Research Summary: Childhood Lead Exposure Trends Explain International Property and Violent Crime Trends, and Differences in USA City Murder Rates

New research by Rick Nevin, an economic consultant and National Center for Healthy Housing senior advisor, shows that trends in childhood lead exposure explain crime rate trends over several decades in the USA, Britain, Canada, France, Australia, Finland, Italy, West Germany, and New Zealand. In an earlier study, Nevin found that 1941-1975 gasoline lead use explained 90% of the 1964-1998 variation in the USA violent crime rate, and paint lead trends from 1879-1938 explained a 10-fold rise and subsequent fall in the USA murder rate from 1900-1959. His new study reveals a similarly stunning relationship between lead exposure trends and USA burglary and index crime rates (mostly property crime), and shows the same relationship between lead exposure and crime in other nations with very different lead exposure and crime trends. This study also shows how lead exposure trends explain subtle shifts in the peak age of offending over time. Analysis of USA city murder rates also shows that murder is especially associated with more severe childhood lead poisoning, which was more common in the USA due to exposure to lead in paint and in gasoline.

Background on Lead Exposure Trends

Lead in paint and gasoline contaminate household dust and that dust is ingested by children as they crawl and engage in normal hand-to-mouth activity. Ingested lead travels through the bloodstream to the developing brain, where elevated blood lead causes many neurological effects that can impair IQ, learning, and behavior later in life. USA use of lead in paint peaked in the first half of the 20th century and was finally banned in 1978, but lead paint is still present in 38 million USA homes. Per capita use of lead in gasoline surged in the USA after World War II and rose at a slower rate in nations with lower per capita gasoline use.

Children exposed to lead in paint and gasoline had greater risk of severe lead poisoning because lead ingestion is additive. Lead used in paint accounted for almost a third of all USA lead output from 1900-1914, when the USA produced over 40% of world lead output. The USA also accounted for most of the global use of lead in gasoline before 1970. The high USA use of lead in early-1900s paint caused severe USA lead paint hazards throughout the 20th Century and to this day. This was aggravated by the high USA use of lead in gasoline from the 1940s through the 1970s. USA and Canadian gas lead use fell sharply from 1975-1985, but gas lead use in most other industrial nations was near its peak through the mid-1980s.

Key Findings from Nevin (2007) Study

Preschool Blood Lead and International Crime Trends

A statistical analysis shows preschool blood lead is highly significant in explaining crime trends, with time lags consistent with neurobehavioral damage in the first year of life and peak offending ages for each crime category (see attached graphs of preschool blood lead versus crime rate trends). Burglary and other property crime arrests peak at ages 15-20, and the best statistical-fit time lag for burglary is 18 years across all nations studied, and 16-19 years in separate analyses for the USA, Canada, Britain, France, Finland, West Germany, and New Zealand. Aggravated assault peaks from age 18 through the late-20s, and the best-fit is 22-24 years for aggravated assault in the USA

and Britain and for violent and sexual assault in Canada and New Zealand. Robbery arrests peak from age 15 to the mid-20s, and the best-fit lag is 20-21 years in separate analyses for the USA, Canada, West Germany, and New Zealand. The best fit lag for index crime is 18-21 years in the USA, Britain, Canada, Italy, Finland, and New Zealand.

Although time series comparisons can result in coincidental correlations, no nation shows any statistically significant correlation between burglary and blood lead with a lag of less than 10 years. No nation shows any significant relationship between robbery and blood lead with a lag of less than 11 years, between aggravated assault and blood lead with a lag of less than 14 years, or between rape and blood lead with a lag of less than 13 years. The significance of blood lead at lags consistent with peak offending ages is especially striking in light of divergent crime trends. Canada's index crime rate was 60% higher than the rate in Britain in the early-1970s, but 20% lower in 2001. The USA index crime rate was 22% higher than the French rate and 41% higher than Australia's rate in 1980, but the USA rate was 40% lower than the French rate and 41% lower than Australia's rate in 2002. The 1974 USA burglary rate was 50% and 98% higher than rates in Britain and Australia, but the 2002 USA rate was 56% and 63% lower than rates in Britain and Australia. The Canadian robbery rate was five times the rate in Britain in 1962, but the 2002 Canadian rate was less than half the rate in Britain. All these trends mirror exposure to lead within each nation over many decades.

