DEPARTMENT OF HEALTH

Community Report

HEALTHY RURAL AND URBAN KIDS PROJECT

The Minnesota Department of Health (MDH) Biomonitoring program measures chemicals in people from Minnesota communities to provide information about their exposures to environmental chemicals that may harm health. Healthy Rural and Urban Kids is our first biomonitoring project focused on a broad range of chemicals in young children. The project responded to community concerns about exposures. It supports the MDH vision of health equity, where all communities are thriving, and all people have what they need to be healthy.

Children's developing bodies are especially vulnerable to chemicals that are found in our environment – in our air, water, soil, food, and consumer products. Kids living in rural areas may be exposed to different chemicals than kids living in urban areas. Using these comparisons is one way to help identify unusual exposures and opportunities to prevent chemicals getting into kids' bodies. Knowing more about how kids are exposed can inform programs and policies that reduce childhood exposures and create healthy neighborhoods and homes for kids.

While this project is relatively small, it led to new funding for MDH to expand this work and involve more kids and chemicals in a statewide approach.

Testing for chemicals in kids: Biomonitoring

- The Minnesota Biomonitoring program has been measuring chemicals in Minnesota communities since state legislation passed in 2007.
- We know that most kids have small amounts of many chemicals in their bodies.
- Finding chemicals in a child's urine or blood does not mean their health will be affected. For most chemicals, scientists are still studying what levels in a child's body may be unsafe.
- Biomonitoring helps us find out ways kids are coming into contact with chemicals and whether some groups of kids are more vulnerable to being exposed. With this information, we can work on reducing exposures to harmful chemicals in kids.

About the Healthy Rural and Urban Kids Project

The Healthy Rural and Urban Kids Project measured chemicals in preschool-aged children living in Minnesota rural and urban communities in the summer of 2018. Kids were from these areas:

- Neighborhoods in North Minneapolis with community concerns about air pollution and other environmental issues.
- Counties in North-Central Minnesota with community concerns about pesticides and chemicals in private well water.

We worked in these communities with exposure concerns because we do not have baseline information about Minnesota kids' exposures to chemicals to use for comparison. Comparing kids in these areas, along with looking at kids overall, can tell us about unusual exposures.

MDH partnered with Minneapolis Public Schools, Becker County Public Health, Todd County Health & Human Services, and Wadena County Public Health to offer participation to kids coming in for their routine Early Childhood Screening (ECS) visit. ECS is a required screening for all Minnesota kids before they enter kindergarten.

