THE HEALTH OF LINN COUNTY, IOWA
A COUNTYWIDE ASSESSMENT OF HEALTH STATUS AND HEALTH RISKS

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Public Health
Prevent. Promote. Protect.

Linn County, Iowa
Chapter 9 Environmental Health

Introduction
The environment, in which we live, plays a significant role in our health. By improving certain environmental factors, public health can prevent many diseases and other health issues. Environmental factors may include the quality of the water and food consumed, air breathed, or the presence of external contaminants. Drinking water quality and food safety are important for reducing water- and food-borne illnesses, as well as other conditions, such as blue baby syndrome (methemoglobinemia). Outdoor and indoor air quality can affect the prevalence and incidence of chronic diseases such as heart disease, respiratory diseases, and cancer. Additionally, lead poisoning may affect the mental and physical development among children and lead to vital organ failure among both children and adults. Overall, these environmental factors contribute to the development or mitigation of many other types of health issues.

Chapter 9 describes environmental health in terms of drinking water quality, food safety, outdoor air quality, and indoor air quality.

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Drinking Water Quality

Violations and Advisories

**Linn County 2020 Goal**
Increase the proportion of persons served by community water systems who receive a supply of drinking water that meets the regulations of the safe drinking water act to 100%.

**Trends**
In 2016, 99.9% of Linn County residents who received drinking water from a public water system received it from a system without a health-based violation in the year. Public water systems with violations served 999 residents. This percentage is an improvement from 2015 with only 82.3% of the Linn County population served by a safe drinking water source. During this time, 35,842 residents were impacted by a health-based violation, with one of the seven public water suppliers with a health-based violation serving approximately 35,005 residents. The systems with violations in 2016 account for 95.6% of the public water systems in Linn County, similar to that of Iowa with 95.4% (Figure 9.1). Overtime, the percentage of public water systems that have health-based violations have decreased in Linn County and Iowa. Health-based violations tend to occur among very small and small public water systems serving 25 to 500 individuals and 501 to 3,300 individuals, respectively (Figure 9.2).

**Figure 9.1 Percent of public water systems that met the safe drinking water standards, Linn County and Iowa, 2010-2016**

![Chart showing percent compliance of water systems in Linn County and Iowa from 2010 to 2016.]

**Source:** Iowa DNR; EPA Envirofacts, SDWIS

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Figure 9.2 Health-Based Violations in small and very small public water supplies, Linn County, 2010-2016

Source: Iowa DNR; EPA Envirofacts, SDWIS

Risk and Protective Factors
Risk factors for not receiving safe drinking water year round include receiving water from wells located in areas with Karst features, where groundwater may be more vulnerable to contamination. Areas with easily dissolved bedrock near the ground surface said to have Karst features. Providing well owners with easy access to water testing may help to decrease the population receiving drinking water that does not meet the Safe Drinking Water Standards. Through the Grants to Counties programs public health agencies are able to assist a limited number of private well owners with well testing, plugging, and renovation.

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64 Center for Health Effects of Environmental Contamination. University of Iowa. *Iowa Statewide Rural Well Water Survey Phase 2 (SWRL2): Results and Analysis.* s.l.: Watershed Monitoring and Assessment Section. Iowa Department of Natural Resources, 2013.
Food Safety

Food Establishments

Linn County 2020 Goal
Improve food safety practices related to foodborne illness in food retail establishments and foodservice.

Trends
Food establishments are routinely inspected on 30 different criteria, categorized into five violation types including approved source (AS), facilities have adequate equipment and tools (FAE), good hygienic practices (GHP), proper cooling (PC), and toxic materials identified, used, and stored properly (TMI). The leading violation type between 2014 and 2017 was FAE (Figure 9.3). In 2017, 30% of routine inspections had a violation due to FAE, followed by 16% with TMI, 7% due to PC, 6% due to AS, and 3% due to GHP. Within the criteria types, the seven leading criteria violations were due to uncleaned food surfaces, proper date marking of foods, supplied and accessible hand washing stations, procedures related to vomiting and diarrheal events, related to warewashing, proper cold hold temperatures, and employee knowledge of food regulations (Figure 9.34).