Arrest rate shifts

Age-14 British males had the highest index crime arrest rates in 1958, but peak offending shifted to age 18 by 1997. Males ages 12-14 in 1958, born as gas lead use rose after World War II, had higher offending rates than older teens born before that rise in lead exposure. By 1997, offending fell relative to 1958 only for males under 14, born after the mid-1980s fall in British gas lead use, while offending rates rose for older teens and adults born over years of rising gasoline lead use.

After USA per capita gas lead use increased 400% from 1945-55, the California juvenile index crime arrest rate surged almost 300% from 1965 to 1975. Those trends reversed in the 1990s when arrest rates fell faster for juveniles, born after USA air lead peaked in the early-1970s. In 1975, California's juvenile index crime arrest rate was twice the adult rate, but 2000-2004 index crime arrest rates were higher for adults

The USA property crime arrest rate for youths under age 15 fell 45% from 1970-2003, as the arrest rate for adults over 24 rose 58%. The 45% drop in the under-15 arrest rate compares 1970 juveniles born near a 1956 interim peak in USA gas lead versus 2003 juveniles born after the early-1980s fall in gas lead. The 58% increase in the over-24 arrest rate compares 1970 adults mostly born before the 1950s rise in gas lead versus their 2003 counterparts born before the 1980s decline in gas lead.

Cross-Sectional Analysis of 1985-1994 USA City Murder Rates

It is well known that 1980-1994 USA murder rates mainly reflected trends in large cities, but air lead trends by city size, due to lead emissions from traffic, explain why the largest USA cities had such high murder rates. Cities with population over a million had 1960s air lead about twice the level in cities of 250,000 to a million, which had air lead 40% higher than cities of 100-250 thousand. Average 1985-1994 murder rates in cities over a million were then 57% higher than in cities of 250,000 to a million, which had average 1985-1994 murder rates 40% higher than cities of 100-250 thousand. The 1980s phase-out of USA gas lead left little air lead difference by city size, and there was little city size variation in 2000-2004 murder rates.

Paint lead also contributes to both air and lead dust through paint deterioration, paint scraping and sanding, demolition and other activities that generate dust from lead paint. Nevin shows that city differences in circa-1970 childhood lead paint poisoning, and the additive effects of paint lead and gas lead exposure, also explain much of the variation in 1980-1994 city murder rates.

Abortion, Crime, and Lead Exposure Trends

The Nevin study also challenges the controversial theory linking the 1990s USA crime decline to the early-1970s abortion of "unwanted" children, presumed more likely to engage in crime as juveniles and adults. USA preschool blood lead peaked in the early-1970s, and blood lead trends can explain earlier USA and international crime trends. Britain legalized abortion before the USA, but violent crime soared in Britain in the 1990s, consistent with the lead-crime relationship but contradicting the abortion-crime theory. Early abortion legalization has been credited with early crime declines in New York and California, but state-wide legalization did not presage an early state-wide New York crime decline: That early decline was evident only in New York City where there was an early pronounced decline in lead poisoning. California also limited gas lead per liter to 0.26 g in 1977 and 0.18 g in 1978, before a national limit of 0.29 g in 1983. California per capita (leaded) gasoline use was also 30% higher than the rest of the USA in 1950, 20% higher over the 1950s, and 10% higher in the 1960s. California's violent crime rate was then 40% higher than the rest of the USA from 1960–1990, and its burglary rate was 75% higher in the 1960s, 55% higher in the 1970s, and 27% higher in the 1980s.

