

Erythromycin

Selected References:

- Abdellatif M, et al. 2019. Association between exposure to macrolides and the development of infantile hypertrophic pyloric stenosis: a systematic review and meta-analysis. *Eur J Pediatr* 178(3):301-314.
- Adair CD, Gunter M, Stovall TG et al. 1998. Chlamydia in pregnancy: A randomized trial of azithromycin and erythromycin. *Obstet Gynecol* 91:165-168.
- Andersson NW, Olsen RH, Andersen JT. 2021. Association between use of macrolides in pregnancy and risk of major birth defects: nationwide, register based cohort study. *BMJ*. 372:n107.
- Bahat Dinur A, et al. 2013. Fetal safety of macrolides. *Antimicrob Agents Chemother* 57(7):3307-11.
- Berard A, et al. 2015. Use of macrolides during pregnancy and the risk of birth defects: a population-based study. *Pharmacoepidemiol Drug Saf* 24(12):1241-1248.
- Cohen I, et al. 1990. Improved pregnancy outcome following successful treatment of chlamydial infection. *JAMA* 263:3160-3163.
- Committee on Drugs, American Academy of Pediatrics. 2001. The transfer of drugs and other chemicals into human breast milk. *Pediatrics* 108:776-89.
- Damkier P, et al. 2019. In utero exposure to antibiotics and risk of congenital malformations: A population-based study. *Am J Obstet Gynecol* 221:648.e1-15.
- Fan H, et al. 2020. Associations between macrolide antibiotics prescribing during pregnancy and adverse child outcomes in the UK: population based cohort study. *BMJ* 368:m331.
- Flenady V, et al. 2013. Prophylactic antibiotics for inhibiting preterm labour with intact membranes. *Cochrane Database Syst Rev* 5;12:CD000246.
- FitzSimmons J et al. 1990. Chlamydial infections in pregnancy. *J Reprod Med* 31:19-22, 1986.
- Goldstein LH, et al. 2009. The safety of macrolides during lactation. *Breastfed Med* 4:157-200
- Källén B, Danielsson BR, 2014. Fetal safety of erythromycin. An update of Swedish data. *Eur J Clin Pharmacol* 70(3):355-60.
- Keskin-Arslan E, et al. 2023. Pregnancy outcomes following maternal macrolide use: A systematic review and meta-analysis. *Reprod Toxicol*; 115:124-146.
- Lin KJ, et al. 2013. Safety of macrolides during pregnancy. *Am J Obstet Gynecol* 208(3):221.e1-8.
- Lund M, et al. 2014. Use of macrolides in mother and child and risk of infantile hypertrophic pyloric stenosis: nationwide cohort study. *BMJ* 11;348:g1908.
- Marlow N, et al. 2017. The ORACLE Children Study: educational outcomes at 11 years of age following antenatal prescription of erythromycin or co-amoxiclav. *Arch Dis Child Fetal Neonatal Ed* 102(2):F131-F135.
- McCormack WM et al. 1987. Effect on birth weight of erythromycin treatment of pregnant women. *Obstet Gynecol* 69:202-207.
- McGregor JA et al. 1986. Adjunctive erythromycin treatment for idiopathic preterm labor: Results of a randomized, double-blind, placebo-controlled trial. *Am J Obstet Gynecol* 154:98-103.
- Romøren M, et al. 2012. Pregnancy outcome after gestational exposure to erythromycin – a population-based register study from Norway. *Br J Clin Pharmacol* 74(6):1053-62.
- Ryan GM Jr, et al. 1990. Chlamydia trachomatis infection in pregnancy and effect of treatment on outcome. *Am J Obstet Gynecol* 162:34-39.
- Schachter J, et al. 1986. Experience with the routine use of erythromycin for chlamydial infections in pregnancy. *N Engl J Med* 314:276-9Sorensen, HT et al. 2003. Risk of infantile hypertrophic pyloric stenosis after maternal postnatal use of macrolides. *Scand J Infect Dis* 35:104-6
- Shen Q, et al. 2025. Associations between urinary antibiotic exposure and semen parameters among adult men: a biomonitoring-based cross-sectional study. *Environmental Pollution* 375: 126335

- WHO Working Group, Bennet PN (ed). 1988. Drugs and Human Lactation. Elsevier, Amsterdam, New York, Oxford, pp. 253-4.

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Selected References:

- Cheema R, et al. 2023. Protecting Breastfeeding during the COVID-19 Pandemic. *Am J Perinatol*. 40(3):260-266.
- Dernoncourt A, et al. 2023. Fetal and Neonatal Adverse Drug Reactions Associated with Biologics Taken During Pregnancy by Women with Autoimmune Diseases: Insights from an Analysis of the World Health Organization Pharmacovigilance Database (VigiBase®). *BioDrugs*.37(1):73-87.
- Food and Drug Administration. 2025. Kevzara® (sarilumab) Prescribing Information. Available at: <https://www.accessdata.fda.gov>label>.
- Khiali S, et al. 2021. A comprehensive review on sarilumab in COVID-19. *Expert Opinion on Biological Therapy*; 21(5):615-626.
- Krysko KM, et al. 2023. Family planning considerations in people with multiple sclerosis. *Lancet Neurol*. 22(4):350-366.
- Garcia-Vicuña R, et al. 2020. Subcutaneous Sarilumab in hospitalized patients with moderate-severe COVID-19 infection compared to the standard of care (SARCOVID): a structured summary of a study protocol for a randomized controlled trial. *Trials*; 21(1):772.
- McCarty D, Robinson A. 2018. Efficacy and safety of sarilumab in patients with active rheumatoid arthritis. *Ther Adv Musculoskelet Dis*; 10(3):61-67.
- Mizutani Set al. 2023. A Woman with Rheumatoid Arthritis Who Successfully Delivered a Healthy Child with Continuous Administration of Sarilumab Throughout Pregnancy. *Intern Med*.62(4):633-636.
- Nana M, et al. 2024. Use of interleukin-6 receptor antibodies in the second and third trimester of pregnancy: a retrospective cohort study. *Lancet Rheumatol*. 6(9):e625-e635.

