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What can we learn from environmental accidents?

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Abstract

Accidents happen, and when they do, it is important to learn from them. Environmental accidents are no different. They teach society about the dangers of a chemical or process. In 1973, a chemical company in Michigan made chemicals called polybrominated biphenyls (PBBs) and a food supplement for farm animals. The company made a mistake and sent the PBBs to mix into animal feed instead of the food supplement. The contaminated feed was sent to farms all over the state. The contamination was discovered a year later, after a farmer spent months investigating why his cows were getting sick. By that time, millions of people in Michigan had eaten food (like meat, dairy, and eggs) contaminated with PBBs.

Scientists conducted many studies to figure out the health effects of PBBs. We reviewed these studies and summarized the results. We found that PBBs had some short-term effects on people's health. They also had many long-term health effects. People exposed in their youth experienced different health effects than the exposed adults. PBBs also negatively affected the children and grandchildren of people who ate food products with PBBs.

Introduction

Some chemicals designed to improve life turn out to be dangerous. One example is a group of chemicals known as **polybrominated biphenyls (PBBs)**. These chemicals reduced the **flammability** of many products in the 1970s. But their use stopped in 1976. Why? People found out that these chemicals are **persistent pollutants**. They cause negative health effects as they stay in the environment and people's bodies for a long time.

People discovered the dangers of PBBs because of an accident. In 1973, livestock feed companies in Michigan received a mixture of PBBs by mistake. They added it to the animal feed instead of adding a food supplement. For a year, cows, chickens, hogs, and other animals ate food containing these chemicals. People ate the dairy, meat, and egg products from these farms. It has been estimated that 6.5 million people ate animal products with PBBs.

A tombstone placed on the former site of the chemical company warning of ground contamination.

Since this accident occurred, scientists have conducted many studies. We wanted to figure out how much we know about the human health effects of PBBs. We reviewed scientific studies about people affected by the Michigan accident. We summarized the short-term and long-term health effects. We also summarized the health effects experienced by their children and grandchildren.

Methods

We searched scientific databases to find studies about the human health effects of PBBs. We then chose studies that focused on the effects of PBBs in Michigan because of the animal feed accident. We analyzed each study to find out how PBBs affected three groups (Fig.1).

- Group A: people **exposed** as adults and children.
- Group B: children of at least one parent from Group A.
- Group C: grandchildren of at least one parent from Group A.

We summarized the results of each study. Then we organized our findings into four sections.

