cognitive and language impairment (Snodgrass et al. 2016; Vanker et al. 2017; Zhou et al. 2014; He et al., 2018; Sabbagh et al., 2015; Wang et al., 2019).

China is the world's largest consumer of tobacco and exposure to ETS remains a significant public health problem (J. Chen et al., 2020), with approximately 55.19% of non-smokers having been exposed to ETS in public places or at home (Li et al., 2011). Although policies prohibiting smoking in public places have been promoted globally over the past few decades with intensive research on the health effects of ETS, the household environment remains a high-risk setting for ETS exposure (J. Chen et al., 2020). Non-smoking reproductive age females are one of the high-risk groups, with 65.1% of Chinese women aged 15-49 years having been exposed to ETS in their homes according to the 2010 Global Adult Tobacco Survey (GATS) (WHO, 2010). Moreover, subsequent and extended epidemiological studies found that approximately 31.5% of children and 54.6% of pregnant women were exposed to ETS at home in China (Dai & Chan, 2020; J. Chen et al., 2020). It is well-established that in order to reduce the burden of disease attributable to second-hand smoke, an urgent need to reduce the prevalence of ETS exposure, especially among pregnant women and women of reproductive age is warranted (Öberg et al., 2011; USDHHS, 2014).

Despite all this, research on the association between children's health outcomes and prenatal ETS exposure in China remains inadequate, and the lack of high-quality data from relevant studies hinders the development of more effective policies to prevent ETS exposure from children and pregnant women (J. Chen et al., 2020). Therefore, a systematic scoping review was conducted to address such a broad research question and represent the complex and heterogenous evidence (Peters et al., 2015). This review aimed to identify, analyse, and summarise the literature on the adverse effects of foetal exposure to ETS on the health of children in China, and identify gaps for further research.

2. Materials and Methods

A systematic scoping review was performed following the steps of the scoping review methodological framework developed by the Joanna Briggs Institute (JBI) – 1) developing the research question; 2) identifying relevant studies; 3) selection of eligible studies; 4) extraction of the results; and 5) presentation of the results (JBI, 2015). Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses- Extension for Scoping Reviews (PRISMA-ScR) checklist (Rethlefsen & Page, 2022), the reviewers presented the review results in a narrative format.

Eligibility Criteria

The study focused on children's health outcomes with prenatal ETS exposure. So, we included studies in which the study population was the foetus or children aged 0-18 years whose mothers were exposed to ETS during their pregnancy. ETS exposure was defined as indoors or outdoors exposure time daily more than 0 min/d. Studies' ETS exposure was from any sources -- at home, in the workplace, and in public places at the mother's any stage of pregnancy. Additionally, since we were focusing on the context of China, only studies conducted in China were included. And to avoid

 doi:10.20944/preprints202307.0391.v1

confusion of different terminology used and inaccuracy due to translation, we excluded studies published in languages other than English.

Specific inclusion criteria were as followed:

Publication type: peer-reviewed journal article/ report

Article type: systematic reviews, meta-analyses, scoping reviews, cohort studies, cross-sectional studies, case-control studies, non-RCTs, case series, individual case reports

Text availability: full text

Publication date: since 2011

Language: English

Location: Mainland China, Hong Kong, Macau, and Taiwan

Study population: pregnant women, children aged 0-18 years, and foetal

Type of Resource

The literature search on the research topic was conducted in three electronic databases--PubMed, EBSCOhost, and ProQuest, and supplemented by other extensive search techniques, such as screening the reference lists of selected articles and checking the 'cited by' and 'similar articles' options in PubMed, to include relevant articles not included in the primary search strategy.

To obtain the best and latest evidence and maximize the available data, we included all types of journal articles published since 2011. Firstly, experimental and quasi-experimental study designs were considered. But randomized controlled trials would not be included as people cannot be randomly allocated to exposures. In addition, analytical observational studies such as prospective and retrospective cohort studies, case-control studies and analytical cross-sectional studies were the main types of sources for inclusion (JBI, 2020). Furthermore, descriptive observational studies including case series, individual case reports, and systematic reviews that meet the inclusion criteria were also considered (JBI, 2020). However, this scoping review did not include qualitative studies. Finally, other reliable resources, such as government reports, were also considered for inclusion.

Search Strategy

A full search strategy was developed through the initial limited search using the keywords contained in the titles and abstracts of relevant articles. Boolean operators were used to increasing the sensitivity of the search. The keywords we applied included 'environmental tobacco smoke', 'second-hand smoke', 'child*', 'foetal', and 'Chin*'. Moreover, search terms related to 'prenatal exposure' were added but then removed before the search process, because the search results were too limited when this keyword was applied. We refine the final search string as: ((((environmental tobacco smoke) OR second-hand smoke)) AND (((child*) OR foetal) OR fetal)) AND (Chin*). Then in the filters area, "free full text", "full text", "10 years", 'English', and 'Humans' were selected to further narrow search results down. The search process was carried out from June 2022 and revised again in June 2023 for the purpose of this submission.

Selection of Eligible Studies

The reviewers followed the PRISMA Flow Diagrams for study selection to identify the final included articles (Rethlefsen & Page, 2022). Firstly, as the search proceeded, articles retrieved from different databases that met the inclusion criteria were synchronized to Mendeley and then duplicate studies were removed. Then, the titles and abstracts were screened against the eligibility criteria by one reviewer. A second reviewer completed the same process for a random sample of 10% of titles and abstracts, with 100% agreement on inclusion/exclusion decisions. Next, the study proceeded to a full-text review. Full texts of these selected articles were read through to exclude those that were not relevant to the research objective and do not meet inclusion criteria. Finally, the reference lists of retrieved articles were searched to include additional potentially relevant resources. Moreover, where no consensus was reached on inclusion/exclusion decisions, the two reviewers discussed it until an agreement was reached and asked the professor to adjudicate.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 6 July 2023 doi:10.20944/preprints202307.0391.v1

An overview of the selection process was demonstrated in Figure 1.

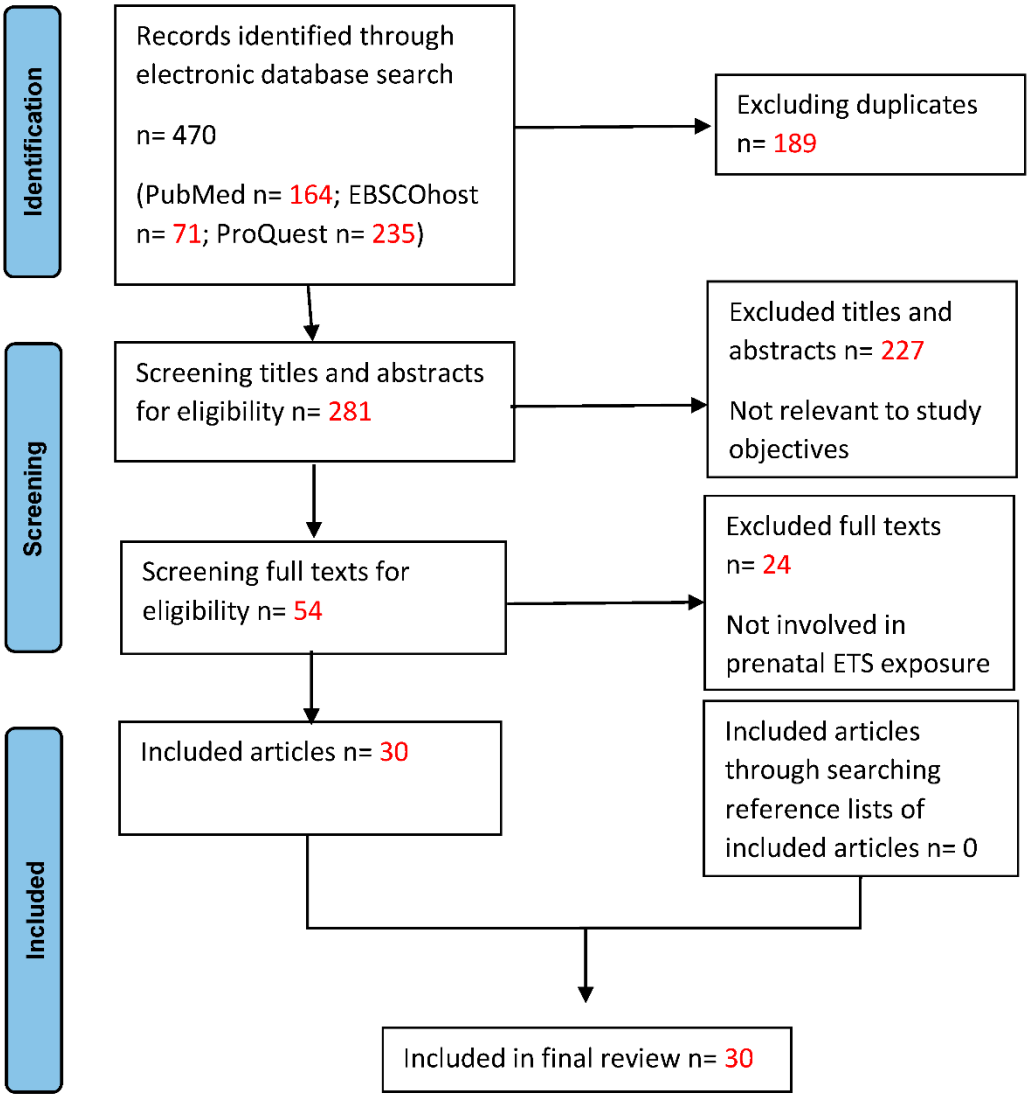

Figure 1. PRISMA Flow chart of the study selection process.