- Prieto-Peña D, et al. 2021. Biologic agents and small-molecule inhibitors in systemic autoimmune conditions: an update. *Pol Arch Intern Med*; 131(2):171-181.
- Raimondo et al. 2017. Profile of sarilumab and its potential in the treatment of rheumatoid arthritis. *Drugs Des Devel Ther*. 11:1593-1603.
- Rüegg L, et al. 2025. EULAR recommendations for use of antirheumatic drugs in reproduction, pregnancy, and lactation: 2024 update. *Ann Rheum Dis*.84(6):910-926.
- Saito J, et al. 2023 Establishment of a measurement system to evaluate breast milk transfer of biological agents using dry filter paper: A multi-institutional study. *Br J Clin Pharmacol*.

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Erythromycin

Selected References:

- Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological Profile for Lead. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.
- American College of Obstetricians and Gynecologists (ACOG). 2023. Lead screening during pregnancy and lactation. Committee Opinion Number 533. *Obstet Gynecol*, 120(2, part 1):416-419
- Appleton AA, et al. 2021. Prenatal lead and depression exposures jointly influence birth outcomes and NR3C1 DNA methylation. *Int J Environ Res Public Health*, 18(22):12169.
- Araujo MSA, et al. 2022. Prenatal exposure to metals and neurodevelopment in infants at six months: Rio Birth Cohort Study of Environmental Exposure and Child Development (PIPA Project). *Int J Environ Res Public Health*, 19(7):4295.
- Ashley-Martin J, et al. 2019. Blood metal levels and early childhood anthropometric measures in a cohort of Canadian children. *Environ Res*, 179(Pt A):108736.
- Ashrap P, et al. 2020. Maternal blood metal and metalloid concentrations in association with birth outcomes in northern Puerto Rico. *Environ Int*, 138:105606.

- Bellinger DC. 2005. Teratogen update: Lead and pregnancy. Birth Defects Research Part A: Clinical and Molecular Teratology, 73: 409-420.
- Bellinger D. 2005. Lead. Pediatrics, 113:1016-1022.
- Bellinger D. 2008. Neurological and behavioral consequences of childhood lead exposure. PLoS Med, 5(5):e115.
- Bloom MS, Fujimoto V, et al. 2012(a). Background exposure to toxic metals in women adversely influences pregnancy during in vitro fertilization (IVF). Reprod Toxicol, 34(3):471-481.
- Bloom MS, Kim K, et al. 2012(b). Associations between toxic metals in follicular fluid and in vitro fertilization (IVF) outcomes. Assist Reprod Genet, 29(12):1369-1379. Bloom MS, Louis GMB, et al. 2011(a). Associations between blood metals and fecundity among women residing in New York State. Reprod Toxicol, 31(2):158-163.
- Bloom MS, Parsons PJ, et al. 2011(b). Toxic trace metals and embryo quality indicators during in vitro fertilization (IVF). Reprod Toxicol, 31(2):167-170.
- Borja-Aburto, VH. 1999. Blood lead levels measured prospectively and risk of spontaneous abortion. Am J Epidemiol, 150(6):590-597.
- Buck Louis GM, et al. 2016. Paternal exposures to environmental chemicals and time-to-pregnancy: overview of results from the LIFE study. Andrology, 4(4):639-47.
- Buck Louis GM, et al. 2017. Low-level environmental metals and metalloids and incident pregnancy loss. Reprod Toxicol, 69:68-74.
- Bui LTM, et al. 2022. Does short-term, airborne lead exposure during pregnancy affect birth outcomes? Quasi-experimental evidence from NASCAR's deleading policy. Environ Int, 166:107354.
- Butts CD, et al. 2021. Toxic elements in follicular fluid adversely influence the likelihood of pregnancy and live birth in women undergoing IVF. Hum Reprod Open, 2021(3):hoab023. Calamandrei, G, et al. 2020. Pregnancy exome and child psychomotor development in three European birth cohorts. Environ Res, 181:108856.
- Cantor AG, et al. 2019. Screening for elevated blood lead levels in childhood and pregnancy: Updated evidence report & systematic review for the US Preventive Services Task Force. JAMA, 321(15):1510-1526. Centers for Disease Control and Prevention (CDC). 2025. About Lead in Paint. Available at: [https://www.cdc.gov/lead-](https://www.cdc.gov/lead-prevention/prevention/paint.html)
- [prevention/prevention/paint.html](https://www.cdc.gov/lead-prevention/prevention/paint.html). [Accessed November 2025].
- CDC. 2010. Guidelines for the Identification and Management of Lead Exposure in Pregnant and Lactating Women. Available at: https://www.cdc.gov/lead-prevention/media/pdfs/2025/03/cdc_147837_DS1.pdf [Accessed 1/2020].
- CDC. 2025. Lead and Breastfeeding. Available at: <https://www.cdc.gov/breastfeeding-special-circumstances/hcp/exposures/lead.html/> [Accessed November 2025].
- Chang SH, et al. 2006. Low blood lead concentration in association with infertility in women. Environ Res, 101(3):380-386.
- Cherkani-Hassani A, et al. 2021. Lead concentrations in breast milk of Moroccan nursing mothers and associated factors of exposure: CONTAMILK Study. Environ Toxicol Pharmacol, 85:103629.
- Cowell W, et al. 2021. Prenatal metal mixtures and sex-specific infant negative affectivity. Environ Epidemiol, 5(2):e14.
- Cowell W, et al. 2020. Prenatal toxic metal mixture exposure and newborn telomere length: Modification by maternal antioxidant intake. Environ Res, 190:110009.
- Dabeka RW, McKenzie AD. 1988. Lead and cadmium levels in commercial infant foods and dietary intake by infants 0-1 year old. Food Addit Contam, 5333-342.
- Dietrich K, et al. 1993. The developmental consequences of low to moderate prenatal and postnatal lead exposure: intellectual attainment in the Cincinnati lead study cohort following school entry. Neurotoxicol Teratology, 15:37-44.
- Disha S, et al. 2019. Association of raised blood lead levels in pregnant women with preeclampsia: A study at tertiary centre. Taiwan J Obstet Gynecol. 58(1):60-63.

