FOREVER CHEMICALS:

HOW WE ARE TACKLING HARMFUL EXPOSURE - AT A GLANCE

1,300 – mother-child pairs we are following in HELIX project

80,000 – mother-child pairs we are following in ATHLETE study

11+ - European countries collaborating

250,000 – children and parents in LifeCycle project

89 - outdoor, chemical, and lifestyle exposures measured during pregnancy

3 – major recommendations for policymakers and **3** for the general public

bib We are family BORNINBRADFORD

EVIDENCE BRIEFING

HARMFUL EXPOSURE: CHEMICALS AND HEALTH

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WHAT IS THE PROBLEM?

Chemicals are all around us in the form of the **objects we touch, the air we breathe, the products we use, and the food** and **liquids we consume**.

Some chemicals are of concern because of the **negative health impacts** they have, such as lead, arsenic, and other naturally-occurring heavy metals on cognitive function and behaviour[1,2].

These are **especially concerning** when exposures occur at sensitive periods of development, such as during **pregnancy** or **in childhood**.

The increasing use of synthetic chemicals such as phthalates and phenols in industrial and everyday consumer products to act as solvents, fixatives, preservatives, and plasticisers has also become a **cause for concern**[3,4].

These chemicals are found in our **personal care products** (shampoos, soaps, lotions/creams, perfumes, etc.) as well as **common household objects** (vinyl flooring, plastic food storage containers and packaging, etc.).

A growing body of evidence suggests that some of these compounds act as endocrine-disrupting hormones, meaning they have the **potential to disrupt** common hormone pathways such as the thyroid, androgen, and oestrogen pathways[4–8].

Exposure to these chemicals have been associated with a range of health implications including **obesity, impaired glucose tolerance, gestational diabetes**, and **semen quality**[9].

WHAT HAVE WE FOUND?

Born in Bradford has been involved in **several European research collaborations** which have looked at the links between **exposures to chemicals from our environment** and **health**.

These collaborations have included the **HELIX (Human Early Life Exposome) study**, a collaboration between **six birth cohorts** in **six European countries** (UK, Spain, Norway, France, Lithuania, Greece) which followed **1,300 mother-child pairs**[10].

We also played a key role in its follow-up and expansion to **16 existing cohorts** in **11 European countries** with **80,000 mother-child pairs** in the **ATHLETE (Advancing Tools for Human Early Lifecourse Exposome Research and Translation)** study[11].

We have also been a partner in the **LifeCycle project**, which established the EU Child Cohort Network of harmonised data from **19 pregnancy and childhood cohorts** with **more than 250,000 children and their parents**[12].

Through these studies, newly-collected data using biological samples such as **urines and blood**, as well as **questionnaire data**, has allowed epidemiological analyses to **answer questions** about the amount of exposure experienced by BiB families and the impact of these exposures on health.

We are routinely exposed to a wide range of environmental chemicals from foetal life through adulthood

We are exposed to a wide range of both **persistent** and **non-persistent chemicals**[13].

Some chemicals, like per- and polyfluoralkyl substances (PFAS), which are used in **non-stick cookware, packaging**, and make **fabrics stain-resistant**, are known as **"forever chemicals"** because they **persist in the environment** or **your body** long after they are used or consumed[14].

Other chemicals, such as Bisphenol A or phthalates, which are used in **plastic containers, medical equipment**, and **personal care products**, don't persist in the environment and have short half-lives in the body, but due to **almost constant exposure** we retain a **body burden** of these chemicals[15,16].

The types of exposures differed between **countries** as well as by **age group**.

Some of this difference can be explained by **different sources of exposure for adults compared to children**,

such as the use of personal care products and cosmetics among adults, or, among children, because of greater inhalation, dermal contact, or dietary intake relative to body size[17].

Exposure to heavy metals and chemicals can negatively impact on behaviour, blood pressure, respiratory health, and liver function in children

We know that foetal life and childhood are important periods for health as they are periods of **rapid development** and adverse events during these periods could have **long-term impacts on health**.

