



Review Article

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A Systematic Narrative Review of Environmental Toxins and Criminal Behavior Association

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Abstract

This review covered the linkage between environmental toxins and criminal behavior. Three databases were searched using “environmental toxins” and “crime” terms in “topics” or “abstract/title/keywords” parts. Without a time or article type limit, all articles were included. As the PRISMA diagram demonstrated, 16 articles remained for narrative analysis. The earliest article found in these databases was from 2000, and the latest one was from 2023. Overall, this study showed that most articles reported ecological observation studies and used population statistics. Therefore, we could talk of correlation between environmental toxins and criminal behavior, rather than causation, as already emphasized in all these articles. Three studies were based on individual data, quasi-experimental with control group. One recent study was a detailed meta-analysis comprising 24 articles. One article was a letter correcting the analysis in an earlier article and finding the same result. Studies strongly linked environmental toxins with criminal behavior. On the other hand, the only published meta-analysis (Higney, Hanley, & Moro, 2022), and one review article (Hall, 2013) found this link as overstated. The majority of articles used the USA crime and polluter statistics.

Keywords: Criminal behavior, Crime, Environmental toxins, Forensic psychology, Neurotoxicity

Introduction

Exposure to environmental toxins such as polluted air, endocrine disrupters, lead, heavy metals like mercury, and many other chemicals have been implicated to have potential neurotoxic effects reflected in undesirable behavior. The relationship between environmental toxins and externalization behavior including aggression, impulsivity, hyperactivity, and antisocial behavior is a multifaceted one, making causal attributions not so easy. This review is conducted to see what kind of studies were published covering this relationship, and how the interest in this topic evolved over the years [1-5].

Method

Systematic narrative analysis method is employed. The terms “environmental toxins” and “crime” were searched within “topics” of Web of Science, “abstract/title/keywords” in Scopus, and “search for research articles” tab of Springer Link, since these locations indicate an article’s focus. No date, no article type (narrative review, meta-analysis, observational research, theoretical, treatment pro-

tolocol etc.), no research designs (correlational survey study, randomized controlled trial, quasi experimental etc.), or toxin exposure/crime involvement age group was excluded. The results yielded 30 articles in Scopus, 715 articles in Springer Link, and 18 articles in Web of Science totaling 763 articles 750 of which screened out due to being out of scope. Springer Link returned the most populous results, since its search function does not aim at a specific part of article like abstract, keywords etc., and thus does not narrow down articles to the most relevant ones, hence the majority was out of scope. The PRISMA diagram below shows the results of article search in databases and relevant articles included in this review [6-10]. The excluded articles were irrelevant, expounding the link of criminality and use of psychoactive drugs, investigating green crimes (i.e., polluting the waters, air, and soil) or corporate crimes (e.g., gas flaring by fuel companies), or about ecological crime policies (Figure 1).

Results

Results are summarized in the table below (Table 1).