- Dorea JG. 2019. Environmental exposure to low-level lead (Pb) co-occurring with other neurotoxicants in early life and neurodevelopment in children. *Environ Res*, 177:108641.
- Dorea JG. 2021. Exposure to environmental neurotoxic substances and neurodevelopment in children from Latin America and the Caribbean. *Environ Res*, 192:110199.
- Dutta S, et al. 2021. Environmental and occupational exposure to metals and female reproductive health. *Environ Sci Pollut Res Int*, doi:10.1007/s11356-021-16581-9.
- Ernhart CB. 1992. A critical review of low-level prenatal lead exposure in the human: effects on the fetus and newborn. *Reprod Toxicol* 6:9-91.
- Ernhart, CB, et al. 1986. Intrauterine exposure to low levels of lead: the status of the neonate. *Archives Environ Health*, 41:287-291.
- Ettinger AS, et al. 2004. Effect of breast milk lead on infant blood lead levels at 1 month of age. *Environ Health Perspect*, 112(14):1381-1385.
- Food and Drug Administration. Guidance for Industry: Lead in Candy Likely To Be Consumed Frequently by Small Children. Retrieved 2022 from: <https://www.fda.gov/regulatory-information/search-fda-guidance-documents/guidance-industry-lead-candy-likely-be-consumed-frequently-small-children>.
- Forsyth JE, et al. 2019. Sources of blood lead exposure in rural Bangladesh. *Environ Sci Technol*, 53(19):11429.
- Fruth V, et al. 2021. Prenatal exposure to a mixture of elements and neurobehavioral outcomes in mid-childhood: Results from Project Viva. *Environ Res*, 201:111540.
- Gardella, C. 2001. Lead exposure in pregnancy: a review of the literature and argument for routine prenatal screening. *Obstet Gynecol Surv*, 56:231-238.
- Gari M, et al. 2022. Prenatal exposure to neurotoxic metals and micronutrients and neurodevelopmental outcomes in early school age children from Poland. *Environ Res*, 204(Pt B):112049.
- Geng F, et al. 2014. Low-level prenatal lead exposure alters auditory recognition memory in 2-month-old infants: an event-related potentials (ERPs) study. *Dev Neuropsychol*, 39(7):516-528. Grossman D, et al. 2019. The impact of the
- Flint water crisis on fertility. *Demography* 45:2005-2031.
- Gulson BL, et al. 1999. Estimation of cumulative lead releases (lead flux) from the maternal skeleton during pregnancy and lactation. *J Lab Clin Med*, 134:631-640.
- Gulson B, et al. 2016. Revisiting mobilisation of skeletal lead during pregnancy based on monthly sampling and cord/maternal blood lead relationships confirm placental transfer of lead. *Arch Toxicol*, 90(4):805-816.
- Guo J, et al. 2020. Prenatal exposure to mixture of heavy metals, pesticides and phenols and IQ in children at 7 years of age: The SMBCS study. *Environ Int*, 139:105692.
- Guo X, et al. 2022. Effects of single and combined exposure to lead and stress during pregnancy on offspring neurodevelopment. *Dev Cogn Neurosci*, 56:101124.
- Gustin K, et al. 2020. Low-level maternal exposure to cadmium, lead, and mercury and birth outcomes in a Swedish prospective birth-cohort. *Environ Pollut*, 265(Pt B):114986.
- Han I, et al. 2020. Characterization of urinary concentrations of heavy metals among socioeconomically disadvantaged black pregnant women. *Environ Monit Assess*, 192(3):200.
- Hertz-Picciotto I. 2000. The evidence that lead increases the risk for spontaneous abortion. *Am J Ind Med*, 38(3):300-309.
- Hong YC, et al. 2014. Postnatal growth following prenatal lead exposure and calcium intake. *Pediatrics*, 134(6):1151-1159
- Igra AM, et al. 2021. Environmental metal exposure and growth to 10 years of age in a longitudinal mother-child cohort in rural Bangladesh. *Environ Int*, 156:106738.
- Isaac CP, et al. 2012. Lead levels in breast milk, blood plasma and intelligence quotient: a health hazard for women and infants. *Bull Environ Contam Toxicol*, 88(2):145-149.
- Kabamba M, Tuakuila J. 2020. Toxic metal (Cd, Hg, Mn, Pb) partition in the maternal/foetal unit: A systematic mini-review of recent epidemiological studies. *Toxicol Lett*, 332:20-26.