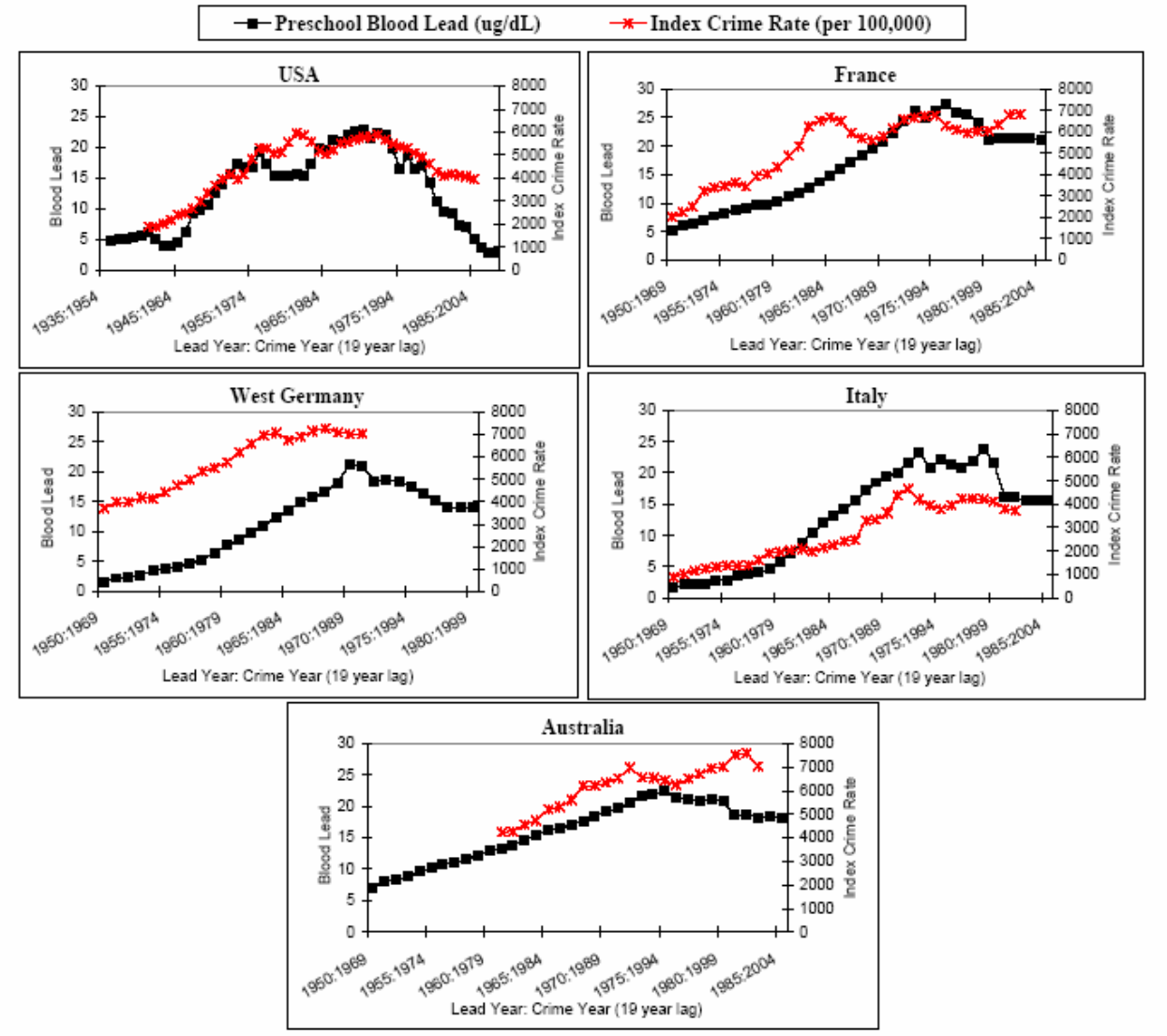
A Window of Opportunity

The new Nevin study and other research linking childhood lead exposure to crime and delinquency should lend urgency to efforts to eliminate childhood exposure to lead paint hazards in older housing. Rick Nevin and David Jacobs, the Research Director for the National Center for Healthy Housing, have also published two recent studies showing how a simple window replacement strategy in older housing can protect children from lead paint hazards while increasing energy efficiency and residential home value, and reducing peak-load electricity demand and associated power plant emissions, with important implications for climate change. One study (Jacobs and Nevin, 2006) shows how a federal report accurately forecasted the 1990s decline in children with elevated blood lead based on window replacement rates in older housing. The second study (Nevin