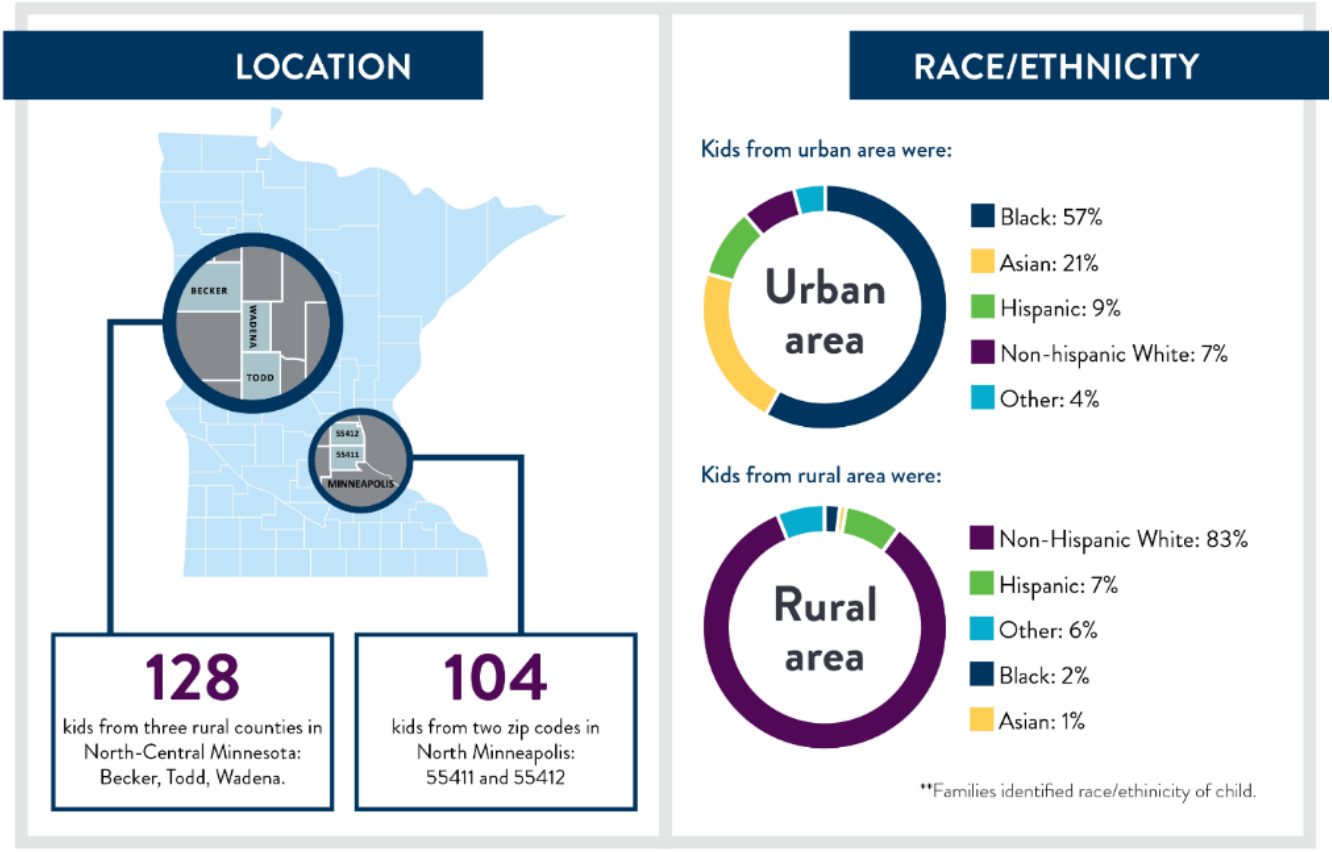
After learning about the program at their appointment, 232 families gave consent for their child to participate. Families completed a short survey[1] and then helped their child collect a urine sample. All kids' urine samples were analyzed for 21 different chemicals[2] that may harm development in kids or cause other health problems. These chemicals tell us about exposure to air pollution, metals, and pesticides. We chose them with guidance from our external scientific advisory panel and based on community concerns. This was the first time the MDH Public Health Laboratory measured many of these chemicals in people in our state. It helped us build capacity to do more of this work in the future.

Families received their child's individual results and information about ways to reduce exposure to the chemicals. Families whose kids had higher levels of certain chemicals received a phone call from a family physician to talk about results. All personal information collected is kept private and protected under Minnesota law.

[1] A copy of the survey can be found at our web site: https://www.health.state.mn.us/communities/environment/biomonitoring/projects/ruralurbankids.html.

[2] See the section below for more information on chemicals tested and Appendix A for acronyms.

Participants



More on the 232 participants

- Kids from rural area were more likely to be age 3. Kids from urban area were more likely to be age 4-6.
- Kids from rural area were more likely to live in households that earn more than $75,000 per year (38% of rural kids and 5% of urban kids in this group). Kids from urban area were more likely to live in households that earn less than$25,000 per year (47% of urban kids and 11% of rural kids).

