Proceedings of the 6th International Conference on Biological Engineering and Medical Science
DOI: 10.54254/2753-8818/2026.38196

Evidence Status and Assessment Challenges of Microplastic Exposure on Neonatal Health Outcomes

Yangyi Wang

Jiangsu Tianyi High School, Wuxi, China
wyy20081026@gmail.com

Abstract. Microplastics have become ubiquitous pollutants in our environment. Recent evidence suggests that these particles can cross the placenta and hence they pose a potential threat to fetal development and neonatal health. In this paper the literature on the influence of microplastics on perinatal biological media and the health consequences of their presence is systematically analyzed. The studies reveal the presence of microplastics in the placenta, amniotic fluid, umbilical cord blood, breast milk, and in meconium. The polymer types mainly include polyethylene, polypropylene and polystyrene. The observational studies indicate that microplastic pollution may negatively affect birth outcomes, including low birth weight and shorter gestation periods. The experimental studies show that microplastics negatively impact the health of offspring, causing oxidative stress, inflammation, and various defects. However, the existing population epidemiological data on the topic is still limited and inconsistent due to small sample sizes, methodological inconsistencies, complexity of confounders, and imprecision in toxicological conclusions. In this paper, four problems constraining the assessment of perinatal health risks of microplastics have been identified and specific solutions for the scientific and healthcare practices have been proposed.

Keywords: Microplastics, neonatal health, maternal-fetal transmission, exposure assessment

1. Introduction

Microplastics are small particles of plastic that are smaller than 5 mm and are found in the surface water, land and air. People can be exposed to microplastics through various pathways including food consumption, drinking water, breathing in the air and skin contact. Increasingly being recognized are the studies on biological monitoring of humans that indicate microplastic particles can move across the placental barrier and move from the pregnant body into the fetus. Newborns form an exceptionally sensitive group of people: their organs are still in the process of formation and differentiation, their immunity is not yet fully established, and their detoxification and metabolism mechanisms are not fully developed. When compared to adults, newborns are at a much higher risk of being affected by environmental pollutants, including microplastics, exposing them to possible adverse effects during pregnancy.

Global research on perinatal microplastic pollution has developed rapidly in recent years. International biomonitoring studies have successfully detected microplastic contaminants in multiple

© 2026 The Authors. This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (https://creativecommons.org/licenses/by/4.0/).

DOI: 10.54254/2753-8818/2026.38196

maternal and neonatal biological matrices, including placenta, amniotic fluid, umbilical cord blood, breast milk and neonatal meconium [1]. A large number of in vitro experiments and animal toxicological studies have verified that gestational microplastic exposure can trigger oxidative stress, inflammatory activation and multi-organ developmental damage in offspring [2]. Considering this, the current epidemiologic data remains limited and inconsistent. Most published works focus on small sample pilot studies without cross-cohort validation. Thus, it can be stated that the causal evidence of health risks of newborns is not sufficient. In China, certain progress has been made in the area of perinatal microplastic monitoring. Different local studies have confirmed the presence of microplastic contamination in perinatal biological samples. However, domestic studies mainly focus on the qualitative and quantitative analysis of the pollutants while high-quality prospective birth cohort studies are required to establish the connection between the microplastic load and health effects of newborns. All in all, there is still a huge amount of gaps in research on the issue of perinatal microplastics, including the absence of unified exposure assessments, the uncertainty of the causal potential harm mechanism of microplastics for health, and the absence of risk assessment for newborns.

At this time, studies conducted thus far regarding the danger posed by microplastics to infants are very few and taken mainly from individual toxicological studies and few biological surveys. No systematic reviews or serious evaluations have been performed that would give a comprehensive view on this matter and have been able to point out contradictions and difficulties arising from current research. Furthermore, the reviews carried out so far have not succeeded in identifying challenges that make it difficult to study possible microplastics risks for infants and have not provided necessary recommendations for further studies and mother-child care. This review aims to fill this gap in research by bringing together all the information available regarding microplastics contamination and possible health threats for newborns.