- Karatela S, et al. 2020. Exposure to toenail heavy metals and child behavior problems in nine-year-old children: A cross-sectional study. *Int J Environ Res Public Health*, 17(11):4120.
- Kaur M, et al. 2022. Increased incidence of spontaneous abortions on exposure to cadmium and lead: a systematic review and meta-analysis. *Gynecol Endocrinol*, 38(1):16-21.
- Kim SS, et al. 2020. Birth outcomes associated with maternal exposure to metals from informal electronic waste recycling in Guiyu, China. *Environ Int*, 137:105580.
- Kortei NK, et al. 2020. Potential health risk assessment of toxic metals contamination in clay eaten as pica (geophagia) among pregnant women of Ho in the Volta Region of Ghana. *BMC Pregnancy Childbirth*. 20(1):160.
- Lamadrid-Figueroa H, et al. 2007. Association between the plasma/whole blood lead ratio and history of spontaneous abortion: A nested cross-sectional study. *BMC Pregnancy Childbirth*, 7:22.
- Lee S, et al. 2020. Female Infertility Associated with Blood Lead and Cadmium Levels. *Int J Environ Res Public Health*; 17(5):1794.
- Lee MS, et al. 2021. Umbilical cord blood metal mixtures and birth size in Bangladeshi children. *Environ Health Perspect*, 129(5):57006.
- Li J, et al. 2017. Maternal serum lead level during pregnancy is positively correlated with risk of preterm birth in a Chinese population. *Environ Pollut*, 227:484-489.
- Li S, et al. 2021. Relationship between maternal heavy metal exposure and congenital heart defects: a systematic review and meta-analysis. *Environ Sci Pollut Res Int*, doi:10.1007/s11356-022-21071-7.
- Lui C, et al. 2022. Association of both prenatal and early childhood multiple metals exposure with neurodevelopment in infant: A prospective cohort study. *Environ Res*, 205:112450.
- Liu J, et al. 2014. Lead exposure at each stage of pregnancy and neurobehavioral development of neonates. *Neurotoxicology*, 44:1-7.
- Liu M, et al. 2021. Associations between prenatal exposure to cadmium and lead with neural tube defect risks are modified by single-nucleotide polymorphisms of fetal *MTHFR* and *SOD2*: A case-control study. *Environ Health*, 20(1):66.
- Liu T, et al. 2019. Trace minerals, heavy metals, and preeclampsia: Findings from the Boston Birth Cohort. *J Am Heart Assoc*, 8(16):e012436.
- Ludvigsson J, et al. 2019. Toxic metals in cord blood and later development of Type 1 diabetes. *Pediatr Dimens*, 4(2):10.15761/PD.1000186.
- Ma J, et al. 2022. Exposure to metal mixtures and hypertensive disorders of pregnancy: A nested case-control study in China. *Environ Pollut*, 306:119439.
- Margetaki K, et al. 2021. Associations of exposure to cadmium, antimony, lead and their mixture with gestational thyroid homeostasis. *Environ Pollut*, 289:117905.
- Minnesota Department of Public Health. Blood Lead Screening Guidelines for Pregnant Women in Minnesota. Available at: <https://www.leg.state.mn.us/docs/2008/other/080007.pdf> [Accessed 2022].
- Miyashita C, et al. 2021. Association between the concentrations of metallic elements in maternal blood during pregnancy and prevalence of abdominal congenital malformations: The Japan Environment and Children's Study. *Int J Environ Res Public Health*, 18(19):10103.
- Montrose L, et al. 2020. Neonatal Lead (Pb) exposure and DNA methylation profiles in dried bloodspots. *Int J Environ Res Public Health*, 17(18):6775.
- National Center for Environmental Health (NCEH)/Agency for Toxic Substances and Disease Registry (ATSDR)/CDC. 2010. Guidelines for the Identification and Management of Lead Exposure in Pregnant and Lactating Women. <https://www.atsdr.cdc.gov/index.html>
- Nyanza EC, et al. 2021. Effects of prenatal exposure and co-exposure to metallic or metalloid elements on early infant neurodevelopmental outcomes in areas with small-scale gold mining activities in Northern Tanzania. 149:106104.
- Osorio-Yáñez C, et al. 2021. Metal exposure and bone remodeling during pregnancy: Results from the PROGRESS cohort study. *Environ Pollut*, 282:116962.
- Ovayolu A, et al. 2020. Amniotic fluid levels of selected trace elements and heavy metals in pregnancies complicated with neural tube defects. *Congenit Anom (Kyoto)*, 60(5):136-141.