Main take-aways

- The number of kids involved in Healthy Rural and Urban Kids was not large, but there were differences between kids from the urban and rural areas in levels of chemicals in their urine. We cannot fully explain these differences with information collected in the project, but the results provide evidence that is important to explore further.
  - Kids from the urban area had higher urine levels of air pollution chemicals compared to rural kids and the U.S. average in kids. For one of these chemicals (2NAP), we saw a link between using incense in the home and urine levels. Kids who drove with a smoker had higher urine levels of a different air pollution chemical (1PYR). These chemicals are part of a large class of chemicals made during combustion called PAHs.[3]
  - Kids from the rural area had higher urine levels of one pesticide (2,4-D) compared to urban kids but not the U.S. average in kids. We saw a link between living closer to corn and other types of agricultural fields and urine 2,4-D levels. 2,4-D is an herbicide used on agricultural crops and for lawn treatment.
- We also learned about potential ways Minnesota kids may be coming in contact with the chemicals. These results point to equity issues that are important to address. Chemical exposures differed between rural and urban kids, and within racial/ethnic groups.
  - Kids who ate rice frequently had urine arsenic levels that were twice as high as kids who did not eat rice. Asian kids were more likely to eat rice frequently and have higher urine arsenic levels.
  - Kids from the urban area whose family used a pesticide in the home recently had urine levels of one pesticide chemical (3PBA) that were three times as high as kids whose family did not use a home pesticide. 3PBA shows exposure to synthetic pyrethroid insecticides used in home pesticide sprays, bug bombs, mosquito sprays, and farming. Urban kids were more likely to rent their homes; they may live with inadequate home maintenance and not have control over use of pesticides in their homes.
  - The link between using incense in the home and higher urine levels of the air pollution chemical 2NAP has not been reported before to our knowledge. Black/African American kids were more likely to be around incense frequently and have higher urine 2NAP levels.
- These results tell us that exposures may be higher in some groups of Minnesota kids compared to others. They do not tell us what levels of exposure may impact a child's health. Seeing higher levels of chemicals in some kids' bodies helps us work with families and partners to learn more and find ways to prevent exposures.
- Measuring exposures from the environment is complicated and there are many factors involved. These are early findings for our state, and we need to do more work in this area.

[3] Polycyclic aromatic hydrocarbons. Read more: www.cdc.gov/biomonitoring/PAHs_FactSheet.html.

Chemicals tested in urine

The MDH Public Health Laboratory used standard laboratory methods to measure chemicals in urine. For two air pollution chemicals, the University of Washington did the lab analysis. For some chemicals, the main chemical itself was measured. For other chemicals, the body breaks down the main chemical into metabolites, so we measured metabolites instead. See Appendix A for full names and information on metabolites measured.

Metals

About	Metals measured	Children's health
• Found naturally in the environment and can be in water, some foods, and air. • Also used in industry, consumer products, and agriculture. • Some metals, like manganese and chromium, are essential nutrients at low levels.	• Arsenic • Chromium • Cobalt • Manganese • Nickel	• Health effects of concern in children and developing babies include learning and behavior problems, allergic reactions, damage to the heart and kidneys, and cancer.

Pesticides

About	Pesticides measured	Children's health
• Used to control insects, pathogens, weeds, or other pests. • Used to control pests on crops and inside the home, and treat lawns. • Residues found on some foods.	• Organophosphates: Metabolites TCPY, 4NP, IMPY • 2,4-D • Pyrethroids: Metabolites 3PBA, 4F3PBA, trans-DCCA • Mancozeb: Metabolite ETU • Carbaryl: Metabolite 1NAP	• Exposure to some pesticides may harm the nervous system, interfere with the body's natural hormone levels, or increase cancer risk. • Infants and children are often more sensitive to the harmful effects of pesticides than adults.

Air pollution chemicals

About	Air pollution chemicals measured	Children's health
• Many different chemicals are in air. Most of those we measured are from burning or combustion. • Outside sources are traffic, industrial facilities, fires/smoke, and diesel lawn equipment. • Inside sources are incense, cooking, and burning wood. • Tobacco smoke and some grilled or smoked foods can also have these chemicals.	• PAHs: Metabolites 1PYR, 1NAP, 2NAP, 2FLUO, 3FLUO, 3PHEN • 1-NP: Metabolites 6OHNP, 8OHNP	• Air pollution may cause heart and lung problems, and cancer. Effects on brain development are a growing concern. • It may be more harmful for kids because their lungs and organs are developing. • It may trigger asthma attacks in kids with asthma.

Learn more about these chemicals

- Find information on ways to reduce child exposures: health.mn.gov/healthykidsrpt.
- For more information, see the U.S. Centers for Disease Control and Prevention's Environmental Chemicals: www.cdc.gov/biomonitoring/environmental_chemicals.html.