1. Short-term effects on Group A
2. Long-term effects on Group A
3. Effects on Groups B and C
4. Recent findings

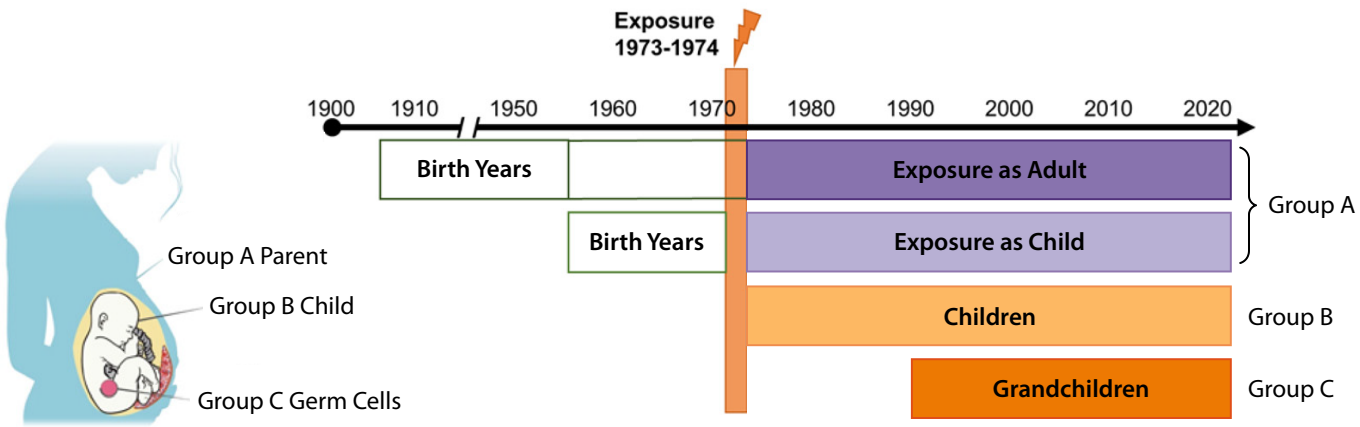

Figure 1: The birth and follow-up years for Groups A, B, and C. The children in Group B already carried the **germ cells** that would go on to create the grandchildren in Group C. So all three generations were exposed to PBB contamination.

Results

1. Short-term effects on Group A

We saw that people experienced skin problems shortly after exposure. These problems included rashes, acne, and increased sun sensitivity. Studies found **biomarkers** that may indicate increased risk of cancer and liver problems. Some studies showed a relationship between **thyroid** disorders and a decrease in **immune system** function. People also reported tiredness, headaches, and dizziness (See Fig. 2 on p.3).

2. Long-term effects on Group A

Studies found a link between breast cancer and PBB levels. The higher the PBB levels, the higher the risk of breast cancer. There is a similar relationship with digestive system cancers and **lymphoma**. Women had lower levels of some hormones that affected their menstrual cycle. More men experienced **autoimmune diseases**. We found that issues with thyroid function were more common in people exposed to PBBs as children.

3. Effects on Groups B and C

Babies born to men with high levels of PBBs had lower birth weights. Women with high levels of PBBs had a higher chance of having a baby boy. Breastfed babies had higher PBB levels than non-breastfeed babies. Girls born to women with higher PBB levels were more likely to start menstruation early, especially if they had been breastfed. These girls were also more likely to have **miscarriages** when they became adults. Boys were more likely to start puberty late. But they didn't experience reproductive problems as adults.

4. Recent Findings

We saw that PBBs changed how certain genes work without changing the DNA itself. The changes affected estrogen function, immune function, and sperm development. High levels of PBBs are linked to age acceleration. That means people's **biological age** increased faster than their **chronological age**. This acceleration was more common in people exposed to PBBs as children.

How did the identified health effects of PBB exposure change over time for the people in Group A?

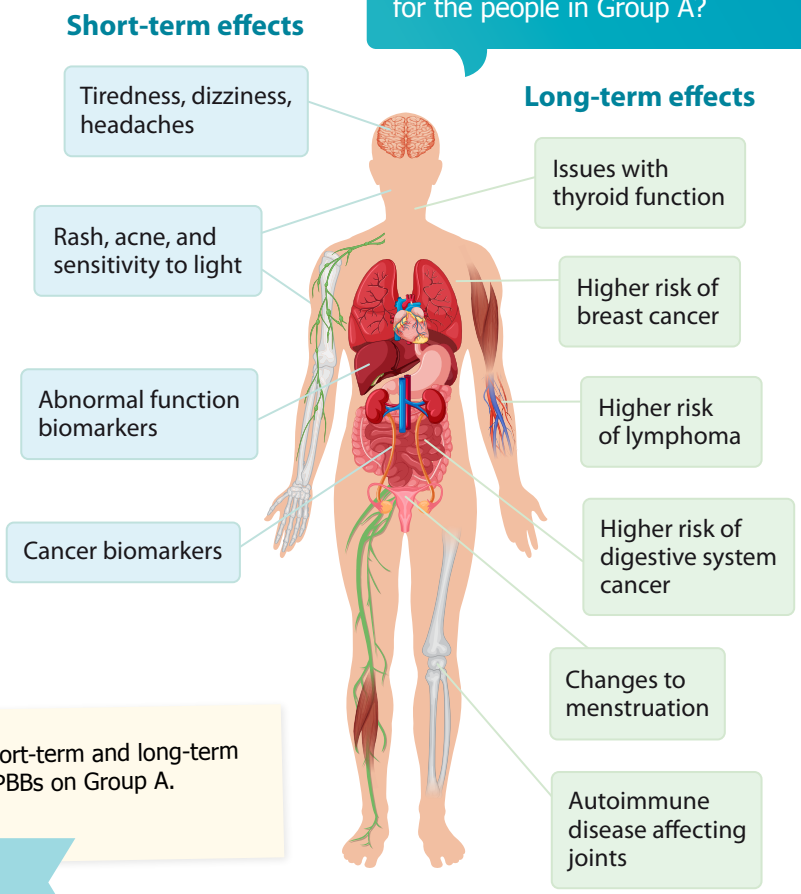

Figure 2: The short-term and long-term health effects of PBBs on Group A.