and Jacobs, 2006) proposes specific regulatory initiatives and financing strategies that encourage widespread "lead-safe window replacement."

Web Links to Nevin and Jacobs studies

Understanding international crime trends: The legacy of preschool lead exposure
(Nevin (2007): doi:10.1016/j.envres.2007.02.008)
How lead exposure relates to temporal changes in IQ, violent crime, and unwed pregnancy
Nevin (2000) doi:10.1006/enrs.1999.4045
Validation of a 20-year forecast of US childhood lead poisoning: Updated prospects for 2010
(Jacobs and Nevin, 2006): http://dx.doi.org/10.1016/j.envres.2005.12.015
Windows of opportunity: lead poisoning prevention, housing affordability and energy conservation
(Nevin and Jacobs, 2006)
http://www.fanniemaefoundation.org/programs/hpd/pdf/hpd_1701_nevin.pdf

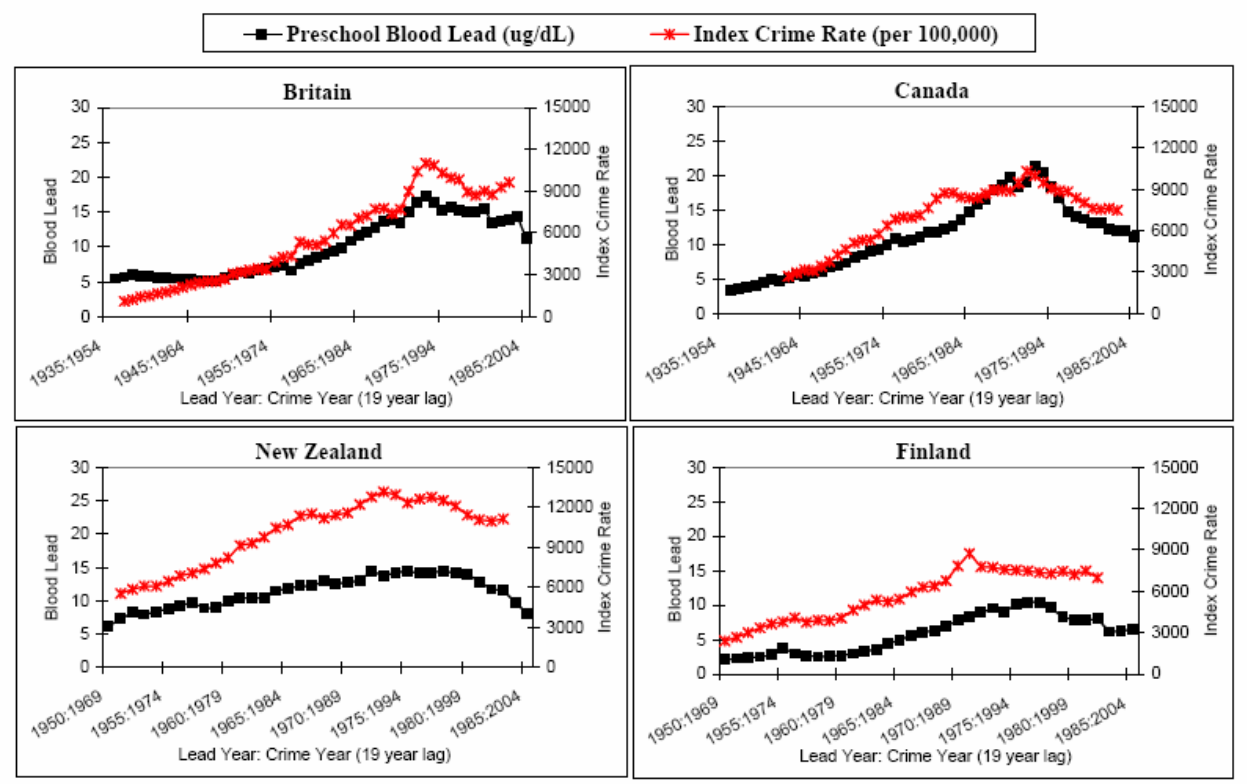
Preschool Blood Lead vs. Narrowly Defined Index Crime with a 19-Year Lag