What we found

General findings

- Chemicals were commonly found in kids in this project. Each of the 21 chemicals were detected in at least one child. The chemicals were generally at lower or similar levels than the U.S. average for kids in this age range, as measured by the U.S. National Health and Nutrition Examination Survey (NHANES).[4]
- There were two exceptions: Kids from the urban area had higher urine levels of two air pollution chemicals – 2NAP and 3PHEN – than the U.S. average. Kids from the rural area had levels similar to the U.S. average. These chemicals are part of a large class of chemicals created during combustion called PAHs.
- Compared to kids from the rural area, kids from the urban area had higher urine levels of three air pollution chemicals: 2NAP, 3PHEN, and 1PYR.
- Compared to kids from the urban area, kids from the rural area had higher urine levels of one pesticide: 2,4-D. 2,4-D is an herbicide commonly used in agriculture and home lawns.

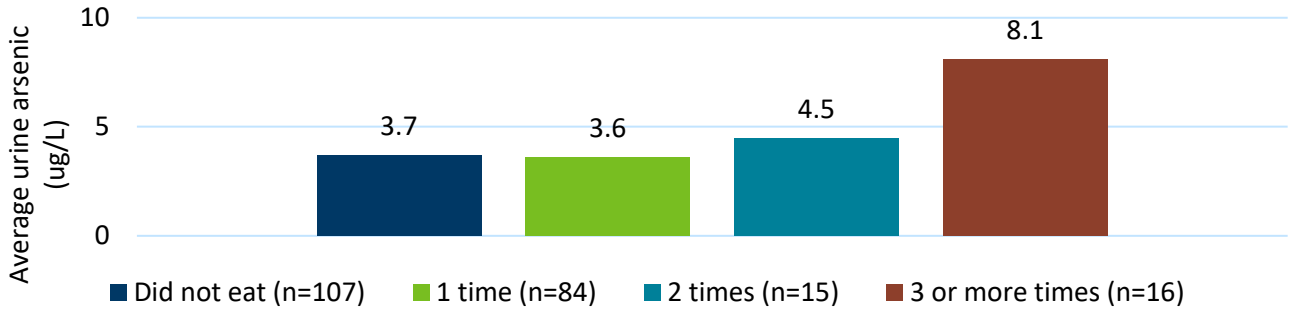
Eating rice frequently and arsenic levels

Rice is a healthy food that many families eat regularly, but sometimes rice can also contain arsenic. Kids from the urban area in our project were more likely to eat rice and eat it frequently. While 28% of rural kids reported eating rice in the three days before their survey, 50% of urban kids ate rice once per day and 29% ate rice two or more times per day.

Kids who ate rice three or more times per day had urine arsenic levels that were over twice as high as kids who did not eat rice (see Figure 1). Studies in other places have seen a similar link between eating rice and higher urine arsenic. We did not find links between other potential sources of arsenic exposure and children's urine levels.

[4] The most recent U.S averages are from 2015-16 for metals and 2013-14 for pesticides and air pollution chemicals.

Figure 1. Urine arsenic and times eating rice in last 3 days (all kids)*



* This excludes five kids who had high levels of a type of arsenic mainly found in seafood. This type is not a concern for health.

Asian children were more likely to eat rice frequently, and to have higher urine arsenic than other kids. Food is an important part of cultural identity and preservation. More needs to be done to ensure that all families have access to safe choices for foods they value.

Reducing arsenic exposure from rice

There are ways to decrease the amount of arsenic kids get from rice, including:

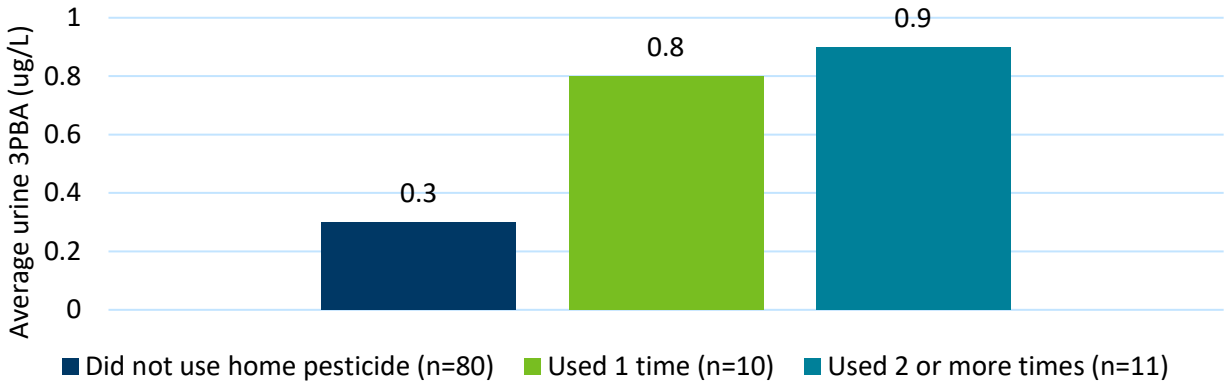
- Offer a variety of grains.
- Choose lower arsenic rice. Testing has found that rice grown in some places has lower arsenic because there is less arsenic in the soil and water: white basmati rice from California, India, and Pakistan, and sushi rice from the U.S.
- Rinse rice and cook it with extra water.
- Limit consumption of other rice products (like rice milk, brown rice syrup, and rice cereal).
- For more information, see Dartmouth's Arsenic in Rice and Rice Products: www.sites.dartmouth.edu/arsenicandyou/arsenic-in-rice-and-rice-products.