2. Occurrence characteristics of microplastics in perinatal biological matrices

Multiple human biomonitoring studies have proved that microplastics can enter the intrauterine environment and come into direct contact with foetal tissues. In placental specimens, researchers have identified diverse polymer types including polyethylene, polypropylene, polyethylene terephthalate and polystyrene [3]. These polymers are mainly derived from everyday plastic waste, textiles, and other plastic products. Various research teams have reported large differences in the concentration of microplastics. For example, certain research studies have shown that microplastic particles are present in both maternal and fetal sides of the placental tissue. This fact provides clear direct evidence of the transfer of materials from mother to the child. It also shows that the placental barrier does not prevent microplastics from penetrating into the fetus and challenges the traditional belief that the placental barrier is capable of isolating everything from the outside environment completely.

Microplastics have been found on several occasions, besides in the placenta, in samples of amniotic fluid, umbilical cord blood, and breast milk. The amniotic fluid surrounds the fetus and is swallowed by it during the second and the third trimesters of pregnancy. The existence of microplastics in the amniotic fluid proves that the fetus is under a continuous state of oral exposure. Microplastics were also detected in umbilical cord blood, confirming their ability to be present in the fetal blood and be distributed to some organs. Breast milk constitutes the main nutrition source after birth, which indicates post-natal microplastic exposure for breast-fed infants, extending pollutant risk from the prenatal stage into early postnatal life. Neonatal meconium, the first faeces of newborns, also contains abundant microplastic particles, reflecting cumulative pollutant exposure

DOI: 10.54254/2753-8818/2026.38196

from prenatal and perinatal stages [4]. Meconium serves as a practical non-invasive biological matrix for exploring overall foetal microplastic burden.

It should also be said that there are numerous distinctions in the published detection outcomes. While some published works reported a higher positive detection rate and a greater amount of microplastic in comparable biological matrices, others documented considerably lower levels of microplastic. The differences are accounted for by multiple influences. Sampling techniques, sample preservation, laboratory pre-treatment methods, efficient blank contamination control measures, and identification technologies may all contribute to such systematic biases. For example, a laboratory's blank may not be carefully distinguished, which can lead to the contamination of samples by air microplastic fibers that can produce false positive results. Moreover, each individual and his/her characteristics such as geographical location, diet, drinking water sources, pollution, and socio-economic status may influence how much microplastic he/she gets exposed to. Up to now, there is no universally accepted reference range for microplastic particle burden in healthy perinatal and neonatal populations, which makes it difficult to judge whether a measured value represents harmful high exposure or a natural background level [5].

3. Potential neonatal health outcomes linked to microplastic exposure

For birth-related clinical endpoints, researchers have explored associations between prenatal microplastic exposure and several critical neonatal outcomes, including preterm birth, low birth weight and intrauterine growth restriction [6]. These birth-related indicators are core markers of neonatal health and are closely associated with infant short-term mortality and long-term chronic disease risk. Some observational studies suggest that higher placental or cord-blood microplastic load may correlate with elevated risk of these adverse birth events [7]. It is thought by researchers that placental inflammation and disturbances in nutrient transport by the placenta may be possible effects of microplastics. However, any effects indicated by the research results have not been confirmed in other independent groups of people. Even after eliminating such factors as the mother's BMI, gestational diabetes, and smoking history, most studies continue to find no statistically significant impact of microplastics. At the moment, human evidence does not provide definitive answers regarding the connection between microplastic exposure and the disorders of neonatal development.

Microplastic exposure also triggers inflammatory imbalance and immune dysfunction in early life. In vitro cell experiments and animal studies have demonstrated that microplastic particles induce excessive reactive oxygen species production, activate oxidative stress pathways and upregulate pro-inflammatory cytokine expression [8]. The joint impact of absorbed heavy metals and plastic additives will aggravate the biological damage. The neonatal period is crucial for immune system development. Chronic inflammatory diseases could affect the immune system development and lead to a higher chance of children suffering from allergic diseases, asthma, and intestinal diseases later. Nevertheless, there are no direct clinical data in humans available at this time. Most toxicological conclusions are derived from experiments, with the great importance of the species difference making such conclusions problematic.