These graphs show preschool blood lead trends versus narrowly defined index crime rates with a 19-year lag. USA index crime includes property crimes (theft and burglary) and the violent crimes of murder, rape, robbery, and aggravated assault (causing injury or with a lethal weapon). The USA index crime rate was 22% higher than the French rate and 41% higher than Australia's rate in 1980, but the USA rate was 40% lower than the French rate and 41% lower than Australia's rate in 2002

Nevin, R., Understanding international crime trends: The legacy of preschool lead exposure, Environ. Res. (2007), doi:10.1016/j.envres.2007.02.008)

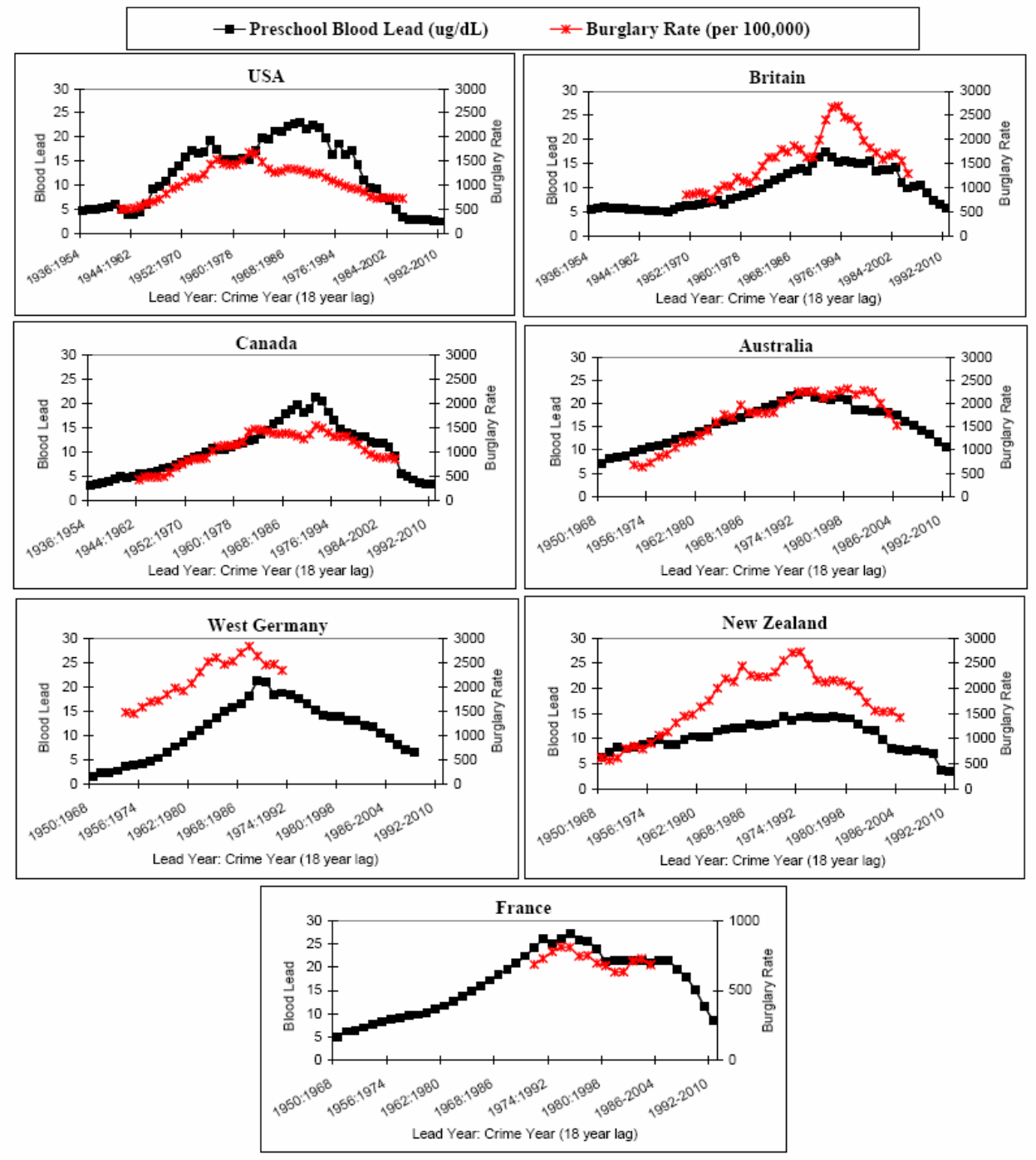
Preschool Blood Lead vs. Broadly Defined Index Crime with a 19-Year Lag