Using pesticides in the home

Pesticides are chemicals used to control insects, pathogens, weeds, or other pests. Twenty-three percent (23%) of kids from both the rural and urban areas had a pesticide used in their home in the last three months.

In kids from the urban area but not the rural area, the family's reported use of pesticides to control pests inside the home was linked with higher urine levels of the pesticide chemical 3PBA. Kids from the urban area whose families said they used home pesticides two or more times in the last three months had 3PBA urine levels that were three times as high as urban kids whose families did not use home pesticides (see Figure 2). 3PBA is a breakdown product of synthetic pyrethroid insecticides, including permethrin. Synthetic pyrethroids are the active ingredient in commonly used home pesticides including Raid®, Hot Shot®, and bug bombs.

Figure 2. Urine 3PBA and home pesticide use in last 3 months (urban kids)*



* This accounts for using pesticides for lawn treatment

There may be different reasons why we saw the link between pesticide use and urine 3PBA levels only in kids from the urban area. In this project, kids from the urban area were much more likely to live in a rental home than kids from the rural area: 66% of urban kids lived in rented homes compared to 25% of rural kids. Inadequate home maintenance may lead to leaks, cracks, or other conditions which result in more pests and pesticide use. Tenants have limited control over landlords' use of pesticides.

We looked at other ways kids may be exposed to pesticides. Kids whose families used lawn pesticides around their homes more than once in the last three months – 27% of rural kids and 11% of urban kids – did not have higher urine pesticide levels compared to those whose families did not use lawn pesticides. Survey reports of diet and drinking from private wells were also not linked with urine pesticide levels.

Dealing safely with pests in the home

- There are ways to make your home less welcome to pests and important steps to take if you use a pest control product. Follow the label carefully if you use a pesticide. Be sure to follow instructions for staying away from your home after it has been treated by a pest control company. Read more: health.mn.gov/healthykidsrpt.
- Contact your landlord or property manager to request repairs if your home has leaking plumbing or cracks that pests can use to come into your home. If you live in Minneapolis and have maintenance issues that your landlord is not fixing, you can call 311 or report online at Rental Unit Issues: www.minneapolismn.gov/report-an-issue/rental-unit-issue.
- If you think pesticides are being wrongly used on your property, you can file a complaint by calling the Minnesota Department of Agriculture at 651-201-6333.

Living near agricultural fields in the rural area

A wide variety of chemicals are used in agricultural production. We asked participants from the rural area about agricultural fields near their homes, and we also looked at maps of cropland and types of crops from the Minnesota Department of Agriculture.[5]

- Kids from the rural area whose families reported living within a quarter mile of a corn field (61% of rural kids) had higher levels of the herbicide 2,4-D in their urine than kids who did not.[6] 2,4-D is commonly used on many agricultural crops and for lawn treatment.
- Kids whose families reported living near corn or other agricultural fields did not have higher urine levels of the other pesticides measured. Kids who lived on any type of farm (25 kids) or whose parents worked in farming (15 kids) did not have higher urine pesticide levels.
- Having more total farm and corn acreage near a kid's home (within 500 meters or 1000 meters) was correlated with higher urine levels of 2,4-D.[7]
- Having more soybean acreage near a kid's home was correlated with higher urine levels of another pesticide, 3PBA. 3PBA is a breakdown product of synthetic pyrethroid insecticides. These insecticides are used on agricultural crops when there are pest infestations, as well as for home pest and mosquito control. We did not see this link when we looked at families' reports of living near soybean fields and urine 3PBA, but the number of kids who reported living near soybean fields was small (22 kids).