Data Charting

The researchers divided the articles equally and extracted data from them, then re-examined the articles reviewed by the other, and finally summarised all the information. The extracted data were categorised and summarised in Excel and later exported into tables and graphs. Data extraction categories include the author(s), publication year, location, aims/purpose, methodology, study population, sample size, data collection and measurement, key findings that relate to the research question, and research quality.

Critical Appraisal

All the included studies were assessed using the JBI Critical Appraisal tools for use in JBI Systematic Reviews. Three different types of study methods were identified in the selected articles, including cohort studies, case-control studies, and cross-sectional studies. Therefore, JBI Critical Appraisal Checklist for Cohort studies, Checklist for Case-control studies, and Checklist for Cross-sectional studies were used to appraise the methodological quality of different study methods. The process of quality assessment was done by one reviewer and then reassessed by the other reviewer until a consensus was reached finally. No article was excluded in the quality assessment process.

 doi:10.20944/preprints202307.0391.v1

Every study received a score based on specific criteria in different checklists. The score was given as follows: (NO or Unclear or Not applicable) = 0 and (YES) = 1. Later total scores and the percentage of scores were calculated to evaluate the methodological quality. The maximum score was 11, and the low, moderate, and high quality fell in the range of 0-50%, 50%-75%, and 76%-100%, respectively.

Synthesis of Results

Study results were summarised and reported in narrative formats in two parts:

1. A descriptive analysis, mapping the data, showing the distribution of studies by year of publication, origin, study method, aims and quality.

2. A thematic summary, narratively describing how identified research relates to the scoping review research question and objectives, and the main findings from these organised by theme.

Characteristics and Quality of the Included Studies

The main characteristics of the selected articles were summarised in Table 1.

We included thirty journal articles, all of which were primary research. The majority (60%) were cross-sectional studies, five were cohort studies, and seven were case-control studies. The quality scores (%) of these studies appraised using JBI Critical Appraisal Checklists ranged from 55% to 82%. And the numbers of studies with high quality, moderate quality, and low quality were 11, 19, and 0, respectively. The results of the critical appraisal were presented in Table 2.

Health Outcomes

Table 3 shows the main health outcomes of prenatal ETS exposure in Chinese children which were found in the twenty-two included articles.

Hypertension

One study by Zhang et al. (2020) found a significant association between maternal ETS exposure during pregnancy and hypertension in their offspring. The research results showed that prenatal ETS exposure led to higher odds of hypertension in children even after excluding the effects of potential confounders such as age of the mother, prematurity, and low birth weight.

Foetal and Children's Development

Seventeen studies reported the health impact of prenatal ETS exposure on foetal and child development.

Table 1. Characteristics and quality of the included studies.

Authors	Publication Year	Location	Aims/Purpose	Methodology	Sample Size	Study Population	Data Collection and Measurement	Study Quality
Zhang et al.	2020	Liaoning Province	Evaluate the association of ETS exposure with hypertension and blood pressure (BP) in children.	Cross-sectional study	9354	School-aged children (5-17years)	Questionnaire	Moderate
Chen et al.	2020	Taiwan (Chaiyi)	Evaluated the influences of air quality, including ETS and particulate matter (PM), on foetal development.	Longitudinal correlation study	74	Non-smoking pregnant women	Questionnaire & Laboratory result	High
Wang et al.	2020	Shanghai	Explore if the LBW in children is positively associated with mothers' prenatal cigarette smoke exposure.	Cross-sectional study	8586	Kindergarten children	Interview & Questionnaire	Moderate
Liu et al.	2013	Jiangsu Province (Changzhou)	Examine the association between maternal ETS exposure during pregnancy and child behaviour problems.	Cross-sectional study	646	Mother-child pairs	Questionnaire & Evaluation tool	Moderate
He et al.	2018	Guizhou Province	Examines the association between prenatal exposure to ETS and the development of children in their first two years of life.	Cross-sectional study	446	Children	Questionnaire	Moderate
Lin et al.	2017	Shenzhen City	Examine the association between prenatal ETS exposure and hyperactivity behaviours in young children.	Cross-sectional study	21,243	Preschool children	Questionnaire & Evaluation tool	Moderate
Lee, Samet, et al.	2012	Beijing and Changchun Province	Examine the magnitude of association between maternal SHS exposure during pregnancy and reduction in infant birth weight in China.	Cross-sectional study	2770	Non-smoking postpartum women	Interview & Questionnaire	Moderate
Wang et al.	2019	Liuzhou City	Test the hypothesis that prenatal tobacco smoking exposure (PSE)	Case-control study	401 (168 cases & 233 controls)	Children aged 6-12years	Interview & Questionnaire	High

doi:10.20944/preprints202307.0391.v1

			could modulate the association of genetic variants with ADHD.					
Pi et al.	2018	Shanxi Province	Examine whether exposure to SHS during the periconceptional period among nonsmoking women is associated with an increased risk for orofacial clefts (OFCs) in offspring.	Case-control study	1660 (240 cases & 1420 controls)	Newborns	Interview & Questionnaire	Moderate
Ren et al.	2020	Shandong Province	Assessed the association between maternal exposure to SHS during pregnancy and children's cerebral palsy (CP).	Cross-sectional study	5067	Mother-child pairs	Questionnaire	Moderate
Chen et al.	2021	Wuhan City	Clarify the association of ETS before and during pregnancy with the risk of adverse birth outcomes.	Cohort study	7,147	Mothers-infant pairs	Questionnaire & Delivery records	High
Dong et al.	2011	Liaoning Province	Assess the interaction of ETS exposure and allergic predisposition regarding respiratory health.	Cross-sectional study	23,474	Children from elementary schools	Questionnaire	Moderate
Hu et al.	2017	Liaoning Province	Investigate whether gender or asthma status modifies the association of SHS exposure with lung function.	Cross-sectional study	6,740	School-aged children	Questionnaire & Electronic spirometers	Moderate
Lee, Lam, et al.	2012	Hong Kong	Examine the association of foetal exposure to maternal passive smoking with childhood asthma, allergic rhinitis, and eczema.	Cross-sectional study	7,393	Children≤ 14Y	Questionnaire, interview & evaluation tool	Moderate
Lin, Xu, Wu, Zhou, Ma, Chen, Chen, et al.	2021	Liaoning Province	Evaluate the associations of prenatal, early postnatal, or current SHS exposure with ADHD symptoms and subtypes.	Cross-sectional study	45,562	School-aged children	Questionnaire & Evaluation tool	Moderate
Liu et al.	2018	Shanghai	Investigate the associations of household environmental factors during gestation with preterm birth, low birth weight, term low birth	Cross-sectional study	13,335	Children aged 4-6 years	Questionnaire	Moderate