- Pérez-Debén S, et al. 2020. Copper and lead exposures disturb reproductive features of primary endometrial stromal and epithelial cells. *Reprod Toxicol*, 93:106-117.
- Pesce G, et al. 2020. Foetal exposure to heavy metals and risk of atopic diseases in early childhood. *Pediatr Allergy Immunol*, 32(3):242-250.
- Pollack AZ, et al. 2011. Cadmium, lead, and mercury in relation to reproductive hormones and anovulation in premenopausal women. *Environ Health Perspect*, 119(8):1156-1161.
- Poropat AE, et al. 2018. Blood lead and preeclampsia: A meta-analysis and review of implications. *Environ Res*, 160:12-19.
- Rabinowitz, M, et al. 1987. Pregnancy hypertension, blood pressure during labor, and blood lead levels. *Hypertension*, 10:447-451.
- Rabito FA, et al. 2014. Changes in low levels of lead over the course of pregnancy and the association with birth outcomes. *Reprod Toxicol*, 50: 138-144.
- Röllin HB, et al. 2020. In utero exposure to aluminium and other neurotoxic elements in urban coastal South African women at delivery: An emerging concern. *Int J Environ Res Public Health*, 17(5):1724.
- Rosa MJ, et al. 2022. Prenatal lead exposure and childhood lung function: Influence of maternal cortisol and child sex. *Environ Res.*, 205:112447.
- Rothenberg, S, et al. 2000. Maternal bone lead contribution to blood lead during and after pregnancy. *Environ Res*, 82:81-90.
- Rygiel CA, et al. 2021. Prenatal lead (Pb) exposure and peripheral blood DNA methylation (5mC) and hydroxymethylation (5hmC) in Mexican adolescents from the ELEMENT Birth Cohort. *Environ Health Perspect*, 129(6):67002.
- Sallmen M, et al. 1995. Time to pregnancy among women occupationally exposed to lead. *J Occup Environ Med*, 37(8):931-934.
- Shvachiy L, et al. 2020. Persistent effects on cardiorespiratory and nervous systems induced by long-term lead exposure: Results from a longitudinal study. *Neurotox Res*, 37(4):857-870.
- Silbergeld, EK 1991. Lead In bone: implications for toxicology during pregnancy and lactation. *Environ Health Perspect*, 91:63-70.
- Sukhn C, et al. 2021. Paternal exposure to non-essential heavy metal affects embryo cleavage and implantation in intracytoplasmic sperm injection (ICSI) cycles: Evidence for paradoxical effect. *Reprod Sci*, 28(9):2550-2561.
- Sun X, et al. Maternal heavy metal exposure, thyroid hormones, and birth outcomes: A prospective cohort study. *J Clin Endocrinol Metab*, 104(11):5043-5052.
- Taylor C, et al. 2015. Adverse effects of maternal lead levels on birth outcomes in the ALSPAC study: A prospective birth cohort study. *BJOG*, 122(3):322-328
- Tiwari AKM, et al. 2020. Effect of iron and folate supplementation on Pb levels in pregnant anemic women: a prospective study. *Free Radic Res*, 54(8-9):662-669. Tong, S, et al. 1996. Lifetime exposure to environmental lead and children's intelligence at 11-13 years: The Port Pirie Cohort Study. *BMJ*, 312:1569-1575.
- Tung PW, et al. 2022. Association between placental toxic metal exposure and NICU Network Neurobehavioral Scales (NNNS) profiles in Rhode Island Child Health Study (RICHS). *Environ Res*, 204(Pt A):111939.
- United States Environmental Protection Agency (EPA). Learn about Lead. Available at: <https://www.epa.gov/lead/learn-about-lead>. [Accessed November 2025]
- Wang C, et al. 2022. Maternal exposure to heavy metals and risk for severe congenital heart defects in offspring. *Environ Res*, 212(Pt C):113432.
- Wang D, et al. 2020. Association between blood lead level during pregnancy and birth weight: A meta-analysis. *Am J Ind Med*, 63(12):1085-1094.
- Wang H, et al. 2017. High serum lead concentration in the first trimester is associated with an elevated risk of small-for-gestational-age infants. *Toxicol Appl Pharmacol*, 1:332:75-80.
- Wang R, et al. 2021. Something in the pipe: the Flint water crisis and health at birth. *J Popul Econ* 35:1723-1749.

- Xu S, et al. 2022. Maternal blood levels of toxic and essential elements and birth outcomes in Argentina: The EMASAR Study. *Int J Environ Res Public Health*, 19(6):3643.
- Zhang M, et al. 2021. *In Utero* exposure to heavy metals and trace elements and childhood blood pressure in a U.S. urban, low-income, minority birth cohort. *Environ Health Perspect*, 129(6):67005.
- Zhou F, et al. 2019. Toxicity assessment due to prenatal lactational exposure to lead, cadmium and mercury mixtures. *Environ Int*, 133(Pt B):105192.
- Zhou L, et al. 2021. Metal elements associate with *in vitro* fertilization (IVF) outcomes in 195 couples. *J Trace Elem Med Biol*, 68:126810.