Animal toxicological studies have confirmed that gestational microplastic exposure causes multi-organ developmental damage in offspring, including nervous system developmental defects, intestinal barrier dysfunction, liver tissue injury and reproductive system abnormalities [9]. During the period of fetal development, microplastics are capable of crossing the blood-brain barrier causing disruption to neuronal differentiation and leading to abnormal behavior in juvenile animals. Microplastics in the intestine can result in the impairment of the epithelial integrity, the disturbance

DOI: 10.54254/2753-8818/2026.38196

of the establishment of the earliest intestinal microbiota, the additional impact on long-term metabolic development, and an increase of the childhood obesity risk. It is important to note that the exposure levels used in many animal experiments is significantly higher than the real-life level of exposure for humans. In real life pregnant exposure scenarios, chronic toxicity from low doses is unknown, and there is a great lack of long-term follow-up data on the children exposed to microplastics.

4. Core bottlenecks in perinatal microplastic health risk assessment

Standardized exposure assessment systems are currently absent in perinatal microplastic research [10]. The technical procedure is diverse in terms of sampling techniques, pollution prevention, types of filters used, detection methods and quantitative measures, but there seems not to be any consistent standards. Different chemical agents, membranes and reading systems lead to significant disparity in research results from various research institutions. Additionally, indicators of particle count and mass concentration vary in different institutions, which means there are more problems related to data standardization and cohesion. Moreover, traditional biological monitoring methods only allow for static evaluation of exposure levels during pregnancy, which results in biased assessments of exposure.

Epidemiological studies have some inherent limitations in methods. Presently, the majority of studies about microplastics during pregnancy are characterized by small sample sizes, which has resulted in lack of statistical power of these studies, and, therefore, detection of weak health effects of low-level exposure to environmental microplastics is impossible. Existing research studies cannot eliminate various confounding factors in various studies, which include multiple exposures to different environmental pollutants, medical complications of pregnant envisions and individual food habits.

The uncertainty in toxicology extrapolation processes represents another critical constraint. Studies involving experimental animals generally administer significant doses—a situation that differs from the prolonged low dose exposure found in human fetuses. Further complicating risk assessment is the addition of microplastics and chemical pollutants found in them, along with the presence of nanoplastics with strong tissue penetration capabilities. All this poses a significant challenge, especially since the development of advanced and sensitive detection methods has not yet caught up with the increasing number of issues.

The absence of adequate biological data brings about limitations in risk assessment at the population level. At the moment, no established reference normal range of microplastics for healthy pregnant women and newborns exists. Additionally, the manner in which such factors as the age of the mother, the number of pregnancies she underwent, and the living environment of the region influence microplastic accumulation in the fetus is still unclear.

5. Research optimization strategies and public health interventions

The scientific community has recognized the necessity of developing standardized protocols for reliability studies regarding microplastics in perinatal specimens. One critical aspect of the development of these methods is the implementation of adequate blank controls and proper procedures for reporting the findings. Furthermore, testing protocols should ensure the consistency of measurements in different research laboratories. In addition, a multicenter research project should be launched so that the outcome of the exposure to microplastics could be better understood through the collection of longitudinal data on exposures at the early stages of pregnancy and the health

DOI: 10.54254/2753-8818/2026.38196

conditions of newborns. The need for conducting long-term low-dose toxicity studies of microplastics is also relevant since they could assist researchers in replicating real-life scenarios of human exposure to these substances. Special attention should also be given to the joint toxic action of microplastics and toxic chemical additives. In addition, new high-sensitivity methods for micronanoplastics detection in biological samples should also be developed in order to compensate for the limitations of currently available technologies related to the study of the risk of micronanoplastics.

With respect to health prevention and regulation, comprehensive environmental health education aimed at the issues affecting females of reproductive age and pregnant women should be implemented to minimize their risk of microplastic exposure. The authorities should tighten source pollution control in textile, plastic disposal and food packing industries to decrease the release of microplastics. The country should gradually develop a long-term monitoring system for perinatal environmental pollution that will help collect data on microplastics in expectant mothers and newborns leading to the generation of reliable information for health risk alerts and development of appropriate policies in environmental health.

Different research techniques have various strengths and weaknesses; animal experiments can carry out controlled analysis of mechanisms but have clear limitations when it comes to drawing conclusions based on extrapolating results; small-scale biological monitoring can establish the presence of pollutants in human bodies, but cannot prove that they are harmful for health in the future; epidemiological cohort studies are the closest method to human situation, but require huge expenses for the research and its long duration. Though current scientific studies lack sufficient evidence, the great sensitivity of fetuses and newborns requires taking urgent public heath measures as a precaution.