doi:10.20944/preprints202307.0391.v1

			weight, and small for gestational age.					
Huang et al.	2020	Guangdong Province (Foshan & Shenzhen)	Examine the relationship between prenatal environmental tobacco smoke (ETS) exposure and full-term low birth weight (FT-LBW).	Case-control study	1632 (243 cases & 1389 controls)	Mothers-infant pairs	Interview & Medical records	High
Leung et al.	2015	Hong Kong	Estimated the associations of early SHS exposure during the prenatal and postnatal periods with several aspects of adolescent mental health.	Cohort study	7,914	"Children of 1997"birth cohort	Questionnaire & Evaluation tool	High
Li et al.	2019	Shenzhen City (Longhua)	Investigate the association between ETS during early life and early-onset astigmatism.	Cross-sectional study	27,890	Preschool children	Questionnaire & Medical diagnosis	Moderate
Lin, Xu, Wu, Zhou, Ma, Chen, Dong, et al.	2021	Liaoning Province	Evaluate the associations of early-life SHS exposure with sleep problems in children.	Cross-sectional study	45,562	School-aged children	Questionnaire & Evaluation tool	Moderate
Yang et al.	2021	Shenzhen City (Longhua)	Explore the association between children's exposure to ETS in early life and autistic-like behaviours.	Cross-sectional study	65,243	Preschool children	Questionnaire & Evaluation tool	Moderate
Zhuge et al.	2020	Urumqi, Taiyuan, Beijing, Nanjing, Shanghai, Wuhan, Chongqing, &Changsha	Analyse associations of ETS with dry night cough, croup, pneumonia, and the frequent common cold.	Cross-sectional study	41,176	Children aged 3-8 years	Questionnaires	Moderate
Liu et al.	2022	Shenzhen City (Longhua)	Explore the independent and joint effects of prenatal exposure to multiple household air pollution (HAP) sources on PTB	Cross-sectional study	63,038	Mother–child pairs	Questionnaire	Moderate
Chen et al.	2023	Shanxi Province (Pingding, Xiyang, Shouyang, Taigu, and Zezhou).	Investigated the impact of maternal exposure to indoor air pollution from coal combustion and tobacco smoke on the risk for neural tube defects (NTDs)	Case-control study	739 (222 cases & 517 controls)	women (during the periconceptional period)	Questionnaire & Evaluation tool	High

doi:10.20944/preprints202307.0391.v1

Wang, Deng et al.	2022	Rural China	Evaluate the association of paternal smoking and preterm birth (PTB).	Cohort study	5,298,043	reproductive-aged couples	Questionnaire & Medical diagnosis	High
Song et al.	2022	Changsha, Hunan Province	Examined the role of MTHFD1 gene and maternal smoking on infant CHD risk and investigated their interaction effects in Chinese populations.	Case-control study	968 (464 cases & 504 controls)	Mother–child pairs	Questionnaire & Laboratory result	Moderate
Wu et al.	2022	Mainland China (nationwide)	Investigate the association between prenatal SHS exposure and suspected DCD in preschoolers	Cross-sectional study	149,005	Preschoolers	Questionnaire & Evaluation tool	Moderate
Ahmed Sakran et al.	2022	Gansu Province	Identify the relationship between environmental factors and nonsyndromic cleft lip and/or palate (NSCL/P) in Northwest China	Case-control study	1260 (600 cases & 660 controls)	Children and their parents	Interview	High
Deng et al.	2022	West China Second University Hospital	Examine the association of maternal ETS with foetal CHDs and the potentially moderating effect by maternal hazardous and noxious substances (HNS), periconceptional folate intake and paternal smoking.	Case-control study	1629 (749 cases & 880 controls)	singleton pregnant women	Questionnaire, interview & Medical diagnosis	High
Wang, Chen et al.	2022	Central China	Estimate the associations of maternal active and passive smoking during the pre-pregnancy/early-pregnancy period with CHDs as well as its common phenotypes in offspring	Cohort study	49158	Pregnant women between the 8th and 14th weeks of gestation	Interview & Medical diagnosis	High

doi:10.20944/preprints202307.0391.v1

Table 2. Quality scores of the included studies.

	Criterion											Total Score	Percentage (%)
Author (Year)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**		
Cross-sectional study													
Zhang et al. (2020)	1	1	0	1	1	0	1	1	n/a	n/a	n/a	6	55%
Wang et al. (2020)	1	1	0	1	1	1	1	1	n/a	n/a	n/a	7	64%
Liu et al. (2013)	1	1	0	1	1	1	1	1	n/a	n/a	n/a	7	64%
He et al. (2018)	1	1	0	1	1	1	1	1	n/a	n/a	n/a	7	64%
Lin et al. (2017)	1	1	0	1	1	1	1	1	n/a	n/a	n/a	7	64%
Lee, Samet, et al. (2012)	1	1	0	1	1	1	1	1	n/a	n/a	n/a	7	64%
Ren et al. (2020)	1	1	0	1	1	0	1	1	n/a	n/a	n/a	6	55%
Dong et al. (2011)	1	1	0	1	1	1	0	1	n/a	n/a	n/a	6	55%
Hu et al. (2017)	1	1	0	1	1	1	1	1	n/a	n/a	n/a	7	64%
Lee, Lam, et al. (2012)	1	1	0	1	1	1	0	1	n/a	n/a	n/a	6	55%
Lin, Xu, Wu, Zhou, Ma, Chen, Chen, et al (2021)	1	1	0	1	1	1	1	1	n/a	n/a	n/a	7	64%
Liu et al. (2018)	1	1	0	1	1	1	1	1	n/a	n/a	n/a	7	64%
Li et al. (2019)	1	1	0	1	1	1	0	1	n/a	n/a	n/a	6	55%
Lin, Xu, Wu, Zhou, Ma, Chen, Dong, et al. (2021)	1	1	0	1	1	1	1	1	n/a	n/a	n/a	7	64%
Yang et al. (2021)	1	1	0	1	1	1	1	1	n/a	n/a	n/a	7	64%
Zhuge et al. (2020)	1	1	0	1	1	1	0	1	n/a	n/a	n/a	6	55%
Liu et al. (2022)	1	1	0	1	1	1	0	1	n/a	n/a	n/a	6	55%
Wu et al. (2022)	1	1	0	1	1	1	1	1	n/a	n/a	n/a	7	64%
Case-control study													
Wang et al. (2019)	1	1	1	0	1	1	1	1	1	1	n/a	9	82%
Pi et al. (2018)	1	0	1	0	1	1	1	1	1	1	n/a	8	73%
Huang et al. (2020)	1	1	1	0	1	1	1	1	1	1	n/a	9	82%
Chen et al. (2023)	1	1	1	0	1	1	1	1	1	1	n/a	9	82%
Song et al. (2022)	1	1	1	0	1	1	1	1	1	1	n/a	9	82%
Ahmed Sakran et al. (2022)	1	1	1	0	1	1	1	1	1	1	n/a	9	82%
Deng et al. (2022)	1	1	1	0	1	1	1	1	1	1	n/a	9	82%
Cohort study													
Chen et al. (2020)	1	1	1	1	1	1	1	0	1	n/a	1	9	82%

doi:10.20944/preprints202307.0391.v1

Chen et al. (2021)	1	1	0	1	1	1	1	1	1	0	1	9	82%
Leung et al. (2015)	1	1	0	1	1	1	0	1	1	1	1	9	82%
Wang, Deng et al. (2022)	1	1	0	1	1	1	1	1	1	0	1	9	82%
Wang, Chen et al. (2022)	1	1	0	1	1	1	1	1	1	n/a	1	9	82%

Table 3. Main health outcomes of prenatal ETS exposure on children.

Authors (Publication Year)	Main Results	Exposure Sources	Exposure Timepoint
	1. Hypertension		
Zhang et al. (2020)	Significant associations were observed for hypertension with ETS exposure in utero, with current major ETS exposure from fathers or anyone, and with intensity of ETS exposure greater than 1 cigarette per day. For SBP, significant associations were only observed in children with major ETS exposure from father and with cigarettes smoking >10/day.	Household (SHS from father or anyone)	In utero and within children's first 2 years of life
	2. Foetal and children's development		
	2.1. Birth outcomes		
Wang et al. (2020)	The mean birthweight was 167.7 g and 66.1 g lower in children born to mothers with prenatally FHS and SHS exposure compared with those children whose mother were not exposed, respectively.	Maternal passive and active smoking	Prenatal exposure
Huang et al. (2020)	Significant association between prenatal ETS exposure and FT-LBW.	Maternal SHS exposure at home, workplace & public places	During pregnancy
Chen et al. (2020)	ETS exposure decreased birth length by ≥1 cm, and potentially is an independent risk factor for foetal growth restriction.	Maternal SHS exposure at home, workplace & public places	During pregnancy
Chen et al. (2021)	Significant association between exposure to ETS during pregnancy with PTB, but not LBW or SGA births.	Maternal ETS exposure (indoor & outdoor)	Before and/or during pregnancy.
Liu et al. (2018)	Positive relation between paternal smoking during gestation and PB, LBW, and SGA, but not significant associations.	Household (paternal and maternal smoking)	During pregnancy
Lee, Samet, et al. (2012)	No deficit in mean birth weight was observed with exposure from all sources of SHS combined.	Maternal ETS exposure at home, workplace & public places	During pregnancy
Liu et al. (2022)	Prenatal exposure to ETS increased the risk of PTB and the PTB risk increased with the average level of daily ETS exposure	Household (Maternal exposure)	Prenatal exposure

