Ambient BTEX levels: Do they pose a threat to public health?

Ashley Bolden, MS
The Endocrine Disruption Exchange
What are BTEX?

- Benzene: 71-43-2
- Toluene: 108-88-3
- Ethylbenzene: 100-41-4

- p-xylene
- o-xylene
- m-xylene

- Xylenes: 1330-20-7
Why study BTEX?

- Common air pollutants detected indoors and outdoors
- BTEX are associated with oil and gas development and production sites
- Typically not studied at low concentrations
- BTEX are precursors to other air pollutants (PAHs, ozone, PM) connected to adverse health effects
How do BTEX get into our air?

- Various household products
- Combustion of fossil fuels from gasoline and diesel vehicles
- During oil and gas extraction
- Gas pump emissions
- Cigarette smoke
Evidence of BTEX exposure

- BTEX leave our bodies relatively quickly
- Found in blood, cord blood, and as metabolites in urine
- Exposure is happening continuously
More support for BTEX exposure

- Typically detected greater than 90% of the time in indoor and outdoor air
- On average we spend greater than 87% of our time indoors
- BTEX levels outdoors near oil and gas development and production much higher than typical levels indoors
Highest average concentrations measured in review

Concentration (µg/m³)

Log scale

- Benzene
- Toluene
- Ethylbenzene
- Xylenes

- Personal
- Indoor
- Outdoor
Objectives of the review

- Identify all the studies in humans at nonoccupational (ambient) exposure levels
- Summarize the findings
- Explore if endocrine signaling could be involved in the health outcomes
How did we conduct the review?

- Performed searches using PubMed
- Used Distiller SR to identify potential studies
- Assessed the quality of the studies using the OHAT approach
What did we find?

- Identified a total of 42 studies
- Fetal, childhood, adolescence, adulthood
- Indoor, outdoor, and personal air, blood, and urinary metabolite levels
- Prospective, cross-sectional, case-control, and retrospective studies
Developmental

Example: low birth weight

Number of findings

- Benzene: 6
- Toluene: 1
- Ethylbenzene: 1
- Xylene: 1
- BTEX: 2

Effect vs. no effect

P = 0.05
Examples: disrupts development of immunity, increased susceptibility of allergic conditions, sensitization to common foods
Metabolic/Reproductive

Metabolic
- Example: insulin resistance

Reproductive
- Example: altered sperm parameters

Number of findings
- benzene
- toluene
- ethylbenzene
- xylene
Examples: asthma and poor respiratory function

Number of findings:

- Benzene: Effect
- Toluene: Effect
- Ethylbenzene: Effect
- Xylene: Effect
- BTEX: No effect

Examples:

- Asthma and poor respiratory function
Cardiovascular and blood

Examples: altered blood parameters
increased risk of cardiovascular disease

Number of findings

- Benzene: 3
- Toluene: 2
- Ethylbenzene: 1
- Xylene: 1

Effect
- Benzene: Effect
- Toluene: Effect
- Ethylbenzene: Effect
- Xylene: Effect

No effect
Connecting health effects to endocrine signaling

- Occupational evidence of endocrine disruption

- Health effects can have origins in early development

- Exposure to endocrine disruptors at lower levels can result in adverse health impacts
Occupational studies

- At higher exposure levels
- Disrupted abnormal sperm production and altered menstrual cycles
- Altered reproductive hormone levels (LH and FSH)
- Disrupted fertility and spontaneous abortion
The involvement of hormones

- Hormones are involved in the programming of growth patterns and development of immunity
  - insulin-like growth factor, thyroid hormone, cortisol, estrogens, and androgens

- Hormones regulate immune function throughout life
  - glucocorticoids, estrogens, and progesterone
Health effect levels compared to EPA safe concentrations

**Concentration (µg/m³)**

- **Benzene**: 1.01
- **Toluene**: 6.95
- **Ethylbenzene**: 1.5
- **Xylenes**: 5.6

**Log scale**

- **Lowest Effect**
- **RfC**

---

**Highest Effect**: 5000

**RfC**: 1000

---

19
Conclusions and recommendations

- Health effects were associated with levels of BTEX that are considered safe by the US EPA.
- The methods used to assess and regulate chemicals with effects at low concentrations should be reevaluated.
To reduce exposure...

- BTEX should be removed or limited in consumer and industrial products

- They should be replaced with chemicals that do not have biological activity
Concentrations of BTEX in outdoor air near oil and gas impacted areas

Conclusions and recommendations

- Air near oil and gas development can be orders of magnitude higher than exposures for which we found health effects, sometimes exceeding EPA safe levels.

- Measures should be taken to protect citizens from unsafe exposure.
Thanks to my co-authors Carol Kwiatkowski and Theo Colborn and the TEDX staff

Our funders Winslow Foundation, Arkansas Community Foundation, and Wallace Genetic Foundation

TEDX, Paonia, Colorado
tedx.org