6. Conclusion

This paper makes a thorough analysis of the present data on microplastic contamination of perinatal biological matrices and its potential effect on the infant health outcomes. Existing studies confirm the presence of microplastics in placenta, amniotic fluid, umbilical cord blood, breast milk, and newborn meconium and verify both intrauterine and early postnatal pathways of exposure. The types of supposedly detected polymers are commonly polyethylene, polypropylene and polystyrene; nevertheless, the amount of detected microplastics varies considerably across studies, which can mainly be explained by the differences in research methodologies. Observational studies indicate that the load of microplastics may be correlated with negative birth outcomes like low birth weight, short period of gestation, and intrauterine growth restriction; and experimental studies indicate that it may induce oxidative stress, inflammatory activation, immune disorders and developmental toxicity in several organs of the offspring. However, data on human epidemiology remain insufficiently detailed and contradictory. Currently, there are four major limitations to the reliable risk assessment: the absence of standardized exposure assessment schemes; a natural gap in small-sample epidemiological studies; the ambiguity in toxicological doses extrapolation; and the lack of basic biological monitoring data in healthy perinatal populations. The results of the study indicates that it is imperative to create unified detection standards, to set up large-scale multicenter prospective birth cohorts, to ensure the long-term follow up of children exposed to pollutants, to create low-dose combined toxicity assessment approaches, and to implement national perinatal environmental pollution monitoring systems. Because of the unique physiological fragility of fetuses and newborns, it is crucial to utilize preventive public health approaches ahead of time, before determining causation. This review has limitations related to the variety of the quality of the

DOI: 10.54254/2753-8818/2026.38196

available literature and as it does not provide original experimental or epidemiological data. Further studies should pay special attention to multicenter cohort studies, toxicity evaluation of microplastics and the chemicals associated with them, highly sensitive detection technologies, as well as chronic intergenerational impact studies.

References

[1] Jinesh, S., & Aditi, P. (2025). Health implications of microplastic exposure in pregnancy and early childhood: A systematic review. *International Journal of Women's Health, 17*, 2805-2818.
[2] Nadarasan, S., Phuna, Z. X., & Zaman, R. (2025). Microplastics and child health: A scoping review of prenatal and early-life exposure routes and potential health risks. *Toxicology Reports, 15*, 102143.
[3] Andonotopo, W., Bachnas, M. A., & Kurjak, A. (2025). Microplastics in the perinatal period: Emerging evidence on maternal exposure, placental transfer, and fetal health outcomes. *Saudi International Journal of Medicine*. DOI: 10.4103/sijm.sijm_24-25.
[4] Xu, D., Liang, Z., Yang, Q., et al. (2026). Microplastics in neonates: An overlooked cost of parenteral nutrition. *Frontiers in Public Health, 14*, 1767555.
[5] Principi, N., Argentiero, A., Campana, B. R., et al. (2025). Plastic pollution and child health: A narrative review of micro- and nanoplastics, additives, and developmental risks. *Journal of Clinical Medicine, 14*(23), 8399.
[6] Sha, M., Peng, J., Yang, Y., et al. (2026). Impact of prenatal micro/nanoplastics exposure on intrauterine development and growth: A systematic review. *Journal of Developmental Origins of Health and Disease, 17*: e12.
[7] Li, J., Jing, L., Shi, M., et al. (2026). Relationship between micro- and nanosized plastics in cord blood and birth weight and gestational age of newborns. *Environmental Pollution, 405*: 128550.
[8] Shi, C., et al. (2026). Polystyrene microplastics disrupt vertical transmission of the breast milk microbiome, impairing early-life gut colonization and immune development in offspring. *The FASEB Journal, 40*(1): e71448.
[9] Valencise, L., et al. (2025). Postnatal development outcomes in mice after gestational exposure to polystyrene nanoplastics. *Scientific Reports, 16*: 36244.
[10] Zhang, H., et al. (2025). Health risks of prenatal and early-life microplastics exposure: A comprehensive review. *ACS Environmental Health*. DOI: 10.1021/envhealth.5c00388.