doi:10.20944/preprints202307.0391.v1

Wang, Deng et al. (2022)	Paternal smoking and preconception paternal smoking was independently positively associated with PTB risk. // The HRs of PTB also increased with the increment of paternal smoking and preconception paternal smoking categories	Paternal and maternal smoking	Preconception exposure
	2.2. Orofacial clefts		
Pi et al. (2018)	Maternal SHS exposure during the periconceptional period increases the risk for OFCs in offspring among nonsmoking mothers, and there was a dose-response relationship.	Maternal SHS exposure at home & indoor public places	Prenatal exposure
Ahmed Sakran et al.(2022)	Maternal passive smoking was found to be a significant risk factor for NSCLP incidence.	Paternal and maternal smoking	the 1st trimester of gestation
	2.3. Neural tube defects (NTDs)		
Chen et al. (2023)	Significant association between passive smoking and neural tube defects (NTDs) occurrence. // dosage respond//	Household	during the periconceptional period (1 month before to 2 months after conception)
	2.4. Congenital heart disease (CHD)		
Song et al. (2022)	Increased risk of CHD in offspring whose mothers were exposed to secondhand smoke during 3 months before pregnancy and in the first trimester of pregnancy	At home and/or at work/school	during 3 months before pregnancy and in the first trimester of pregnancy
Deng et al. (2022)	Maternal exposure to ETS in first trimester was associated with increased risk of CHDs in a dose– response gradient.	Maternal exposure	in the first trimester of pregnancy
Wang, Chen et al. (2022)	Significantly higher risks of CHDs were detected in offspring exposed to maternal cigarette smoking in 3 months before pregnancy. // Maternal cigarette smoking in early pregnancy was also independently associated with risk of CHDs in offspring.	Maternal exposure	3 months before pregnancy & in early pregnancy
	2.5. Developmental coordination disorder (DCD)		
Wu et al. (2022)	Prenatal SHS exposure had the strong negative association with the total score of LDCDQ and increased the risk of suspected DCD	At home and/or at work	Prenatal & postnatal exposure
	2.6. Developmental delay		
Ren et al. (2020)	Children born to mothers exposed to SHS during pregnancy had a higher risk of CP, and the risk increased with exposure time.	Maternal SHS exposure	Prenatal exposure

doi:10.20944/preprints202307.0391.v1

He et al. (2018)	Prenatal ETS exposure was associated with lower cognition scores and language scores. And the frequency of prenatal ETS exposure was negatively associated with language development before children reached two years old.	Maternal ETS exposure	Prenatal exposure
3. Behavioural disorders			
3.1. ADHD			
Wang et al. (2019)	Prenatal tobacco smoke exposure was a significant risk factor for ADHD even after adjusting for other potential confounders. The risk of the genetic variants in ADHD was increased significantly if the child had prenatal tobacco exposure.	Household & workplace	Prenatal & postnatal exposure
Lin, Xu, Wu, Zhou, Ma, Chen, Chen, et al. (2021)	Significant association between SHS exposure from pregnancy to childhood with having ADHD symptoms and subtypes.	SHS exposure	Prenatal, postnatal (ie, first 2 years of life) & current periods
Lin et al. (2017)	Prenatal ETS exposure was significantly associated with an increased risk of hyperactivity behaviours in young children, and there was a dose-response relationship.	Household (Maternal exposure)	Prenatal exposure
3.2. Autism Behaviour			
Yang et al. (2021)	Significant association between being exposed to ETS during gestation and autistic-like behaviours. // dosage respond	Household	During pregnancy, from birth to one year & from one to three years
3.3. Other disorders			
Liu et al. (2013)	ETS exposure was associated with a higher risk of externalizing behaviour problems in offspring of exposed mothers. However, it was not associated with internalizing or total behaviour problems. And no dose-response relationship was found.	Maternal ETS exposure at home, the workplace, and other places	Prenatal exposure
Leung et al. (2015)	Significant association between prenatal SHS exposure from non-parental sources and behavioural problems// Association between paternal smoking and maternal smoking and mental health problems.	Non-parental and parental exposure	Prenatal and postnatal
4. Respiratory diseases			
Zhuge et al. (2020)	Associations between most respiratory health outcomes and parental smoking except for the frequent common cold // Stronger association for father smoking // Insignificant effect for maternal smoking//Most association were insignificant after adjustment.	Parental smoking (mother only, father only, both)	During pregnancy, during the first year of life & current periods
Dong et al. (2011)	Significant association between ETS exposure in utero and the prevalence of respiratory morbidities// dosage respond//	Household (current & maternal)	Prenatal, postnatal (ie, first 2 years of life) & current periods

doi:10.20944/preprints202307.0391.v1

Lee, Lam, et al. (2012)	Significant association between foetal exposure to maternal passive smoking with wheeze ever, current wheeze, allergic rhinitis ever, and eczema ever //dose response	Household (maternal passive & active smoking)	During pregnancy
Hu et al. (2017)	Significant association between in utero exposure to SHS decreased lung function// Childhood asthma mediated the effects.	Household SHS exposure and maternal passive & active smoking	In utero & during early childhood
	5. Others		
Li et al. (2019)	No significant association between exposed to ETS during pregnancy only and astigmatism. // Significant associations were found when exposed to ETS during pregnancy+from one to three years, or during pregnancy+from birth to one year+from one to three years old.	Household	During pregnancy, from birth to one year & from one to three years
Lin, Xu, Wu, Zhou, Ma, Chen, Dong, et al. (2021)	Significant association between being exposed during pregnancy and sleep problems.	Household	Pregnancy & the first 2 years of life

doi:10.20944/preprints202307.0391.v1

 doi:10.20944/preprints202307.0391.v1

Birth Outcomes

Eight articles examined the association between prenatal ETS exposure and children's birth outcomes.

A cross-sectional study conducted in Shanghai investigated the association between LBW and mothers' prenatal tobacco smoke exposure (Wang et al., 2020). The results showed that the incidence of LBW was higher in children whose mothers were prenatally exposed to ETS and their mean birth weight was 66.1g lower than those without exposure history. Furthermore, Huang et al. (2020) found prenatal ETS exposure was linked to a higher risk of giving birth to full-term low birth weight (FT-LBW), and the association remained consistent in subcategories of symmetric FT-LBW but not asymmetric FT-LBW. Moreover, another longitudinal prospective study suggested that maternal ETS exposure was likely to be an independent risk factor for foetal growth restriction and could reduce foetal birth length by more than 1 cm (M. M. Chen et al., 2020). What is more, exposure to ETS during pregnancy was associated with an increased risk of preterm birth (PTB) both before and after adjustment for potential confounders. Liu et al. (2022) also found increased risk of PTB among mothers with prenatal exposure to ETS and the risk increased with the average level of daily ETS exposure. And surprisingly, the increased risk of PTB by ETS during pregnancy was observed only among mothers who were more educated (Chen et al., 2021). This might be because most participating mothers were well-educated and there were significant differences in maternal educational level between PTBs and FTBs (Liu et al., 2022). Liu et al. (2018) also pointed out that paternal smoking during gestation had a significant association with PTB, and the association was more obvious in boys and children with old (≥34-year-old) mothers. Recent findings also suggested paternal smoking and preconception paternal smoking was independently positively associated with PTB risk, and the HRs increased with the increment of paternal smoking and preconception paternal smoking categories (Wang et al., 2022).

However, inconsistent findings were found in the association between ETS during pregnancy and PTB, LBW, and "small for gestational age" (SGA). One study reported a positive but non-significant effect of father smoking during pregnancy on infant birth outcomes (Liu et al., 2018), while another pointed out that the association between ETS during pregnancy and PTB was only found to be consistent in medically indicated PTB and late PTB, but not in spontaneous PTB and early PTB (Chen et al., 2021). In addition, M. M. Chen et al. (2020) stated that there was no evidence linking ETS to low birth weight or SGA based on their findings. Similarly, N. L. Lee et al. (2012) found no significant association between infant birth weight and prenatal ETS exposure in their study. Chen et al. (2021) also reported not a significant association was found between ETS during pregnancy and the risk of LBW or SGA and they suggested the inconsistent results could be due to different rates of LBW and SGA, the differences in ETS definitions, and the exposure magnitude.