We measured one pesticide in urine that is commonly applied to potatoes and other foods: a breakdown product of the fungicide mancozeb called ETU. Mancozeb and other fungicides are aerially sprayed and ground-applied to control potato blight. In this project, we only had a small number of children who reported living near a potato field. The number of children who had ETU detected in their urine was also small, and it was detected in kids from the rural and urban areas. Even though this was an exposure of concern for some community members, we cannot make any conclusions about potential sources and exposure levels because of these small numbers. We would need to design a different type of study to better address this question.

[5] Cropland Data Layer 2018, Minnesota Department of Agriculture: gisdata.mn.gov/dataset/agri-cropland-data-layer-2018.

[6] This accounts for families' reported use of lawn treatment pesticides.

[7] Urine levels of 2,4-D were also associated with more soybean acreage near kids' homes, but 2,4-D-tolerant soybeans were not approved for use in 2018.

Reducing exposure to pesticides used on farms

- Children may be exposed to pesticides that drift from nearby farms or properties. Keep your child inside with windows closed if you know pesticides are being sprayed nearby. If you think your child has come into contact with pesticide drift, read more about steps to take: health.mn.gov/healthykidsrpt.
- Exposure can also happen from contacting pesticides on parents' work clothes and shoes. If you work with pesticides, change clothes, take work shoes off, and shower before being with your child. Read more about steps to take: health.mn.gov/healthykidsrpt.

Private wells and metals, pesticides

Drinking water from household wells that are cracked or old, or tapping into water with naturally-occurring high levels of metals, can be a source of exposure to metals and pesticides. Among kids from the rural area, 55% (70 kids) said they used private well water at home for drinking. These kids had similar levels of arsenic, manganese, and pesticides in their urine as rural kids on city water. In this group of kids from North-Central Minnesota, drinking well water is not a significant contributor to metals or pesticides measured in urine.

It is important to test well water

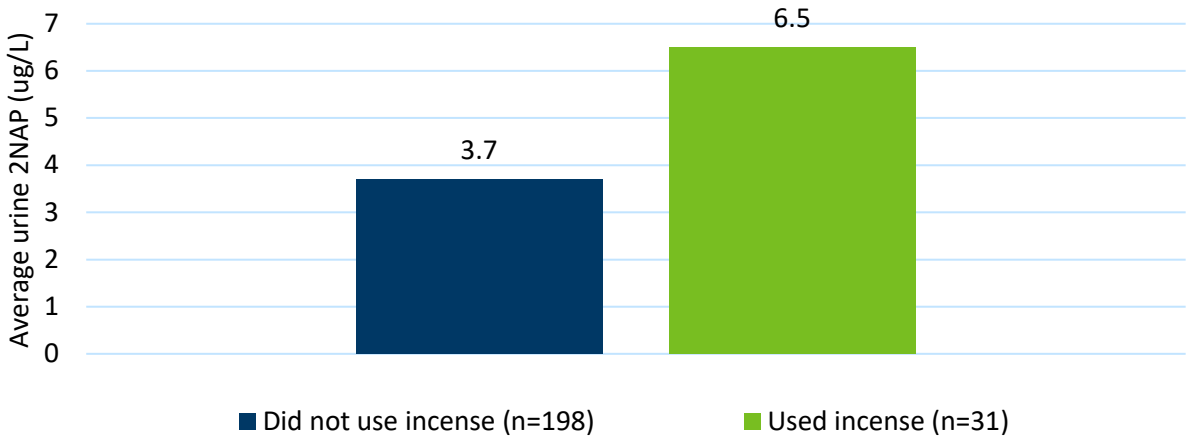
- MDH recommends testing well water for five contaminants, including manganese (before giving water to an infant) and arsenic. Learn more: health.mn.gov/wellwaterqlty.
- If you get your drinking water from a public water system, such as a city, your water is regularly tested and treated for arsenic and other metals to meet U.S. Environmental Protection Agency standards. Some public water systems also test for manganese, but they are not required to. You can contact your public water system to ask if they do.