Figure 9.3 Routine Food Establishment* inspections by violation category, Linn County, 2014-2017

Source: Linn County Public Health, USA Food Safety Dashboard
*Fixed sites only, does not include mobile or temporary sites.
### Risk and Protective Factors

In accordance with the 2013 Iowa Food Code, Linn County Public Health inspects all food establishments in the Linn County area. All food service establishments that sell or serve food to the public must obtain a license and comply with the 2013 FDA Food Code. To assure compliance with these food safety regulations, Linn County Public Health inspects a majority of facilities twice a year as well as inspects temporary and mobile units. Risk factors for compromised food safety identified by the 2013 FDA Food Code include incorrect cooking procedure, reheating, cooling, and hand washing. Failure to comply with food safety regulations may result in increased illness particularly among high-risk populations. High-risk groups may include those with a weakened immune system such as children under the age of 5 years, the elderly, and those with compromised immune systems due to illness or disease.

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**Figure 9.4 Percent of Food Establishments* by criteria violation, Linn County, 2017**

![Bar chart showing percent of food establishments by criteria violation]

*Fixed sites only, does not include mobile or temporary sites.*

Source: Linn County Public Health, USA Food Safety Dashboard
Outdoor Ambient Air Quality

**Linn County 2020 Goal**

Continue the downward trend of PM$_{2.5}$ ambient air concentrations in Linn County. Also, to maintain or reduce the number of days the Air Quality Index exceeds 100 to 1 or less. The 2010 to 2012 three-year average was 0.67 days.

**Trends**

In 2017, the number of days the Air Quality Index exceeded 100 in Linn County was zero, a decrease from 2007-2010 (Figure 9.5). From 2007 to 2017 the number of days ‘unhealthy for sensitive groups’ decreased by 18 days. Additionally, the number of ‘good’ air quality days increased by 42 days.

**Figure 9.5 Air Quality Index, Linn County, Iowa 2007-2017**

![Air Quality Index Chart]

*Source: EPA, Air Quality Summary Report*

*Data collection was not as reliable and some point sources went offline due to the 2009 flood.*

The 3-year average of concentration in ambient air of fine particulate matter (PM$_{2.5}$) in 2015-2017 was 20 µg/m³, the lowest it has been over the 2008-2017 study period.
Figure 9.6). Overtime this value has decreased from 31 μg/m³ in 2008-2010. Linn County’s value continues to fall below the National EPA standard for fine particulate matter of 35μg/m³. However, concentration of ozone in the ambient air has remained stable, also continuing to fall below the EPA standard of 75 parts per billion (ppb) with 61 ppb in 2015-2017 (Figure 9.7).
In 2014, the largest overall source of pollution was due to mobile vehicles (51.5%) including aircrafts, trains, vehicles, and on and off-road equipment (Figure 9.8). The other leading sources of pollutants were from fuel combustion (20.8%), other types like waste disposal and gas stations, and Industrial Processes (5.8%). However, when broken out by pollutant, the largest contributing sector varied depending on the pollutant (Figure 9.9, Figure 9.10, Figure 9.11, In
2014, the largest source of pollution for nitrogen oxides (NOx) was the Mobile sector (51.1%), followed by Fuel Combustion (41.3%) and Other (4.6%).

Figure 9.12, Figure 9.13, and Figure 9.14).

**Figure 9.8 Totals of criteria pollutants by sector, Linn County, Iowa 2014**

Source: EPA, 2014 National Emissions Inventory

In 2014, the largest source of pollution for fine particulate matter (PM$_{2.5}$) was the Fuel Combustion sector (23.4%), followed by Agriculture (20.8%), and Industrial Processes (19.7%).

**Figure 9.9 Fine particulate matter (PM$_{2.5}$) pollution by sector, Linn County, Iowa 2014**

Source: EPA, 2014 National Emissions Inventory
In 2014, the largest source of pollution for particulate matter (PM$_{10}$) was the Agriculture sector (38.5%), followed by Dust (25.8%) and Industrial Processes (12.6%).

Figure 9.10 Particulate matter (PM$_{10}$) pollution by sector, Linn County, Iowa 2014

Source: EPA, 2014 National Emissions Inventory

In 2014, the largest source of pollution for volatile organic compounds (VOCs) was the “Other” sector (32.2%), followed by Mobile (24.9%) and Solvents (20.5%).