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Selected References:

- Abdelmaksoud A, et al. 2023. Isotretinoin and pregnancy termination: an overview. *Int J Dermatol*. 62(4):e255-e256.
- Adams J, et al. 1991. Relationship between dysmorphology and neuropsychological function in children exposed to isotretinoin "in utero". In: T. Fujii and G. J. Boer (eds), *Functional Neuroteratology of Short Term Exposure to Drugs*. Tokyo: Teikyo University Press, pp.159-170.
- Adams J, et al. 1993. Neurobehavioral teratology of isotretinoin. *Reprod Toxicol*. 7(2):175-177.
- Adams J. 1996. Similarities in genetic mental retardation and neuroteratogenic syndromes. *Pharmacol Biochem Behav*. 55(4):683-690.
- Alay MT, et al. 2023. A new perspective on isotretinoin in pregnancy: Pregnancy outcomes, evaluation of complex phenotypes, and importance of teratological counselling, *Eur J Obstet Gynecol Reprod Biol*. 291:148-155.
- Alshaalan ZD. 2022. Knowledge on the Use of Isotretinoin and Its Side Effects and Awareness towards Saudi FDA-Pregnancy Prevention Program among the Female Acne Patients: A Northern Saudi Study.

Medicina (Kaunas). 58(11):1609.

- Autret-Leca E, et al. 2010 Isotretinoin exposure during pregnancy: assessment of spontaneous reports in France. *Drug Saf.* 33(8):659-665.
- Cha EH, et al. 2022. Pregnancy and neonatal outcomes after periconceptional exposure to isotretinoin in Koreans. *Obstet Gynecol Sci.* 65(2):166-175.
- Chelliah P, et al. 2020. Comprehensive review of reports of menstrual irregularities associated with isotretinoin. *Int J Womens Dermatol.* 6(5):365-367.
- Choi EJ, et al. 2021. The rates of major malformations after gestational exposure to isotretinoin; a systemic review and meta-analysis. *Obstet Gynecol Sci.* 64(4):364-373.
- Coleman R, et al. 1994. Effects of isotretinoin on male reproductive system. *Lancet* 344:198.
- Committee on Drugs, American Academy of Pediatrics. 1992. Retinoid therapy for severe dermatological disorders. *Pediatrics.* 90:119-120.
- FDA.
2008 ACCUTANE® (isotretinoin capsules) https://www.accessdata.fda.gov/drugsatfda_docs/label/2008/018662s059lbl.pdf.
- Dai WS, et al. 1989. Safety of pregnancy after discontinuation of isotretinoin. *Arch Dermatol.* 125(3):362-365.
- Dai WS, et al. 1992. Epidemiology of isotretinoin exposure during pregnancy. *J Am Acad Dermatol.* 26(4):599-606.
- DiGiovanna JJ, et al. 1984. Etretinate: persistent serum levels of a potent teratogen. *Clin Res* 32:579A.
- Eun-Hwan C, et al. 2022. Pregnancy and neonatal outcomes after periconceptional exposure to isotretinoin in Koreans. *Obstet Gynecol Sci.* 65(2):166-175.
- Fallah H, et al. 2022. Isotretinoin for acne vulgaris – an update on adverse effects and laboratory monitoring. *J Dermatol Treat.* 33(5):2414-2424.
- Goldsmith LA, et al. 2004. American Academy of Dermatology Consensus Conference on the safe and optimal use of isotretinoin: summary and recommendations. *Journal of the American Academy of Dermatology*, 50(6), 900-906.
- Gurel A, et al. 2023. Effect of systemic isotretinoin therapy on semen parameters. *Annals of medicine*, 55(1), 2207038.
- Jajoria H, et al. 2020. Washout Period for Pregnancy Post Isotretinoin Therapy. *Indian Dermatol Online J.* 11(2):239-242.
- Ivask M, et al. 2023. Compliance with Pregnancy Prevention Recommendations for Isotretinoin Following the Amendment of the European Union Pregnancy Prevention Program: A Repeat Study in Estonia. *Drugs Real World Outcomes.* 11(1):91-98.
- Lammer EJ, et al. 1985. Retinoic acid embryopathy. *New Engl J Med.* 313:837-841.
- Lammer EJ, et al. 1988. Isotretinoin dose and teratogenicity. *Lancet.* 2(8609):503-504.
- Lee SM, et al. 2009. A case of suspected isotretinoin-induced malformation in a baby of a mother who became pregnant one month after discontinuation of the drug. *Yonsei Med J.* 50(3):445-447.
- Loureiro KD, et al. 2005. Minor malformations characteristic of the retinoic acid embryopathy and other birth outcomes in children of women exposed to topical tretinoin during early pregnancy. *Am J Med Genet A.* 136(2):117-121.
- Mitchell AA. 1992. Oral retinoids. What should the prescriber know about their teratogenic hazards among women of child-bearing potential? *Drug Saf.* 7(2):79-85.
- Nulman I. 1998. Steady-state pharmacokinetics of isotretinoin and its 4-oxo metabolite: implications for fetal safety. *J Clin Pharmacol.* 38(10):926-930.
- No Author listed. 1991. Recommendations for isotretinoin use in women of childbearing potential. *Teratology.* 44(1):1-6.
- O'Malley S, et al. 2024. Isotretinoin prescribing and pregnancy prevention; insights from dispensing pharmacists in Ireland. *Int J Pharm Pract.* 32(5):426-427.
- You W, et al. 2024. Adverse Pregnancy and Child Outcomes in Oral Retinoid-Exposed Pregnancies: A Nationwide

Population-Based Study. J Korean Med Sci. 39(26):e201.

- Zeynep Tirmikçioğlu Z, et al. 2024. Face-to-face: isotretinoin use and pregnancy outcome. Int J Dermatol. 63(2):232-238.
- Zhu Y, et al. 2025. Isotretinoin Risk Evaluation and Mitigation Strategy and Pregnancy Incidence. JAMA Intern Med. 185(10):1289-1291.