Incense and air pollution chemicals

Air pollution can come from many sources both inside and outside the home. Most of the air pollution chemicals we measured result from burning or combustion. They tell us about exposure to different sources including traffic and industrial emissions, wood smoke, tobacco smoke, and grilled foods. One potential source our survey asked about was burning incense.

Kids from the urban area were more likely to use incense in their homes in the last 3 days: 23% of urban kids used incense compared to 6% of rural kids. Kids from households who reported using incense had urine levels of one air pollution chemical – 2NAP – that were almost two times higher than kids who did not report using incense (see Figure 3). 2NAP is part of a large class of chemicals created during combustion called PAHs. While we cannot say for certain where and how children were exposed, we were not able to find a link with other possible sources in this project, like burning candles, nearby traffic, smoking, or eating grilled foods.

Figure 3. Urine 2NAP and using incense in last 3 days (all kids)*



* This accounts for whether the kids lived in an urban or rural area

Children whose families identified them as Black or African American or chose the "other" category for race/ethnicity were more likely to report using incense in the home. In general, Black/African American kids had higher 2NAP urine levels than other groups. In this project, we were not able to disaggregate cultural groups from the larger Black/African American category. In future work, we will ask the question in a different way so that we can do this.

This is a new finding – we have not seen a link between urine 2NAP and using incense reported anywhere else. In our project, the number of kids using incense (31 kids) was not large. We need to follow up on this result with partners and communities to learn more about which groups may be more at risk for exposure, and how exposure can be reduced.

Reducing exposure from incense

- There are many types of incense, and they may be used for important cultural reasons. Some types may be safer to use, but we do not have that information yet.
- If you use incense inside, consider using good ventilation with fans or opening windows during or after use.

Driving with a smoker and air pollution chemicals

There is no safe level of exposure to secondhand smoke, which can be especially harmful to kids' developing cardiovascular systems. Nationally, around 40% of children aged 3-11 are exposed to secondhand smoke. A small percentage of kids in our project lived and drove with smokers. The percentage was slightly higher for kids from the urban area who drove with a smoker (10 kids, or 10%) compared to kids from the rural area (six kids, or 5%).

Kids who drove with someone who smoked had higher levels of the air pollution chemical 1PYR in their urine compared to those who did not.

Support for quitting smoking

- Get the right help you need to quit smoking for good. For free help, call 1-800-QUIT-NOW or visit www.quitpartnermn.com. Or talk to your doctor.
- If you smoke, smoke outside the home or car away from your child. Ask people not to smoke around your child.
- Local Minnesota communities are bringing cleaner, safer air to residents by working with local property managers to implement smoke-free housing policies. Find information about smoke-free housing options in Minnesota: www.mnsmokefreehousing.org.

Traffic, industry, and air pollution chemicals

Air pollution outside the home can come from multiple sources. Vehicle traffic and industrial facilities are two important sources, especially in Minneapolis and other urban areas. We asked about roadways near kids' homes, and we looked at air pollution data from the Minnesota Pollution Control Agency to explore outdoor levels of air pollutants near kids' homes.

We saw higher levels of three air pollution chemicals (2NAP, 3PHEN, and 1PYR) in urine from kids from the urban area compared to kids from the rural area. These chemicals are part of a large class of chemicals created during combustion called PAHs. In addition, air measurements taken during the project at one location in the urban area and one in the rural area showed that pollutants were quite a bit higher in the urban air than the rural air. The air pollutants naphthalene, phenanthrene, and pyrene, which break down into 2NAP, 3PHEN, and 1PYR in the body, were all 10 or more times higher in urban air compared to rural air.

The estimated amount of air pollution near a child's home was not linked with urine levels of 2NAP, 3PHEN, 1PYR, or other air pollution chemicals, in children from the urban or rural areas. Other survey information such as smoking or eating grilled foods also did not explain the differences between urban and rural kids' urine levels of air pollution chemicals. It is still important to note the differences in exposure. More work is needed to explore different types of air pollution chemicals in urine and how they relate to outdoor air pollution and sources. In particular, household or neighborhood-specific information about outdoor air pollution levels could provide more information for future projects.