Orofacial Clefts (OFCs)

Two studies reported the health impact of prenatal ETS exposure on orofacial clefts. As Pi et al. (2018) stated, prenatal ETS exposure among children of non-smoking mothers was significantly associated with an increased risk of developing OFCs. And the association was dose-dependent, with mothers exposed to ETS more than six days per week leading to an increased risk of OFCs in their offspring. Ahmed Sakran et al. (2022) also reported maternal passive smoking during early gestation to be a significant risk factor for nonsyndromic cleft lip and/or palate (NSCLP) incidence, with OR=4.349.

Neural Tube Defects (NTDs)

One case-control study by H. Chen et al. (2023) found significant association between passive smoking and NTDs occurrence, with a significant dose-response relationship between NTD risk and an exposure index of ETS or other household air pollution.

Congenital Heart Disease (CHD)

 doi:10.20944/preprints202307.0391.v1

Three articles examined the association between prenatal ETS exposure and CHD, mostly focusing on exposure during 3 months before pregnancy and in the first trimester of pregnancy. Both Song et al. (2022) and L. Wang et al. (2022) reported increased risk of CHD in offspring whose mothers were exposed to SHS during 3 months before pregnancy. All three identified articles showed significant association between maternal exposure to ETS and CHDs in offspring (Song et al., 2022; Deng et al., 2022; Wang, Chen et al., 2022). Additionally, Deng et al. (2022) also found a dose-response gradient in risk of CHDs to maternal exposure to ETS in first trimester of pregnancy.

Developmental Coordination Disorder (DCD)

One case-control study conducted by Wu et al. (2022) reported strong negative association with scores of the Chinese version of Little Developmental Coordination Disorder Questionnaire (LDCDQ) and increased risk of suspected DCD, and the prevalence of suspected DCD was significantly higher in prenatal SHS-exposed group and the prevalence of suspected DCD in girls was higher than that in boys in the same age group.

Developmental Delay

Two studies explored the relationship between ETS exposure and development delay.

Ren et al. (2020) noted that there was a higher rate of maternal exposure to ETS during pregnancy in children with cerebral palsy compared to the general population. After adjusting for confounding factors such as delivery mode and birth weight, the results still revealed that children born to mothers exposed to ETS during pregnancy had a higher risk of cerebral palsy than children of unexposed mothers, and this risk increased with increasing duration of ETS exposure (Ren et al., 2020). Moreover, He et al.'s (2018) study indicated that prenatal ETS exposure led to impairment of children's early cognitive and language development in their first two years of life. Additionally, the level of language development was negatively correlated with the frequency of prenatal ETS exposure, with each additional pack of cigarettes smoked per week by a member of the household potentially associated with a 0.48-point decrease in early childhood language scores (He et al., 2018).

Behavioural Disorders

Six studies investigated the association between prenatal ETS exposure and children's behavioural disorders.

ADHD

Three studies have linked the prenatal ETS exposure to the development of ADHD in children.

Wang et al. (2019) examined prenatal tobacco smoking exposure (PSE) as a moderator in association with genetic variants and ADHD. They reported that the genetic risk of ADHD may be affected by environmental factors, and the risk of genetic variation in ADHD is significantly increased if the child has been exposed to ETS prenatally. Thus, PSE was a potential risk factor for ADHD, which was significantly associated with all ADHD subtypes in children (Wang et al., 2019). Lin, Xu, Wu, Zhou, Ma, Chen, Chen, et al. (2021) also found ETS exposure from pregnancy to childhood was associated with higher odds of having ADHD symptoms and subtypes, and the associations were stronger in the prenatal periods. Moreover, a significant positive association between prenatal ETS exposure and the risk of hyperactivity disorder in children was evident after adjusting for potential confounders in another cross-sectional study (Lin et al, 2017). Women who have been exposed to ETS during any trimesters of pregnancy are more likely to have children who display hyperactive behaviours (Lin et al, 2017). Further, this relationship was dose-dependent, as the dose of ETS exposure increased, children were more likely to exhibit hyperactivity behaviours (Lin et al, 2017).

Autism Behaviour

One research showed that children with early life ETS exposure were more likely to exhibit autistic-like behaviours and those who were exposed to ETS during gestation had a significantly

 doi:10.20944/preprints202307.0391.v1

increased risk of autistic-like behaviours (Yang et al., 2021). This significant association was consistent was only found in further analysis of the combined effect of children's ETS exposure in three stages of early life-- during pregnancy, from birth to one year and from one to three years (Yang et al., 2021). In addition, with the increase in the duration of exposure and the average number of cigarettes smoked in the child's immediate environment, the risk of autistic-like behaviours increased (Yang et al., 2021).

Other Disorders

Two articles pointed out the association between prenatal ETS exposure and behavioural disorders other than ADHD and autism. Liu et al. (2013) investigated the association between prenatal ETS exposure and externalising behaviours in Chinese children. Children born to mothers who had been exposed to ETS during pregnancy were at higher risk for externalizing behavioural problems, but no dose-response relationship was identified. In addition, a cohort study that estimated the associations of early ETS exposure during the prenatal and postnatal periods with several aspects of adolescent mental health found that prenatal ETS exposure from non-parental sources was associated with behavioural problems in children after adjustment for potential confounders (Leung et al., 2015). While paternal smoking and maternal smoking were associated with more mental health problems, prenatal ETS exposure from non-parental resources both occasional and daily was associated with several behavioural problems but not with lower self-esteem or depressive symptoms (Leung et al., 2015).

Respiratory Outcomes

Four studies have explored the association between prenatal ETS exposure and children's respiratory outcomes.

In a study investigating the associations between children's exposure to tobacco smoke in utero, in the first year of life and childhood and respiratory outcomes, Zhuge et al. (2020) reported that 14.3% of the children aged 3-8 years had at least one respiratory symptoms, and pneumonia was the most frequently reported respiratory outcome with a 32.3% lifetime ever incidence among, followed by dry night cough (17.1%), frequency common cold (9.5%), and croup (6.0%). Except for the frequent common cold, crude odd ratios showed a stronger association between most respiratory health outcomes and paternal smoking only during pregnancy and the effect of maternal smoking on respiratory outcomes was insignificant possibly due to the low maternal smoking rate (Zhuge et al., 2020).

Similarly, Dong et al. (2011) pointed out that compared to unexposed children, the prevalence of respiratory morbidities (including the history of asthma, current asthma, current wheeze, persistent cough, persistent phlegm and allergic rhinitis) was higher in children with ETS exposure in utero and increased with the increase in numbers of cigarettes smoked. S. L. Lee et al. (2012) also suggested that perinatal and postnatal problem was more prevalent in the children whose mothers with maternal passive smoking during pregnancy than those whose mothers actively smoke during pregnancy and those unexposed. Foetal exposure to maternal passive smoking was significantly associated with wheeze ever, current wheeze, allergic rhinitis ever, and eczema ever (S. L. Lee et al., 2012). The dose-response relationship between wheeze ever and current wheeze with increasing exposure to maternal passive smoking was also observed (S. L. Lee et al., 2012).

Furthermore, while the percentage of ETS exposure in utero among children with allergic predisposition was higher than that among children without allergic predisposition, children without allergic predisposition were more susceptible to ETS (Dong et al., 2011). For children without allergic predisposition, ETS exposure in utero was associated with a history of asthma and current asthma only among boys (Dong et al., 2011).

Additionally, it was suggested that the adverse effect of maternal passive smoking or maternal active smoking on foetuses is operated via effects on lung function (S. L. Lee et al., 2012), and Hu et al. (2017) found that in utero exposure to ETS was independently associated with decreased lung function and the association. A significant association between ETS exposure in utero and decreased

 doi:10.20944/preprints202307.0391.v1

maximal mid-expiratory flow (MMEF) was found in children with asthma, but not in those without asthmatics; also, in females but not in males (Hu et al., 2017). No significant associations were observed between ETS exposure in utero and decreased forced vital capacity (FVC) and decreased absolute forced expiratory volume in 1 s (FEV1), but it was reported that 66.4% and 57.2% of cases of prenatal ETS exposure with decreased FVC and decreased FEV1 respectively were mediated by childhood asthma (Hu et al., 2017).