Figure 9.11 Volatile Organic Compound (VOC) pollution by sector, Linn County, Iowa 2014

Source: EPA, 2014 National Emissions Inventory
In 2014, the largest source of pollution for nitrogen oxides (NO\textsubscript{x}) was the Mobile sector (51.1%), followed by Fuel Combustion (41.3%) and Other (4.6%).

**Figure 9.12 Nitrogen Oxides (NO\textsubscript{x}) pollution by sector, Linn County, Iowa 2014**

Source: EPA, 2014 National Emissions Inventory

In 2014, the largest source of pollution for sulfur dioxide (SO\textsubscript{2}) was the Fuel Combustion sector (93.7%), followed by Industrial Processes (5.3%).

**Figure 9.13 Sulfur Dioxide (SO\textsubscript{2}) pollution by sector, Linn County, Iowa 2014**

Source: EPA, 2014 National Emissions Inventory
In 2014, the largest source of pollution for carbon monoxide (CO) was the Mobile sector (80.2%), followed by Fuel Combustion (8.1%), and Other (6.7%).

**Figure 9.14 Carbon Monoxide (CO) pollution by sector, Linn County, Iowa 2014**

Disparities

Adverse health effects such as cancer, asthma, heart disease, respiratory illnesses, and even death have been linked to air pollution. People with lung diseases, cardiovascular disease, and diabetes, as well as children, are more vulnerable to the negative effects of air pollutants. Additionally, adults who exercise or work outside are at an increased risk for adverse health effects from air pollutants. In 2012, it is estimated 9 deaths could have been prevented by lowering PM$_{2.5}$ levels by 10% (Figure 9.15) in Linn County. This is equivalent to a 0.6% decrease in Linn County’s death rate.

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Figure 9.15 Total deaths that would have been avoided by reducing levels of PM$_{2.5}$ by 10%

Source: CDC, Environmental Public Health Tracking Network; Iowa Department of Public Health, Bureau of Vital Statistic; U.S. Census Bureau, 2000, 2010

Risk and Protective Factors
Groups at greatest risk for experiencing health effects from pollution include children, older adults, and people with asthma, chronic obstructive pulmonary disease (COPD), or heart disease. Public health and environmental agencies release information on the current Air Quality Index (AQI) allowing residents to decide if they should exercise outside on specific days. Federal, state, and local laws govern air pollution. Through the application of these laws, regulated entities are required to comply or face enforcement action, including monetary penalties. Compliance inspectors conduct unannounced inspections at major sources.
Indoor Air Quality
Many air pollutants are known to be in higher concentration indoors than outdoors. Linn County residents spend on average 90% of their time indoors.\textsuperscript{66} Therefore, longer exposure and higher concentrations have both short- and long-term health consequences. Through combustion sources like heating and cooking appliances, fireplaces, and tobacco can release fine particulate matter and carbon monoxide. Additionally, volatile organic compounds (VOCs) are let off into indoor air from paints, cleaning supplies, new carpets and other commonly used products. Radon also enters buildings from cracks in the foundation, sump pumps and other areas, and may be found in concentrations above the EPA action level. Finally, nitrogen oxides, sulfur oxides, and biological contaminants can enter buildings from the outside through open windows and doors, ventilation units, and soils brought in on shoes and clothing. As with outdoor air pollutants, children, older adults, and people with respiratory diseases or heart disease are more at risk for health problems from these indoor air contaminants and these people often spend more time indoors. Biological contaminants may also arise from within the home.\textsuperscript{65} Moreover, 9% of public schools report that indoor air quality interferes with instruction to a moderate or major extent in permanent buildings and 12% in portable buildings.\textsuperscript{67}
Radon

Linn County 2020 Goal
Prevent radon induced lung cancer through promotion of radon testing, radon mitigation, and radon resistant building practices in Linn County.

Trends
From 2013-2017, there were 2,013 short term test kits submitted for analysis in Linn County. Of those who tested, 70% had radon levels below the EPA action level of 4 picocuries/liter (pCi/L) (Figure 9.16).