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Selected References:

- Andres RL, et al. 2000. Perinatal complications associated with maternal tobacco use. Semin Neonatol, 5:231-41.
- Anderson TM, et al. 2019. Maternal Smoking Before and During Pregnancy and the Risk of Sudden Unexpected Infant Death. Pediatrics, 143(4):e20183325.
- Baki Yıldırım S, et al. 2023. The Effect of Active and Passive Maternal Smoking During Pregnancy on the Uterine Artery Blood Flow and Obstetric Outcomes: A Prospective Study. Cureus; 15(2):e35270. Brand JS, et al. 2019. Associations of maternal quitting, reducing, and continuing smoking during pregnancy with longitudinal fetal growth: Findings from Mendelian randomization and parental negative control studies. PLoS Med, 16(11):e1002972.
- Briggs GG, et al. 2011. Drugs in Pregnancy and Lactation. 9th ed. Philadelphia : Lippincott Williams & Wilkins. P. 270-77.
- Buyun L, et al. 2020. Maternal cigarette smoking before and during pregnancy and the risk of preterm birth: A dose-response analysis of 25 million mother-infant pairs. PLoS Med, 17(8):e1003158.
- Cnattingius S. 2004. The epidemiology of smoking during pregnancy: smoking prevalence, maternal characteristics, and pregnancy outcomes. Nicotine Tob Res, 6(Suppl 2):S125-40.
- Dechanet C, et al. 2010. Effects of cigarette smoking on reproduction. Hum Reprod Update, 17(1):76-95. Deng

- K, et al. 2013. Periconceptional paternal smoking and the risk of congenital heart defects: A case-control study. *Birth Defects Res (Part A)*, 97:210-21.
- Ellis LC, et al. 2012. Smoking during pregnancy and psychiatric disorders in preschoolers. *Eur Child Adolesc Psychiatry*.
 - Einarson A, et al. 2009. Smoking in pregnancy and lactation : a review of risks and cessation strategies. *Eur J Clin Pharmacol*, 65:325-30.
 - Fan S, et al. 2024. Associations between tobacco inhalation and semen parameters in men with primary and secondary infertility: a cross-sectional study. *Frontiers in endocrinology*, 15:1396793. Guo Q, et al. 2023. Mechanism of Human Tubal Ectopic Pregnancy Caused by Cigarette
 - Smoking. *Reprod Sci*, 30(4):1074-1081.
 - Han J. et al. 2024. Parental Smoking and the Risk of Birth Defects in Offspring in China: A Systematic Review and meta-Analysis. *Birth Defects Res.* 116(12):e2422.
 - Harrod CS, et al. 2015. Exposure to prenatal smoking and early-life body composition: the healthy start study. *Obesity (Silver Spring)*, 23(1): 234-241.
 - Hackshaw A, et al, 2011. Maternal smoking in pregnancy and birth defects: a systematic review based on 173 687 malformed cases and 11.7 million controls. *Hum Reprod Update*, 17(5):589-604.
 - Hernandez-Martinez C, et al. 2016. Effects of prenatal nicotine exposure on infant language development: a cohort follow up study. *Matern Child Health J*. doi: 10.1007/s10995-016-2158-y.
 - Huizink AC, et al. 2006. Maternal smoking, drinking or cannabis use during pregnancy and neurobehavioral and cognitive functioning in human offspring. *Neurosci Biobehav Rev*, 30:26-41.
 - Karumai-Mori H, et al. & Japan Environment and Children's Study Group. 2025. Impact of maternal smoking and secondhand smoke exposure during singleton pregnancy on placental abruption: analysis of a prospective cohort study (the Japan Environment and Children's Study). *BMJ open*, 15(3):e089499.
 - Keyes KM, et al. 2014. Associations of prenatal maternal smoking with offspring hyperactivity: causal or confounded? *Psychological Medicine*, 44: 857-867.
 - Kia F, et al. 2018. Examining characteristics associated with quitting smoking during pregnancy and relapse postpartum. *Addict Behav*, 78:114-119.
 - Ko T-J, et al. 2014. Parental smoking during pregnancy and its association with low birth weight, small for gestational age, and preterm birth offspring: a birth cohort study. *Pediatr Neonatol*, 55(1):20-7.
 - Kwon JH, et al. 2015. The effects of prenatal exposure to alcohol and environmental tobacco smoke on the risk for ADHD: a large population-based study. *Psychiatry Res*, 225(1-2): 164-168.
 - Lanari M, et al. & « Study Group of Italian Society of Neonatology on Risk Factors for RSV Hospitalization. » 2015. Prenatal tobacco smoke exposure increases hospitalizations for bronchiolitis in infants. *Respir Res*, 16:152.
 - Leite M, et al. 2014. Maternal smoking in pregnancy and risk for congenital malformations: results of a Danish register-based cohort study. *Acta Obstet Gynecol Scand*, 93(8): 825-834.
 - Little J, et al. 2004. Tobacco smoking and oral clefts : a meta-analysis. *Bull World Health Organ*, 82(3):213-8.
 - Liu B, et al. 2020. Maternal cigarette smoking before and during pregnancy and the risk of preterm birth: A dose-response analysis of 25 million mother-infant pairs. *PLoS Med*, 17(8):e1003158.
 - Lumley J, et al. 2009. Interventions for promoting smoking cessation during pregnancy. *Cochrane Database Syst Rev* : CD001055.
 - Martin-Alonso R, et al. 2024. Association between Perinatal Outcomes and Maternal Risk Factors: A Cohort Study. *Medicina (Kaunas, Lithuania)*, 60(7):1071.
 - Meyer MB, et al. 1977. Perinatal events associated with maternal smoking during pregnancy. *Am J Epidemiol*, 103:464-476.
 - Meller SE, et al. 2014. Risk of childhood overweight after exposure to tobacco smoking in prenatal and early postnatal life. *PLoS One*, 9(10): e109184.
 - Natacha M De Genna, et al. 2023. Trajectories of Return to Cigarette Smoking Up to 1 Year Postpartum Among People Who Quit Smoking During Pregnancy. *Nicotine & Tobacco Research*, 25(5):875-881.