Reducing exposure to air pollution

- Find out more about air quality in your area and sign up to get air quality alerts: www.pca.state.mn.us/air/current-air-quality. During an air quality alert, limit your child's outside time and close windows. This is especially important if your child has asthma. Learn more about this and other asthma triggers: health.mn.gov/asthmatriggers.
- Find pollution sources in your neighborhood: www.pca.state.mn.us/data/whats-my-neighborhood. For North Minneapolis, the state has special air monitoring. Learn more and sign up for updates: www.pca.state.mn.us/air/north-minneapolis-air-monitoring-project.

- In Minneapolis, it is illegal to idle cars for more than three minutes and buses/trucks for more than five minutes unless you're sitting in traffic or a bus needs to keep people warm. Learn more: www.pca.state.mn.us/featured/no-idling-please-young-lungs-work.
- If you have an air pollution or environmental complaint, you can call 311 in Minneapolis or submit a complaint form in other areas: www.pca.state.mn.us/air/have-complaint.

Limitations of this project

- Kids in this project from the urban and rural areas, while they were enrolled in the same way through Early Childhood Screening programs, reflect slightly different populations. In the urban area, kids were from two zip codes in North Minneapolis. In the rural area, kids were from a larger region of three North-Central Minnesota counties (Becker, Todd, and Wadena). It is useful to compare the two groups, but it is not a perfect comparison.
- Measuring environmental exposures is complicated – there are many ways kids come into contact with chemicals and chemicals get into their bodies. Biomonitoring is one way to look at these questions, but it may not provide the full picture.
- The chemicals measured in urine in this project do not last a long time in the body and reflect only more recent exposure. These results do not capture exposures kids had in the past or necessarily represent ongoing exposures.

How we are using what we learned and next steps

- Our first commitment in this project is to the families and children who participated. We prioritized sharing results for individual kids first: we called families whose children had higher levels of certain chemicals and mailed families full results for their child. Now that we have the summary results presented in this report, we are working with our partners to share them widely with families, communities, health agencies, and policymakers. These groups can use the findings in different ways to inform household, community, or systems-level action to prevent exposures in children.
- We are expanding this work into a larger statewide program called Healthy Kids Minnesota. Our experience from Healthy Rural and Urban Kids allowed us to get additional funding for the new program that will move systematically to all areas of the state over a five-year period and include more kids and types of chemicals. We will be able to follow up on and further explore the important findings from Healthy Rural and Urban Kids.
- This was a small project, but we still saw differences in chemical exposures between rural and urban kids, and within racial/ethnic groups. As we build and expand this program for all Minnesota families, we will be intentional in our partnerships and recruitment strategies to ensure that the program is accessible to all and the results can shed more light on possible inequities and ways to address them.
- Ultimately, results from this project and the expanded program it made possible will help us take action and shape programs to protect children from exposure to environmental chemicals that may harm development and have other impacts on child health.

Appendix A: Details on metabolites measured

Chemical short name	Chemical long name	Parent chemical
TCPY	3,5,6-trichloro-2-pyridinol	Chlorpyrifos (pesticide)
4NP	4-nitrophenol	Parathion, methyl parathion (pesticides)
IMPY	2-isopropyl-4-methyl-6-hydroxypyrimidine	Diazinon (pesticide)
3PBA	3-phenoxybenzoic acid	Several pyrethroids including deltamethrin, permethrin (pesticides)
4F3PBA	4-fluoro-3-phenoxybenzoic acid	Cyfluthrin (pesticide)
TransDCCA	Trans-3-(2,2-dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid	Cypermethrin, cyfluthrin, and permethrin (pesticides)
1PYR	1-hydroxypyrene	Pyrene (PAH)
1NAP	1-hydroxynapthalene	Carbaryl (pesticide), naphthalene (PAH)
2NAP	2-hydroxynapthalene	Naphthalene (PAH)
2FLOU, 3FLOU	2- and 3-hydroxyfluorene	Fluorene (PAH)
3PHEN	3-hydroxyphenanthrene	Phenanthrene (PAH)
6-OHNP, 8-OHNP*	6- and 8-hydroxy-1-nitropyrene	1-nitropyrene (1-NP)

* Laboratory analysis done by the University of Washington

Minnesota Department of Health
PO Box 64975
St. Paul, MN 55164-0975
1-800-205-4987
health.biomonitoring@state.mn.us
www.health.state.mn.us/biomonitoring

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