Figure 9.16 Radon levels of test kits from homes in Linn County, 2013-2017

Source: IDPH, Bureau of Radiological Health, Radon Program
*Homes may have been tested more than once from 2013-2017

Disparities
Radon is a radioactive gas that enters buildings though cracks and holes in the foundation. In Linn County, all buildings are at risk for having levels of radon above the EPA action level. People spend more than 50% of their time in their homes and long term exposure to radon can lead to lung cancer. Smokers who are exposed to radon have a higher risk of developing lung cancer. In 2013, Linn County Public Health (LCPH) conducted a study of 100 homes that were constructed within the last 5 years. From this study it was determined that homes with an open sump pit tended to have higher levels of radon and 48% of homes without a radon mitigation system had levels above the EPA action level of 4 pCi/L (Figure 9.17).
Figure 9.17 Average radon levels (pCi/L) by type of radon mitigation system and sump pit, Linn County, January-April 2013

Risk and Protective Factors

All Linn County residents are at risk for having indoor levels of radon higher than 4.0pCi/L. Testing is the only way to know what level one is exposed to in their home. LCPH provides access to affordable do it yourself radon test kits and the technical support and expertise to the general public on testing procedures and recommended follow up steps. Also, LCPH has assisted testing 8 school buildings for radon and has a program in place to test additional school buildings through 2016. Finally, in unincorporated Linn County all new single-family residential homes are required to be built with radon resistant new construction features.
Lead

Linn County 2020 Goal
Reduce the percentage of children with confirmed elevated blood lead screenings to less than 0.5%.

Trends
Of the Linn County children born in 2013 (birth cohort) who were screened for blood lead, approximately 0.42% had confirmed elevated blood lead levels (Figure 9.18). This was an 89.9% decrease from the 2000 birth cohort where 2.32% of children had confirmed elevated blood lead levels. Overtime, screening rates in Linn County have increased. However, despite the state requirement that all children in Iowa be tested for lead in their blood at least once before the age of 6 years, the screening rates are not perfect. Among the children born in 2010, 93.6% were screened for blood lead before the age of 6 years (}
Figure 9.19). This is an increase from 70.4% of children born in 2000 having been screened.

Figure 9.18 Children screened that had confirmed Elevated Blood Lead Levels, Linn County and Iowa, 2002-2006 Birth Cohorts

Source: Iowa Environmental Public Health Tracking Network
Disparities

There are several ways that individuals may be exposed to lead in their daily lives; however, exposure to lead-based paint is the most common as well as dangerous source for high-dose exposure for young children. Families who reside in houses built prior to 1978 are at an increased risk for unintentional exposure to lead due to chipping or poorly maintained lead-based paint within the home. A large percentage of homes in Linn County and Cedar Rapids were built prior to 1978. Within Linn County, 60.9% of all homes were built before 1978, and 29.7% of homes were built before 1950 (Figure 9.20). Approximately 66% of the housing stock in Cedar Rapids alone were built before 1978, with 30% built before 1950 (Figure 9.21).

**Figure 9.20** Percent of homes built prior to 1978 and 1950, Linn County overall

*Source: Linn County Assessor’s Office; Cedar Rapids Assessor’s Office*
Figure 9.21 Percent of homes built prior to 1978 and 1950, Linn County and Cedar Rapids

Source: Linn County Assessor’s Office; Cedar Rapids Assessor’s Office

**Geographical Variation**

Certain regions in Linn County have a greater density of children with elevated blood lead levels (Figure 9.22). The greatest concentration of unconfirmed blood lead tests in 2016 was near the heart of downtown Cedar Rapids in census tracts 12, 22, and 27. This area tends to have a higher concentration of older homes compared to other areas in the city.
Figure 9.22 Unconfirmed Blood Lead Level in Children 0-6 years, Linn County 2016

Rate of Unconfirmed Tests (>=5) per 1,000 population

Source: Linn County Public Health, Healthy Homes
Risk and Protective Factors

Children living in homes with lead paint that is chipping or otherwise in disrepair are at greater risk for elevated blood lead levels. Additionally, residents working around products containing lead may also be at risk for elevated blood lead levels. Properties with lead hazards violations are regulated at the local level where children with an elevated blood lead level have been identified. This helps to ensure lead safe work practices during lead remediation of these homes. Moreover, Childhood Lead Poisoning Prevention programming funds are received from the Iowa Department of Public Health to screen and perform medical and environmental case management on children less than six years of age. Finally, Linn County Public Health and the City of Cedar Rapids through partnership received a Lead Hazard Control Grant to assist applicants whose properties were built prior to 1978 and have children under the age of six years to identify and eliminate lead based paint hazards on their property.
Severe Housing Problems

Linn County 2020 Goal
Decrease the proportion of housing in Linn County that has severe housing problems from 10% to 8%.