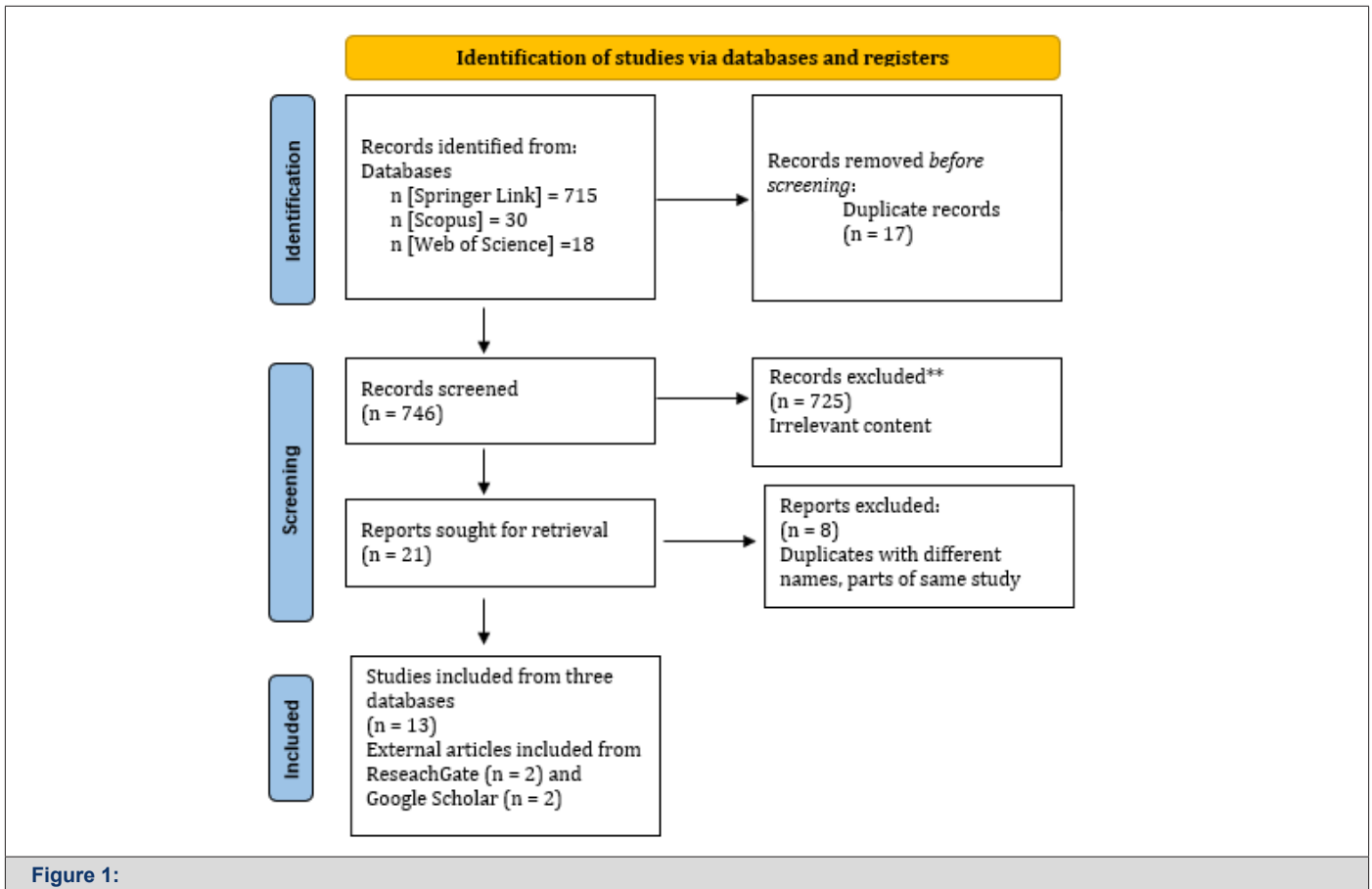


Figure 1:

Note*: PRISMA flow diagram for Environmental Toxins and Criminal Behavior based on database search dated February 2nd -4th, 2024.

Table 1: Overall review findings with prompts “environmental toxins” and “crime”.

Article	Research Type	Research Question	Outcome
Nevin, 2000, USA	Ecological study. 3rd to 12 grade children cognition scores, Geological Survey gasoline lead exposure data, and US Justice Department violent crime statistics were analyzed.	Is there a correlation between lead exposure at very early age and lower IQ, early pregnancy, and criminal behavior?	Childhood lead-exposure and unwanted social behavior in adolescence and adulthood was documented.
Stretesky & Lynch, 2004, USA	Ecological study. Environmental Protection Agency, the Bureau of Census, and the FBI crime statistics were analyzed.	Is there a correlation between air-borne lead and crime across USA?	Especially in the most deprived counties, air-lead level and crime association was stronger.
Carpenter & Nevin, 2010	Non-systematic review.	Is there an association between environmental contaminants and violent behavior?	Ecological correlation studies and quasi-experimental controlled studies similarly point to juvenile lead exposure as responsible for brain changes and criminality.
Haynes et al., 2011, USA	Ecological study. Analysis of metal exposure data extracted from the Environmental Protection Agency AirData, adjudication data was gathered from Ohio County Courts.	Is there an ecological association between floating air metals, particulate matter, and arbitrated criminal delinquents?	Airborne manganese, mercury, and particulate matter exposure are correlated with adjudication.
Masters, 2012, USA (a chapter)	Ecological study. Aggregate blood-lead data, gasoline sales, substance abuse, and FBI county-level violent crime data were analyzed.	Do silicofluorides (SiF) or sodium fluoride cause increased lead absorption from environmental sources and subsequent neurotoxicity leading to violent crime?	Cessation of SiF in public water would be a viable prevention strategy for substance abuse and violent criminal behaviors.
Hall, 2013, Australia	Non-systematic review	If lead and crime are really connected, then is it possible to decrease crime rates by lead elimination?	Cohort studies and ecological studies yielded different relationships, the former being weaker.