Discussion

Scientists learned that PBBs are chemicals that can act like the body's natural **hormones**. They can also block or interfere with them. Hormones are the chemical messages used by the body. Chemicals like PBBs can change, block, or interfere with those messages. This can cause thyroid issues and changes to the start of puberty.

We also found that the timing of exposure was important. People exposed as children experienced health effects that adults did not. Other health effects were related to pregnancy and breastfeeding. That is why scientists observed different health effects in Groups B and C as compared to Group A.

Our review shows the importance of long-term studies. The negative effects of a chemical may take time to develop. Multigenerational studies like this one are important. Some chemicals can pass to children during pregnancy or breastfeeding. That is why children and grandchildren can also experience negative health effects.

Conclusion

The environmental accident in Michigan shows how events in childhood can affect people later in life. The choices we make as children and teens can affect our health as adults. But sometimes, when accidents happen, people don't get a choice. That is why **environmental awareness** is important.

We are still learning about the health effects of PBBs on men, women, and children. Citizen groups are still working to clean up the chemicals and to spread awareness. In the future, you might help with an environmental cleanup, or maybe a similar cause. Check out if there are community activities such as neighborhood cleanups, eco clubs, or planting trees near you! Helping others through observation and research can make a big difference for future generations.

Glossary of Key Terms

Autoimmune disease - a condition caused by the body's immune system attacking healthy tissues and organs. Examples include rheumatoid arthritis and Type 1 diabetes.

Biological age - a number used to describe how a person is aging that is determined by many biological tests.

Biomarkers - substances in the human body that scientists measure to determine if an organ is functioning properly or if a person has an increased risk of developing a disease. Examples include cancer markers and liver function markers.

Chronological age - the number of years a person has lived.

Environmental awareness - the understanding that our actions impact the environment and the motivation to protect it. It involves recognizing the effects of human activities on the natural world, such as manufacturing persistent chemicals and polluting waterways, air, or food, and taking responsibility to reduce harm through preventative strategies.

Expose - put human health at risk of something that might be harmful. For example, when someone starts smoking a cigarette close to you, they expose you to the harmful effects of smoke.

Flammability - a property of matter that describes how easily it catches fire.

Germ cell - the type of cell that creates reproductive cells. In humans, germ cells create sperm and egg cells.

Hormones - chemical messengers in the body. Examples include estrogen and thyroid hormones.

Immune system - the body system that defends against infections, diseases, and foreign substances.

Lymphoma - a type of blood cancer that affects the white blood cells that help protect your body against infections.

Miscarriage - when a baby dies before birth.

Persistent pollutants - chemicals that are harmful and that remain in the environment and in human bodies for long periods of time. Examples include polybrominated (PBBs) and polychlorinated biphenyls (PCBs).

Polybrominated biphenyls (PBBs) - a group of human-made chemicals used in products to reduce their flammability.

Thyroid - a part of the body that produces hormones that regulate body growth and development.

REFERENCES

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Check your understanding

1. How were people in Michigan exposed to polybrominated biphenyls (PBBs)?

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2. Why did PBBs cause health effects like early menstruation in girls, late puberty in boys, and thyroid issues?

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3. Why was it important that scientists conducted studies to determine the human health effects of PBBs decades after the environmental accident occurred in Michigan?

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4. Do you think that scientists should continue to study the health effects experienced by the children and grandchildren of people exposed to PBBs in Michigan? Support your answer with reasoning.

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5. Research another environmental accident that affected human health. Summarize what happened. Then determine how this accident was similar and how it was different from what occurred in Michigan.