These graphs show preschool blood lead trends versus broadly defined index crime rates with a 19-year lag, where broadly defined indexes include USA index crimes plus threats, simple assaults without injury, and petty thefts below a USA monetary threshold. Despite crime recording differences and divergent crime and blood lead trends, the best fit lag for index crime is 18-21 years in separate regressions for the USA, Britain, Canada, Italy, Finland, and New Zealand.

Nevin, R., Understanding international crime trends: The legacy of preschool lead exposure, Environ. Res. (2007), doi:10.1016/j.envres.2007.02.008)

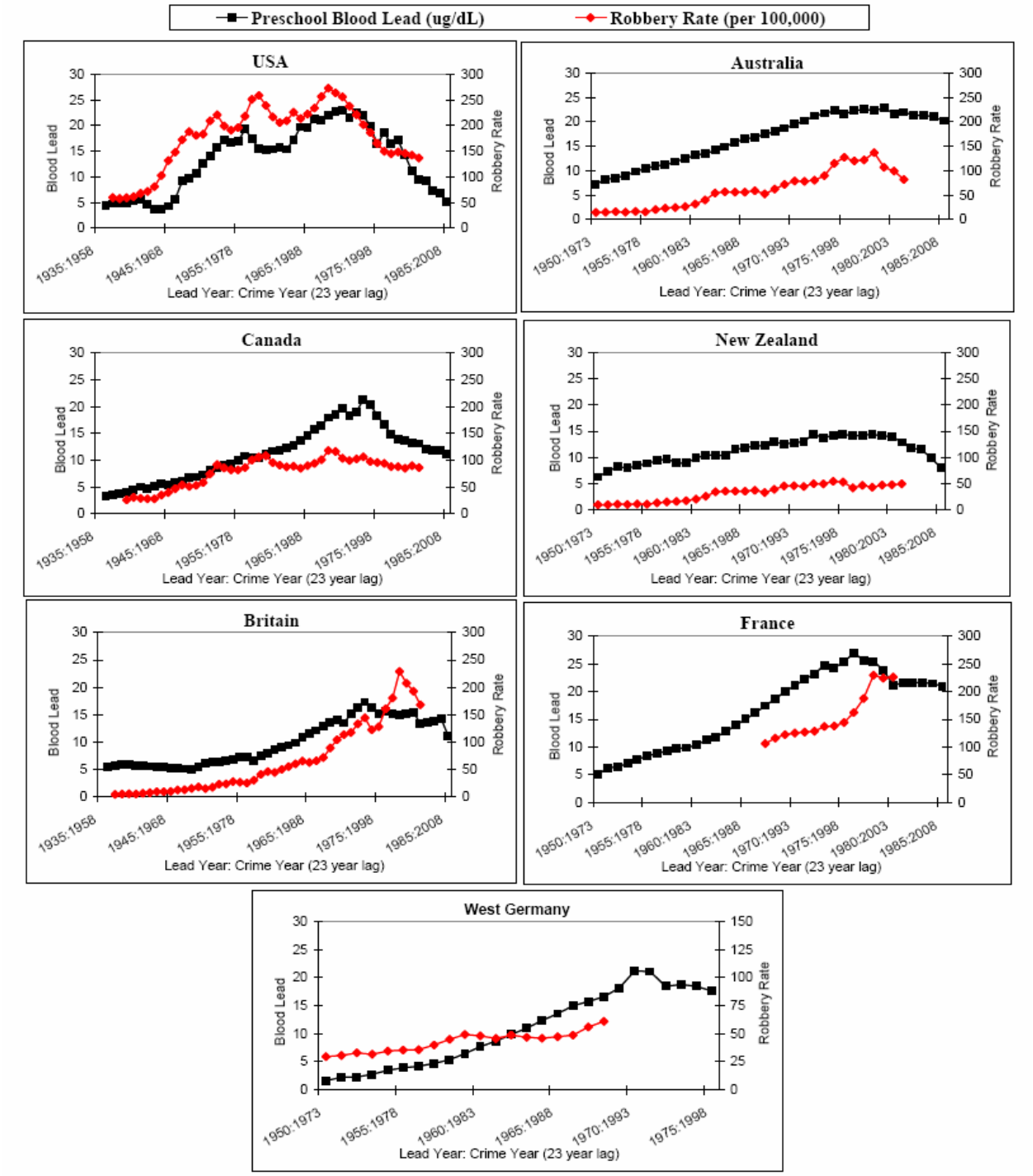
Preschool Blood Lead vs. Burglary with an 18-Year Lag



Burglary arrests peak at ages 15-20, and the best-fit lag for preschool blood lead versus burglary is 18 years in a combined-nation regression and 16-19 years in separate regressions for the USA, Canada, Britain, France, West Germany, Finland, and New Zealand. The 1974 USA burglary rate was 50% and 98% higher than rates in Britain and Australia, respectively, but the 2002 USA rate was 56% and 63% lower than rates in Britain and Australia.

Nevin, R., Understanding international crime trends: The legacy of preschool lead exposure, Environ. Res. (2007), doi:10.1016/j.envres.2007.02.008)