Taylor, Forbes, Opeskin, Parr, & Lanphear, 2016, Australia	Ecological study. Examination of assault related death rates in correlation to exposure to petrol/air lead concentrations 15-24 years ago. Air-lead data were obtained from Environment Protection Authority, while crime and assault data were obtained from the Computerized Operational Policing System.	Is petrol-originated air lead exposure in childhood related to adult aggressive criminal behaviors?	A robust association between air-lead and subsequent aggressive crime rates was documented.
Boutwell, Nelson, Qian, Vaughn, Wright, & Beaver, et al. 2017, USA	Ecological study. Data from a study on city lead exposure, aggregate blood-lead levels and violent crime rates were analyzed.	Is there an association between blood lead levels and violent crime perpetration?	Aggregate blood-lead levels were statistically significant predictors of violent crime (with and without firearms, robbery, homicide, assault etc.).
Brown, Gerretsen, Pollock, & Graff-Guerrero, 2018, Canada	Review-based insight article.	Is it possible to taper off the effects (e.g., crime) of chronic environmental lead exposure via water lithium exposure?	Micro amount lithium was reported as a shield against the neurotoxic lead influence.
Martin & Wolfe, 2018, USA	Ecological study. Aggregate data from the Massachusetts Department of Public Health, Census Bureau, and Boston Police Department were analyzed.	Is housing disadvantage (e.g., lead-based paint) conducive to elevated blood-lead levels and connected to crime rates?	Lead, concentrated disadvantage and crime rates were found to be correlated, yet new studies with new sites of analysis were called for reliable results.
Taylor, Forbes, Opeskin, Parr, & Lanphear, 2018, Australia	This is a letter that provides clarification regarding suburb data.	Same as 7.	The outcome of 7 was confirmed.
Burkhardt et al., 2019	Analysis of daily crimes from FBI statistics, eight-year, detailed U.S. air pollution data, and wildfire fume trails from satellite visuals taken from the National Oceanic and Atmospheric Administration.	Is air pollution related with violent assaults?	Only 10 mg per cubic meter increase in same-day exposure to particulate matter (pm2.5) is correlated with a 1.4% increase in violent assault-type crimes.
Helton et al., 2020, USA	Ecological study. Analyzing aggregate child blood lead level (BLL) tests (1996 to 2000) and validated maltreatment investigations (2006 to 2016) in a large Midwest city.	Is there an ecological association between aggregate blood lead levels (BLL) and rates of child maltreatment?	Child maltreatment seemed to accompany aggregate lead exposure.
Widom, Li, & Carpi, 2022, USA	Prospective longitudinal observational study with matched controls. 556 individuals with blood lead level measures at 41 years of age were checked for criminal history and the number of arrests latest at 50s.	Does blood-lead level lead to violence and crime?	Lead was demonstrated to affect criminal behavior, controlling for confounds.
Maxwell, Taylor, & Barch, 2022, USA	Child data (10-year-olds) of another longitudinal study including the first cognition and brain imaging assessments were analyzed.	Does neighborhood poverty facilitate absorption of more environmental toxins (e.g., particulate matter, nitrogen dioxide, and lead), which decrease brain volume and axonal connections ultimately leading to unwanted, aggressive behavior.	As neighborhood poverty increased, externalizing symptoms increased in children controlling confounds, and shrunk brain volume actively shaped this relationship.
Higney, Hanley, & Moro, 2022,	Meta-analysis of 24 studies delineating a relationship between lead exposure and violent /non-violent crime/only homicides.	Is lead exposure associated with criminal behavior?	Large publication bias was found in majority of studies. Lead cannot explain decreased crime experienced in several countries.
Sadana, 2023, USA	Quasi-experimental study. FBI aggregate crime data in Clean Ambient Air Act (CAAA) enactment term were analyzed.	Is ambient air pollution linked to property crime and can the CAAA cut back on property crime?	Fetal Origins Hypothesis was confirmed. Clean air act in-womb or in early infancy, influences one's behavior across life, decreases propensity for property crime by 6%.

Conclusion

The systematic survey of three large science databases yielded only 13 articles about environmental toxins and criminal behavior across 23 years. Google Scholar and ResearchGate search added 4

additional relevant articles [11-13]. Since most of the studies were based on population level statistics and not experiments, a reliable outcome proving environmental contaminants cause crime was not possible. However, most of the researchers who published on this

topic had a common view supporting a powerful relationship, and they could theoretically explain their point of view with reasonable arguments [14-17].

Conflict of Interest

There is no conflict of interest regarding this review.

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