- Nielsen A, et al. 2006. Maternal smoking predict the risk of spontaneous abortion. *Acta Obstet Gynecol Scand*, 85(9):1057-65.
- Oladipupo I, et al. 2022. Association between cigarette smoking and ovarian reserve among women seeking fertility care. *PLoS One*, 17(12):e0278998.
- Osborne JB, Bailey BA. 2022. Does it matter when I quit? Could I just cut down some? Links between trimester-specific smoking amount, preterm birth, and low birth weight. *Birth Defects Res.* 1;114(1):5-12.
- Phillips EM, et al. 2020 Changes in parental smoking during pregnancy and risks of adverse birth outcomes and childhood overweight in Europe and North America: An individual participant data meta-analysis of 229,000 singleton births. *PLoS Med*, 17(8):e1003182.
- Practice Committee of the American Society for Reproductive Medicine. 2008. Smoking and infertility. *Fertil Steril*, 90(Suppl 3):S254-9.
- Rang NN, et al. 2020. Preterm birth and secondhand smoking during pregnancy: A case-control study from Vietnam. *PLoS One*. 15(10):e0240289.
- Ratnasiri AWG, et al, 2020. Smoking during Pregnancy and Adverse Birth and Maternal Outcomes in California, 2007 to 2016. *Am J Perinatol*, 37(13):1364-1376.
- Rogers JM. 2009. Tobacco and Pregnancy. *Reprod Toxicol*, 28:152-60.
- Schilling L, et al, 2021. Active and Passive Exposure to Tobacco and e-Cigarettes During Pregnancy. *Matern Child Health J*, 25(4):656-665.
- Salihu HM, et al. 2008. Prenatal tobacco use and risk of stillbirth: a case-control and bidirectional case-crossover study. *Nicotine Tob Res*, 10(1):159-66.
- Shenassa ED, et al. 2024. Feeding Method, Nicotine Exposure, and Growth during Infancy. *Journal of pediatrics. Clinical practice*, 14:200127.
- Soares SR, et al. 2007. Cigarette smoking affects uterine receptiveness. *Hum Reprod*, 22(2):543-7.
- Soesanti F, et al. 2019. Antenatal exposure to second hand smoke of non-smoking mothers and growth rate of their infants. *PLoS One*, 14(6):e0218577.
- Stick S. 2006. The effects on in-utero tobacco-toxin exposure on the respiratory system in children. *Curr Opin Allergy Clin Immunol*, 6:312-6.
- Stroud LR, et al. 2009. Maternal smoking during pregnancy and newborn neurobehavior: effects at 10 to 27 days. *J Pediatr*, 154(1):10-6.
- Sun J, et al. 2023. Dose-response association between maternal smoking during pregnancy and the risk of infant death: a nationwide, population-based, retrospective cohort study. *EClinicalMedicine*, 57:101858.
- Timmermans SH, et al. 2014. Maternal smoking during pregnancy and childhood overweight and fat distribution: the KOALA Birth Cohort Study. *Pediatric Obesity*, 9: e14-e25.
- Tarasi B, et al. 2022. Cigarette smoking during pregnancy and adverse perinatal outcomes: a cross-sectional study over 10 years. *BMC Public Health*, 22(1):2403.
- Toppila-Salmi S, et al. 2020. Maternal smoking during pregnancy affects adult onset of asthma in offspring: a follow up from birth to age 46 years. *Eur Respir J*, 55(6):1901857.
- Tsinisizeli N, et al. 2015. Determination of nicotine and cotinine in meconium from Greek neonates and correlation with birth weight and gestational age at birth. *Chemosphere*, 119:1200-7.
- Varner MW, et al. & Eunice Kennedy Shriver National Institute of Child Health and Human Development Stillbirth Collaborative Research Network. 2014. Association between stillbirth and illicit drug use and smoking during pregnancy. *Obstet Gynecol*, 123(1):113-125.
- Wesselink AK, et al. 2019. Prospective study of cigarette smoking and fecundability. *Hum Reprod*, 34(3):558-567.
- Yang L, et al. 2024. Maternal cigarette smoking before or during pregnancy increases the risk of severe neonatal morbidity after delivery: a nationwide population-based retrospective cohort study. *Journal of epidemiology and community health*, 78(11):690-699.
- Zhang K, Wang X. 2013. Maternal smoking and increased risk of sudden infant death syndrome: a meta-analysis. *Legal Medicine*, 15:115-121.

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