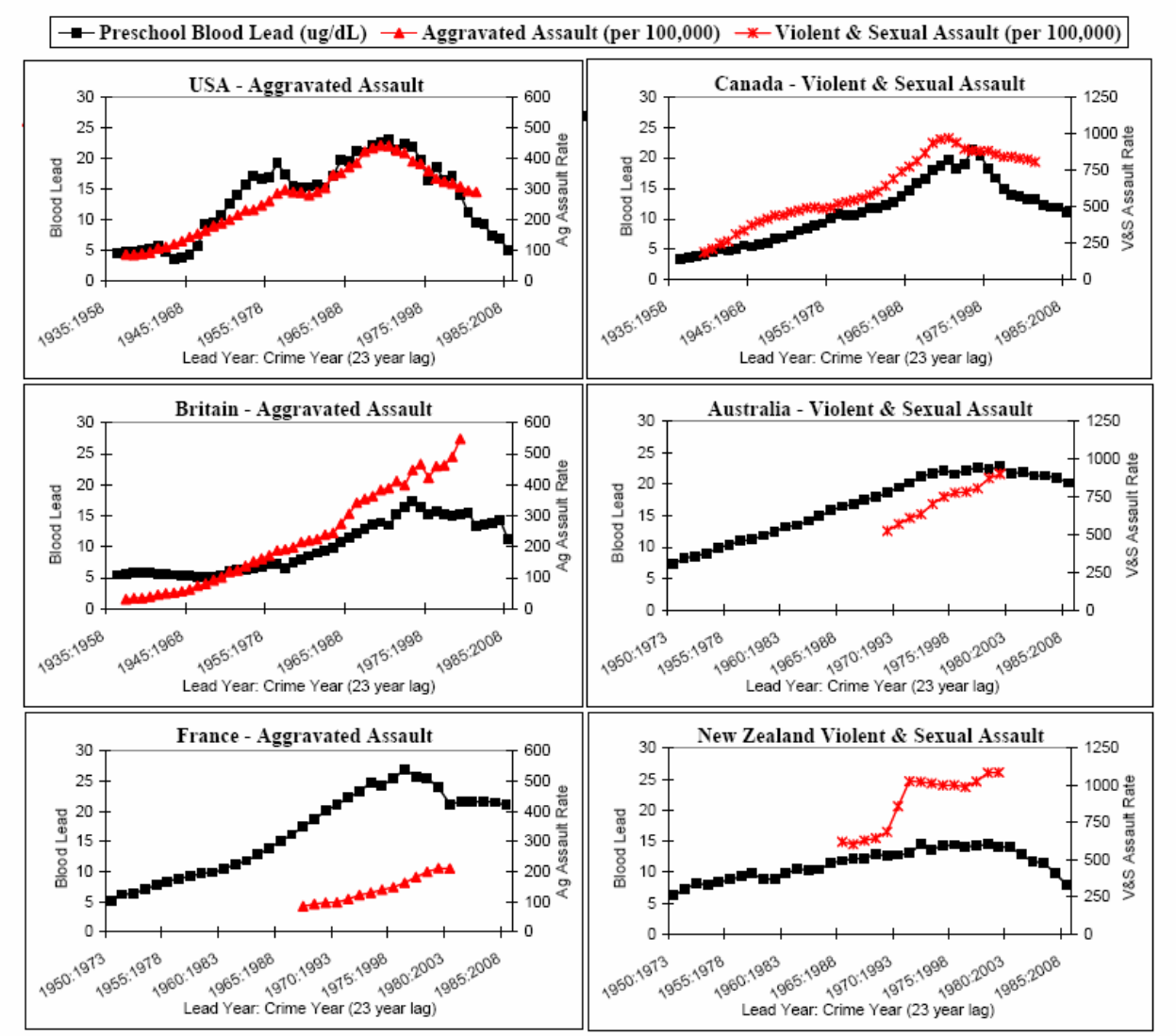
Preschool Blood Lead vs. Robbery with a 23-Year Lag



Robbery arrests peak from age 15 to the mid-20s, and the best-fit lag is 23 years in a combined nation regression and 20-21 years in separate regressions for the USA, Canada, West Germany, and New Zealand. The Canadian robbery rate was five times the rate in Britain in 1962, but the 2002 Canadian rate was less than half the rate in Britain.

Nevin, R., Understanding international crime trends: The legacy of preschool lead exposure, Environ. Res. (2007), doi:10.1016/j.envres.2007.02.008)

Assault vs. Preschool Blood Lead with a 23-Year Lag
(Aggravated Assault or Violent & Sexual Assault)



Aggravated assault peaks from age 18 to the late-20s, and the best-fit lag is 23 years in a combined nation regression, and 22-24 years for aggravated assault in the USA and Britain and for violent and sexual assault in Canada and New Zealand. The 1960 USA aggravated assault rate was almost three times the rate in Britain, but the 2002 USA rate was half the rate in Britain.

Nevin, R., Understanding international crime trends: The legacy of preschool lead exposure, Environ. Res. (2007), doi:10.1016/j.envres.2007.02.008)