However, the association between children's exposure to tobacco smoke in utero and respiratory outcomes were insignificant after adjustment for potential confounders (Zhuge et al., 2020). Zhuge et al. (2020) found indoor smoke odour to be clearly and strongly associated with most investigated respiratory outcomes and argued that the perceived indoor smoke odour could be a more direct indicator of ETS exposure than parental smoking. This might be because parents who smoke may avoid smoking in the presence of children, which can be supported by the weak relationship between parental smoking and tobacco smoke odour (Zhuge et al., 2020).

Others

Astigmatism

One study investigating the association between ETS exposure during early life and early-onset astigmatism showed no significant increased risk of astigmatism when children were exposed to ETS only during pregnancy, but significant combined effects were observed -- children were more likely to exhibit astigmatism when they were exposed to ETS during both pregnancy and from one to three years, or during both pregnancy and the first three years (Li et al., 2019).

Sleep Disorder

According to Lin and his colleagues (2021), ETS exposure during pregnancy was associated with higher total T-scores of the Sleep Disturbance Scale for Children (SDSC) and higher T-scores in six domains of sleep disturbance. ETS exposure during both pregnancy and the first 2 years had the highest total T-scores of SDSC and higher odds of increased sleep problems, with the strongest associations found in sleep-wake transition disorders (SWTD) and higher odds of long sleep latency in disorders of initiating and maintaining sleep (DIMS) (Lin, Xu, Wu, Zhou, Ma, Chen, Dong, et al., 2021).

3. Discussion

This systematic scoping review, which included twenty-two well-designed studies, has provided vital insights into the health impacts of ETS on Chinese children. Several studies have indicated that Chinese women have a low prevalence of passive smoking but a high incidence of ETS exposure at home and in public places. This special exposure profile reduces the interference of active smoking over passive smoking when investigating the health effects of tobacco exposure. Thus, our findings could provide convincing evidence to examine the harmful effects of ETS exposure during pregnancy on foetuses and children.

Prenatal ETS exposure has been reported to cause LBW, congenital birth defects, and infant mortality. According to Leonardi-Bee et al. (2011), prenatal ETS exposure increased the risk of a foetus having congenital birth defects, such as cardiovascular, reproductive, musculoskeletal, and facial defects, by 10-50%. And maternal exposure to ETS during pregnancy was approximately twice as likely to deliver LBW infants as non-exposed mothers (Pereira et al., 2017). Similar findings as above were shown in our study. Moreover, our review found that prenatal ETS exposure significantly increases Chinese children's risk of developing respiratory diseases. Research has suggested that infant prenatal exposure to ETS increased susceptibility to childhood respiratory diseases by impairing immune function in the early years of life (Vanker et al., 2017). As a result, ETS exposure affected lung development in infants and was associated with respiratory infections, wheezing, and asthma in children. In addition, it increased the risk of lifelong poor lung health and was associated with more serious respiratory diseases, such as lung cancer, in adulthood (Vanker et al., 2017). Our

findings corroborated this conclusion. Furthermore, findings from this review also revealed that after adjusting for potential confounders, such as parental intelligence, parental literacy, and socioeconomic status, prenatal or childhood ETS exposure remained a significant contributor to impaired cognitive function and the onset of behavioural problems such as ADHD. These findings were consistent with similar findings from a systematic review by Zhou and colleagues (Zhou et al., 2014).

By conducting this systematic scoping review, we found numerous studies worldwide over the past decade investigating the health effects of prenatal ETS exposure on children. The currently available evidence on prenatal ETS exposure in Chinese children also has addressed a wide range of health outcomes, including respiratory diseases, hypertension, foetal and children development, behavioural disorder, sleep disorder and astigmatism. However, relevant Chinese studies are still inadequate. For example, the research examining the association between ETS exposure and childhood cancers and infant mortality in China remains almost empty. Therefore, researchers need to focus on these gaps to design and conduct studies to further improve the well-being of children and pregnant women.

Evidence showed a promising decline in the ETS exposure rate from 46.8% to 30.8% in recent years compared to data from the previous two decades (Pi et al., 2018). However, the prevalence of ETS exposure in the household environment was still high (Xiao et al., 2020). M. M. Chen et al. (2020) stated that although nearly half of women experienced passive smoking before pregnancy in a household environment, fewer women (36.5%) were exposed to ETS during their pregnancy from their family members. While ETS exposure before or during pregnancy is more common among women who are younger, less educated, multiparous and have lower average personal income. Those women are also significantly more likely to drink alcohol, compounding their risk of poor pregnancy outcomes (Chen et al., 2021). Therefore, all stakeholders must better understand and act effectively on the ETS exposure among pregnant women.

To prevent pregnant women from ETS exposure from their husbands or other household members, policymakers and public health professionals in the Chinese health system need to employ an evidence-based framework to assess and identify the health services needed for children and pregnant women, and to develop more effective and tailored anti-smoking policies and smoking cessation programmes for their family members. Moreover, healthcare providers, such as doctors and nurses, should educate both the pregnant women and their husband the importance of tobacco control, raise public awareness about the harms of ETS exposure during pregnancy and engage vulnerable populations in actively participating in smoking cessation programs.

4. Limitation

Our study shows some limitations. Firstly, the number of included studies was small. And research articles published in Chinese did not be included in this systematic scoping review, which may lead to data missing from potentially high-quality articles written in Chinese. Although we included only twenty-two articles, we carried out a well-structured screening process, and we included all the resources available to us under our screening criteria. This review involved studies conducted in urban and rural areas of Mainland of China, Hong Kong, and Taiwan. Thus, the findings can be broadly applied to the general Chinese population because the survey data were drawn from a diverse geographic and socioeconomic population in China.

Secondly, most studies measure the extent of ETS exposure by collecting self-reported data through questionnaires. However, people are often biased when they report their own experiences. For example, many individuals are either consciously or unconsciously influenced by "social desirability." That is, they are more likely to report experiences that are socially acceptable or preferred rather than being truthful. In addition, the validity of self-reported data may be limited by participants' recall bias and introspective ability. Therefore, future studies on the association between ETS exposure and children's health outcomes should use more objective exposure measurements to quantify exposure levels and reduce bias caused by data collection.

Finally, even though our scoping review study performed a quality appraisal for the included articles, which makes the results of the review more reliable, further systematic reviews and meta-analysis are required to provide a better level of evidence and confirm some of the findings of this systematic-scoping review.

5. Conclusion

This systematic-scoping review provided a comprehensive summary of the adverse health effects of prenatal ETS exposure on Chinese children and identified a number of health issues in this context, including LBW, respiratory diseases, hypertension, foetal and children development, behavioural disorder, sleep disorder and astigmatism. Our findings may provide a strong framework for the development and implementation of smoking bans in indoor and public settings to minimize the harmful effects of ETS exposure on our offspring. In addition, the findings may also support health care providers in raising awareness about the above public health issues. Mata-analysis may be required to confirm these findings.