Trends
In 2010-2014, 11% of Linn County households had severe housing problems defined as one or more of the following: overcrowding, high housing costs, and no kitchen or plumbing facilities.

Disparities
Throughout the United States, severe housing problems tend to be concentrated in low-income neighborhoods. Competition for affordable housing both nationally and locally has increased with many homeowners transitioning to renters, and those with higher incomes looking for affordable housing. Some of the issues related to housing challenges in Iowa include discrimination, fear of reporting housing issues, accessibility of the available housing stock, and cost-burden of housing. In Iowa, some property owners still discriminate against and take advantage of individuals who do not understand the Fair Housing Laws well enough. Undocumented individuals may also be afraid to complain to their property owners for fear of repercussion. Disabled individuals often find it difficult to obtain affordable housing that meets their accessibility needs. Finally, while individuals living in urban areas tend to be more cost burdened, those living in rural areas tend to have more problems with finding housing.

Geographical Variation
Figure 9.24 illustrates the concentration of total cost-burdened households throughout Linn County, with the largest concentration located in the downtown Cedar Rapids area.

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Figure 9.24. Cost burdened households in Linn County, 2015

Source: American Community Survey 5-yr estimates 2011-2015
Risk and Protective Factors
Throughout Iowa and the United States, low income and disabled individuals are more likely to have severe housing issues. However, building codes, increasing the affordable housing stock, better lending practices, and enforcing fair housing policies can help to alleviate these issues. Additionally, LCPH has programming to assist with property maintenance inspection and enforcement for nuisance complaints in unincorporated Linn County. LCPH also works with residents that have respiratory health issues to identify issues within the home, especially indoor air quality issues. During these sessions, LCPH teaches residents about the seven principles of a healthy home to help decrease severe housing problems and improve indoor air. These principles include keeping a home maintained, pest free, clean, dry, safe, ventilated, and contaminant free. Through promotion of these principles and integrated pest management principles on the Healthy Homes website and in classes with health care providers LCPH educates residents on ways to better maintain their homes and to improve their indoor air quality. Finally, LCPH works with landlords to help them offer smoke-free housing and decrease the amount of environmental tobacco smoke residents are exposed to.
Summary
Drinking water has and continues to meet the Safe Drinking Water Standards at a rate higher than the Healthy People 2020 goal. However, smaller public water supplies serving less than 500 individuals continue to account for a high percentage of health-based violations each year. Likewise, individuals served by private wells are at an increased risk for contamination if they do not regularly test their systems. Food is another source of potential contamination if proper food handling, maintaining, and facility cleaning is not practiced. The most common finding during routine inspection of Linn County food establishments is uncleaned surfaces for food preparation. This increases opportunity for cross-contamination of foods served to the public and food borne illnesses.

The outdoor air quality in Linn County has improved significantly over time with 79% of 2017 being “good” air quality days as indicated by the Air Quality Index. With the improvement in the AQI, there has also been a decrease in the Ambient Air Concentration of PM$_{2.5}$ over time. Currently, the largest overall source of pollution was due to mobile vehicles (51.5%) including aircrafts, trains, vehicles, and on and off-road equipment. Conversely, testing of the indoor air quality related to radon continues to demonstrate elevated levels with 30% of Linn County homes tested having a test result above the EPA action level. With an increase in the number of children tested for blood lead increasing, the percent of children with a confirmed elevated blood lead has decreased. However, there were a higher concentration of lead poisoned children in parts of Linn County, which is reflective of the age and condition of housing in that area. Finally, severe housing problems affect 11% of Linn County residents, and throughout Iowa severe housing problems affect low-income residents the most.