BiB was part of a **novel study** that was the first to look simultaneously at a range of **89 outdoor, chemical, and lifestyle exposures during pregnancy** and **128 exposures during childhood** on different health outcomes in childhood:

- We found that exposure to both persistent (PFAS) and non-persistent (BPA) chemicals and metals (copper) are associated with **increased blood pressure** in children whereas persistent organochlorine compounds such as PCBs, as well as non-persistent compounds like phthalates, have been **inversely associated with childhood blood pressure**[18].
- We found that exposure to BPA, phthalates, and DETP, a pesticide known to be neurotoxic, in the foetal period was associated with **worse externalising behaviour in childhood**[19]. Heavy metals such as **lead** and **copper** were also associated with worse childhood behaviour such as scoring higher on an **ADHD index**[20].
- We found that BPA exposure in the foetal period was associated with higher odds of **childhood wheeze** and **asthma**[21]. Worse **childhood lung function** was also linked with exposures to PFAS, copper, parabens (a common preservative used in personal care products, pharmaceuticals, and the food industry), and phtahlates[22]. **Exposure to copper** has also been implicated in **childhood obesity**[23].
- We found that exposure to PFAS in the foetal period was linked to an increased risk of **liver injury in childhood**[24].

Some chemicals found in foods, or formed when foods are cooked, can have harmful effects for our health

- Acrylamide is a neurotoxin and probable **cancer-causing** agent; exposure to this compound has been linked to intakes of starchy foods that have been fried or baked at high temperatures. In the BiB cohort, **chips, toast,** and **crisps** were the greatest contributors to intakes of acrylamide, with **White British women** more likely to have higher intakes with increasing levels of **deprivation**[25]. Dietary intakes of acrylamide was associated with a **reduced birth weight** and **smaller head circumference**[26].

- **Fish intake** is beneficial for health but excessive intake of fish (more than four times every week) can increase the amount of exposure to persistent chemicals and heavy metals found in the fish, such as polychlorinated bisphenyls (PCBs), arsenic, and mercury compared to the recommended 2-3 times/week[27]. By keeping to recommended intakes of fish, rather than low or excessive intakes, a **better metabolic profile was observed in children,** with a decrease in a metabolic syndrome score as well as lower levels of inflammatory biomarkers[28].

- **Pesticides** are commonly used in agriculture and we are exposed to these pesticides through **food consumption**. **Fruit intake** increases exposures to organophosphate pesticides but consuming **organic foods** reduces these exposures.

Individuals can lower their exposure to some chemicals by swapping out plastic food storage containers and choosing alternative personal care products

We are constantly exposed to chemicals in **our daily life**. Some of these chemicals, like BPA, parabens, and phthalates, don't stay in the body for long periods of time after exposure but because they are used in everyday products like **cosmetics, lotions, creams, toothpastes, shampoos, food containers** and **food packaging**, we are **repeatedly exposing ourselves** to these chemicals. We undertook a review of the current scientific literature to understand whether it is possible to reduce our exposure to these chemicals through actions that we can take.

We found that it is possible to reduce our exposures by **replacing plastic food and beverage containers with glass or stainless steel, looking at the labels on our cosmetics and personal care products to see if they contain the chemicals**, or **decreasing intakes of canned and packaged foods** [29].

WHAT HAS CHANGED AS A RESULT?

Our findings have helped **increase our understanding** of how our **everyday exposures can impact on our health** and **the health of our children**.

This has **prompted a human study** to understand whether feasible and effective interventions can be created to **reduce our exposures to chemicals** found in our **cosmetics** and **personal care products**.

Our work has also contributed to national, international, and US changes in guidelines to reduce exposures to acrylamide.

RECOMMENDATIONS FOR POLICYMAKERS BASED ON OUR EVIDENCE

- That **consumer information on the presence of chemicals** used within products and packaging are **made accessible** and **widely available**
- That policy is implemented to **target the use of chemicals** in multiple sectors including **processing, manufacturing,** and **packaging** to reduce individual burden in identifying and finding alternative products
- That **greater consideration to the potential harms of chemicals**, such as **pesticides** and **preservatives**, is given prior to these chemicals being introduced into manufacturing processes or consumer products

ADDITIONAL RECOMMENDATIONS FOR THE GENERAL PUBLIC

- Try to use **fewer plastic food and beverage storage containers**, especially when **microwaving**, and switch to non-reactive materials like glass or stainless steel if you can
- Try to **reduce your consumption of tinned foods and foods stored in plastic packaging** because chemicals in packaging can migrate into the food
- Keep to the **recommended fish intake of 2-3 times/ week** and switch to **organic foods** if you can
- When buying personal care products, look at the ingredients list and try to **avoid products with triclosan, phthalates, and parabens** which are known to impact health

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