References

1. Ahmed Sakran, K., Mutahar Abotaleb, B., Khaled Al-Rokhami, R., Hsieh, T.-yen, Al-Wesabi, M. A., Mohammed, A. A., Al-Sharani, H. M., Shi, P., & He, D. (2022). Analysis of environmental exposures for nonsyndromic cleft lip and/or palate: a case-control study. Iranian Journal of Public Health, (20220313). https://doi.org/10.18502/ijph.v51i3.8934
2. Chao, M. R., Cooke, M. S., Kuo, C. Y., Pan, C. H., Liu, H. H., Yang, H. J., Chen, S. C., Chiang, Y. C., & Hu, C. W. (2018). Children are particularly vulnerable to environmental tobacco smoke exposure: Evidence from biomarkers of tobacco-specific nitrosamines and oxidative stress. *Environment International*, *120*, 238–245. https://doi.org/10.1016/j.envint.2018.08.006
3. Chen, H., Zhang, Y., Zhang, L., Liu, J., Jin, L., Ren, A., & Li, Z. (2023). Indoor air pollution from coal combustion and tobacco smoke during the periconceptional period and risk for neural tube defects in offspring in five rural counties of shanxi province, china, 2010-2016. Environment International, 171. https://doi.org/10.1016/j.envint.2023.107728
4. Chen, J., Li, X., & Fang, P. (2020). Influence of family resources on secondhand smoking in pregnant women: A cross-sectional study in the border and minority urban areas of Northwest China. *BMC Pregnancy and Childbirth*, *20*(1), 642. https://doi.org/10.1186/s12884-020-03251-w
5. Chen, M. M., Chiu, C.-H., Yuan, C.-P., Liao, Y.-C., & Guo, S.-E. (2020). Influence of Environmental Tobacco Smoke and Air Pollution on Fetal Growth: A Prospective Study. *International Journal of Environmental Research and Public Health*, *17*(15), E5319. https://doi.org/10.3390/ijerph17155319
6. Chen, X., Huang, L., Zhong, C., Li, Q., Chen, R., Sun, G., Jin, Z., Yang, X., Hao, L., Yang, H., & Yang, N. (2021). Association between environmental tobacco smoke before and during pregnancy and the risk of adverse birth outcomes: a birth cohort study in Wuhan, China. *Environmental Science and Pollution Research*, *28*(21), 27230–27237. https://doi.org/10.1007/s11356-021-12626-1
7. Dai, S., & Chan, K. C. C. (2020). Household environmental tobacco smoke exposure in healthy young children in Hong Kong: Prevalence and risk factors. *PLOS ONE*, *15*(1), e0227733. https://doi.org/10.1371/journal.pone.0227733
8. Deng, C., Pu, J., Deng, Y., Xie, L., Yu, L., Liu, L., Guo, X., Sandin, S., Liu, H., & Dai, L. (2022). Association between maternal smoke exposure and congenital heart defects from a case–control study in china. Scientific Reports, 12(1). https://doi.org/10.1038/s41598-022-18909-y
9. DiGiacomo, S. I., Jazayeri, M.-A., Barua, R. S., & Ambrose, J. A. (2018). Environmental Tobacco Smoke and Cardiovascular Disease. *International Journal of Environmental Research and Public Health*, *16*(1), E96. https://doi.org/10.3390/ijerph16010096
10. Dong, G.-H., Wang, D., Yang, Z.-H., Zhang, P.-F., Ren, W.-H., Zhao, Y.-D., & He, Q.-C. (2011). Gender-specific differences in effects of prenatal and postnatal environmental tobacco smoke exposure on respiratory symptoms in 23,474 children with and without allergic predisposition: results from 25 districts of northeast China. *International Journal of Environmental Health Research*, *21*(3), 173–188. https://doi.org/10.1080/09603123.2010.515673

11. Greenhalgh, E. M., Scollo, M. M. & Winstanley, M. H. (2022). *Tobacco in Australia: Facts and issues*. Melbourne: Cancer Council Victoria. www.TobaccoInAustralia.org.au
12. He, Y., Luo, R., Wang, T., Gao, J., & Liu, C. (2018). Prenatal Exposure to Environmental Tobacco Smoke and Early Development of Children in Rural Guizhou Province, China. *International Journal of Environmental Research and Public Health*, *15*(12), E2866. https://doi.org/10.3390/ijerph15122866
13. Huang, L., Tian, F.-Y., Fan, L., He, Y.-H., Peng, D., Xie, C., Tao, L., Yuan, S.-X., Jia, D.-Q., & Chen, W.-Q. (2020). Appetite during the second and third trimesters mediates the impact of prenatal environmental tobacco smoke exposure on symmetric full-term low birth weight. *The Journal of Maternal-Fetal & Neonatal Medicine*, *33*(9), 1544–1553. https://doi.org/10.1080/14767058.2018.1522299
14. Hu, L.-W., Yang, M., Chen, S., Shah, K., Hailegiorgis, Y., Burgens, R., Vaughn, M., Huang, J., Xaverius, P., Paul, G., Morawska, L., Lu, T., Lin, S., Zhong, S.-Q., Kong, M.-L., Xie, Y.-Q., Hao, Y.-T., Zeng, X.-W., Qian, Z., & Dong, G.-H. (2017). Effects of in utero and Postnatal Exposure to Secondhand Smoke on Lung Function by Gender and Asthma Status: The Seven Northeastern Cities (SNEC) Study. *Respiration*, *93*(3), 189–197. https://doi.org/10.1159/000455140
15. Lee, N. L., Samet, J. M., Yang, G., Zhou, M., Yang, J., Correa, A., & Lees, P. S. J. (2012). Prenatal Secondhand Smoke Exposure and Infant Birth Weight in China. *International Journal of Environmental Research and Public Health*, *9*(10), 3398–3420. https://doi.org/10.3390/ijerph9103398
16. Lee, S. L., Lam, T. H., Leung, T. H., Wong, W. H. S., Schooling, M., Leung, G. M., & Lau, Y. L. (2012). Foetal exposure to maternal passive smoking is associated with childhood asthma, allergic rhinitis, and eczema. *The Scientific World Journal*, *2012*, 542983. https://doi.org/10.1100/2012/542983
17. Leonardi-Bee, J., Britton, J., & Venn, A. (2011). Secondhand smoke and adverse fetal outcomes in nonsmoking pregnant women: A meta-analysis. *Pediatrics*, *127*(4), 734–741. https://doi.org/10.1542/peds.2010-3041
18. Leung, C. Y., Leung, G. M., & Schooling, C. M. (2015). Early second-hand smoke exposure and child and adolescent mental health: evidence from Hong Kong's 'Children of 1997' birth cohort. *Addiction*, *110*(11), 1811–1824. https://doi.org/10.1111/add.13033
19. Li, C.-G., Yang, G.-Y., Schmid, K. L., Huang, L.-H., He, G.-H., Liu, L., Ruan, Z.-L., & Chen, W.-Q. (2019). Associations between Environmental Tobacco Smoke Exposure in Early Life and Astigmatism among Chinese Preschool Children. *International Journal of Environmental Research and Public Health*, *16*(19), E3725. https://doi.org/10.3390/ijerph16193725
20. Lin, L.-Z., Xu, S.-L., Wu, Q.-Z., Zhou, Y., Ma, H.-M., Chen, D.-H., Chen, G.-B., Yu, H.-Y., Yang, B.-Y., Zeng, X.-W., Hu, L.-W., & Dong, G.-H. (2021). Association of Prenatal, Early Postnatal, or Current Exposure to Secondhand Smoke With Attention-Deficit/Hyperactivity Disorder Symptoms in Children. *JAMA Network Open*, *4*(5), e2110931. https://doi.org/10.1001/jamanetworkopen.2021.10931
21. Lin, L.-Z., Xu, S.-L., Wu, Q.-Z., Zhou, Y., Ma, H.-M., Chen, D.-H., Dong, P.-X., Xiong, S.-M., Shen, X.-B., Zhou, P.-E., Liu, R.-Q., Chen, G., Yu, H.-Y., Yang, B.-Y., Zeng, X.-W., Hu, L.-W., Zhou, Y.-Z., & Dong, G.-H. (2021). Exposure to second-hand smoke during early life and subsequent sleep problems in children: a population-based cross-sectional study. *Environmental Health*, *20*(1), 127. https://doi.org/10.1186/s12940-021-00793-0
22. Lin, Q., Xiang-Yu, H., Xiao-Na, Y., Guo-Min, W., Sun, D., Xian, D.-X., Fan, L., Jiang, H., Jin, J., Yu, J., Chuan-An, W., & Wei-Qing, C. (2017). Prenatal Exposure to Environmental Tobacco Smoke and Hyperactivity Behavior in Chinese Young Children. *International Journal of Environmental Research and Public Health*, *14*(10), Article 10. https://doi-org.torrens.idm.oclc.org/10.3390/ijerph14101132
23. Li, Q., Hsia, J., & Yang, G. (2011). Prevalence of Smoking in China in 2010. *New England Journal of Medicine*, *364*(25), 2469–2470. https://doi.org/10.1056/NEJMc1102459
24. Liu, J., Leung, P. W. L., McCauley, L., Ai, Y., & Pinto-Martin, J. (2013). Mother's environmental tobacco smoke exposure during pregnancy and externalizing behavior problems in children. *Neurotoxicology*, *34*, 167–174. https://doi.org/10.1016/j.neuro.2012.11.005
25. Liu, W., Huang, C., Cai, J., Wang, X., Zou, Z., & Sun, C. (2018). Household environmental exposures during gestation and birth outcomes: A cross-sectional study in Shanghai, China. *Science of The Total Environment*, *615*, 1110–1118. https://doi.org/10.1016/j.scitotenv.2017.10.015
26. Liu, X.-C., Strodl, E., Huang, L.-H., Hu, B.-J., & Chen, W.-Q. (2022). Effect of prenatal exposure to household air pollution from multiple sources on risk of preterm birth. Atmosphere, 13(12), 2022–2022. https://doi.org/10.3390/atmos13122022

27. Öberg, M., Jaakkola, M. S., Woodward, A., Peruga, A., & Prüss-Ustün, A. (2011). Worldwide burden of disease from exposure to second-hand smoke: A retrospective analysis of data from 192 countries. *The Lancet*, *377*(9760), 139–146. https://doi.org/10.1016/S0140-6736(10)61388-8
28. Pereira, P. P. da S., Da Mata, F. A. F., Figueiredo, A. C. G., de Andrade, K. R. C., & Pereira, M. G. (2017). Maternal Active Smoking During Pregnancy and Low Birth Weight in the Americas: A Systematic Review and Meta-analysis. *Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco*, *19*(5), 497–505. https://doi.org/10.1093/ntr/ntw228
29. Peters, M. D. J., Godfrey, C. M., Khalil, H., McInerney, P., Parker, D., & Soares, C. B. (2015). Guidance for conducting systematic scoping reviews. *JBI Evidence Implementation*, *13*(3), 141–146. https://doi.org/10.1097/XEB.0000000000000050
30. Pi, X., Li, Z., Jin, L., Liu, J., Zhang, Y., Zhang, L., Wang, L., & Ren, A. (2018). Secondhand smoke during the periconceptional period increases the risk for orofacial clefts in offspring. *Paediatric and Perinatal Epidemiology*, *32*(5), 423–427. https://doi.org/10.1111/ppe.12497
31. Ren, S., Xie, S., Li, X., Li, G., Wang, Y., Liu, W., & Wang, L. (2020). The association between maternal exposure to secondhand smoke during pregnancy and their children's cerebral palsy, Shandong, China. *Tobacco Induced Diseases*, *18*, 87. https://doi.org/10.18332/tid/127872
32. Rethlefsen, M. L., & Page, M. J. (2022). PRISMA 2020 and PRISMA-S: Common questions on tracking records and the flow diagram. *Journal of the Medical Library Association : JMLA*, *110*(2), 253. https://doi.org/10.5195/jmla.2022.1449
33. Sabbagh, H. J., Hassan, M. H. A., Innes, N. P. T., Elkodary, H. M., Little, J., & Mossey, P. A. (2015). Passive smoking in the etiology of non-syndromic orofacial clefts: A systematic review and meta-analysis. *PloS One*, *10*(3), e0116963. https://doi.org/10.1371/journal.pone.0116963
34. Snodgrass, A. M., Tan, P. T., Soh, S. E., Goh, A., Shek, L. P., van Bever, H. P., Gluckman, P. D., Godfrey, K. M., Chong, Y. S., Saw, S. M., Kwek, K., Teoh, O. H., & GUSTO Study Group. (2016). Tobacco smoke exposure and respiratory morbidity in young children. *Tobacco Control*, *25*(e2), e75–e82. https://doi.org/10.1136/tobaccocontrol-2015-052383
35. Song, X., Li, Q., Diao, J., Li, J., Li, Y., Zhang, S., Zhao, L., Chen, L., Wei, J., Shu, J., Liu, Y., Sun, M., Huang, P., Wang, T., & Qin, J. (2022). Association of mthfd1 gene polymorphisms and maternal smoking with risk of congenital heart disease: a hospital-based case-control study. Bmc Pregnancy and Childbirth, 22(1). https://doi.org/10.1186/s12884-022-04419-2
36. The Joanna Briggs Institute. (2020). *Template for scoping review protocols*. https://jbi.global/scoping-review-network/resources
37. The Joanna Briggs Institute. (2015). *The Joanna Briggs Institute Reviewers' Manual 2015, Methodology for JBI scoping reviews.* https://nursing.lsuhsc.edu/JBI/docs/ReviewersManuals/Scoping-.pdf
38. U.S. Department of Health and Human Services. (2014). *The health consequences of smoking—50 years of progress: A report of the Surgeon General.* https://www.ncbi.nlm.nih.gov/books/NBK179276/pdf/Bookshelf_NBK179276.pdf
39. Vanker, A., Gie, R. P., & Zar, H. J. (2017). The association between environmental tobacco smoke exposure and childhood respiratory disease: A review. *Expert Review of Respiratory Medicine*, *11*(8), 661–673. https://doi.org/10.1080/17476348.2017.1338949
40. Wang, L., Deng, Y., Yang, Y., Liu, F., Xu, Q., Peng, Z., He, Y., Wang, Y., Xu, J., Zhang, H., Zhang, Y., Wang, Q., Shen, H., Zhang, Y., Yan, D., & Ma, X. (2022). Paternal smoking and preterm birth: a population-based retrospective cohort study among non-smoking women aged 20–49 years in rural china. Reproductive Health, 19(1). https://doi.org/10.1186/s12978-022-01378-x
41. Wang, R., Sun, T., Yang, Q., Yang, Q., Wang, J., Li, H., Tang, Y., Yang, L., & Sun, J. (2020). Low birthweight of children is positively associated with mother's prenatal tobacco smoke exposure in Shanghai: A cross-sectional study. *BMC Pregnancy and Childbirth*, *20*, 1–9. https://doi-org.torrens.idm.oclc.org/10.1186/s12884-020-03307-x
42. Wang, T., Chen, L., Ni, B., Sheng, X., Huang, P., Zhang, S., & Qin, J. (2022). Maternal pre-pregnancy/early-pregnancy smoking and risk of congenital heart diseases in offspring: a prospective cohort study in central china. Journal of Global Health, 12, 11009–11009. https://doi.org/10.7189/jogh.12.11009
43. Wang, Y., Hu, D., Chen, W., Xue, H., & Du, Y. (2019). Prenatal Tobacco Exposure Modulated the Association of Genetic variants with Diagnosed ADHD and its symptom domain in children: A Community Based Case-Control Study. *Scientific Reports*, *9*(1), 4274. https://doi.org/10.1038/s41598-019-40850-w

44. World Health Organization. (2000). *Air Quality Guidelines for Europe* (2nd ed.). World Health Organization. Regional Office for Europe.
45. Wu, M., Williams, G. J., Chen, G., Zhang, L., Hu, C., Dai, X., Du, W., & Hua, J. (2022). Prenatal second-hand smoke exposure and the risk of suspected developmental coordination disorder in preschoolers: a nationwide retrospective cohort study in china. Frontiers in Public Health, 10, 993471–993471. https://doi.org/10.3389/fpubh.2022.993471
46. World Health Organization. (2010). *Global Adult Tobacco Survey (GATS) – China Fact Sheet 2010*. https://www.tobaccofreekids.org/assets/global/pdfs/en/GATS_china_2010.pdf
47. Xiao, L., Jiang, Y., Zhang, J., & Parascandola, M. (2020). Secondhand Smoke Exposure among Nonsmokers in China. *Asian Pacific Journal of Cancer Prevention: APJCP*, *21*(S1), 17–22. https://doi.org/10.31557/APJCP.2020.21.S1.17
48. Yang, J.-H., Strodl, E., Wu, C.-A., Yin, X.-N., Wen, G.-M., Sun, D.-L., Xian, D.-X., Chen, J.-Y., Chen, Y.-J., Chen, J., & Chen, W.-Q. (2021). Association between environmental tobacco smoke exposure in early life and autistic-like behaviors in Chinese preschoolers. *Journal of Psychosomatic Research*, *152*, 110680. https://doi.org/10.1016/j.jpsychores.2021.110680
49. Zhang, H., Yu, L., Wang, Q., Tao, Y., Li, J., Sun, T., Zhang, Y., & Zhang, H. (2020). In utero and postnatal exposure to environmental tobacco smoke, blood pressure, and hypertension in children: The Seven Northeastern Cities study. *International Journal of Environmental Health Research*, *30*(6), 618–629. https://doi.org/10.1080/09603123.2019.1612043
50. Zhou, S., Rosenthal, D. G., Sherman, S., Zelikoff, J., Gordon, T., & Weitzman, M. (2014). Physical, behavioral, and cognitive effects of prenatal tobacco and postnatal secondhand smoke exposure. *Current Problems in Pediatric and Adolescent Health Care*, *44*(8), 219–241. https://doi.org/10.1016/j.cppeds.2014.03.007
51. Zhuge, Y., Qian, H., Zheng, X., Huang, C., Zhang, Y., Li, B., Zhao, Z., Deng, Q., Yang, X., Sun, Y., Zhang, X., & Sundell, J. (2020). Effects of parental smoking and indoor tobacco smoke exposure on respiratory outcomes in children. *Scientific Reports*, *10*(1), 4311. https://doi.org/10.1038/s41598-020-60700-4