Health Effects of E-Waste

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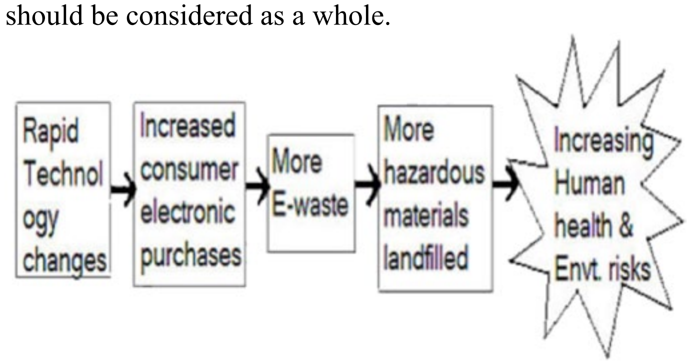
What is E-Waste?

Electronic and electrical waste (e-waste), is defined as any end-of-life "equipment which is dependent on electrical currents or electromagnetic fields in order to work properly". Included in this definition are small and large household appliances; information technology and telecommunications equipment; lighting equipment; electrical and electronic tools, toys, and leisure and sports equipment; medical devices; monitoring and control instruments; and automatic dispensers. Components of electrical and electronic equipment such as batteries, circuit boards, plastic casings, cathode-ray tubes, activated glass, and lead capacitors are also classified as e-waste. Although e-waste is informally processed in many regions, high-volume informal recycling has been reported in China, Ghana, Nigeria, India, Thailand, the Philippines, and Vietnam.

Why is E-Waste a Problem?

The changing lifestyle of people and urbanization has led to increasing rates of consumption of electronic products. This has made electronic waste management an issue of environment and health concern.

Pollutants are released as a mixture, and the effects of exposure to a specific compound or element cannot be considered in isolation. However, a more complex understanding of the interactions between the chemical components of e-waste is needed. Exposure to e-waste is a complex process in which many routes and sources of exposure, different lengths of exposure time, and possible inhibitory, synergistic, or additive effects of many chemical exposures are all important variables. Exposure to e-waste is a unique variable in itself and the exposures implicated should be considered as a whole.



Sources of Exposure

Sources of exposure to e-waste can be classified into three sectors: informal recycling, formal recycling, and exposure to hazardous e-waste compounds remaining in the environment (i.e., environmental exposure). Informal electronic waste recycling includes the dismantling of end-of-life electronics to retrieve valuable elements with primitive techniques, without or with very little technology to minimise exposure or protective equipment, allowing the emission of dangerous chemicals. Formal electronic waste recycling facilities use specifically designed equipment to safely remove salvageable materials from obsolete electronics while protecting workers from adverse health effects. However, these centres are very expensive to build and run and are rare in less developed countries. Varying national safety standards can mean that workers at formal or semiformal recycling centres still risk exposure at low doses. Because of the high levels of environmental, food, and water contamination, residents living within a specific distance of e-waste recycling areas are also at risk of environmental exposure, although at lower levels than through occupational exposure.

Exposure Routes

Exposure routes can vary dependent on the substance and recycling process (Table 1). Generally, exposure to the hazardous components of e-waste is most likely to arise through inhalation, ingestion, and dermal contact. In addition to direct occupational (formal or informal) exposure, people can come into contact with e-waste materials, and associated pollutants, through contact with contaminated soil, dust, air, water, and through food sources, including meat. Children, fetuses, pregnant women, elderly people, people with disabilities, workers in the informal e-waste recycling sector, and other vulnerable populations face additional exposure risks.

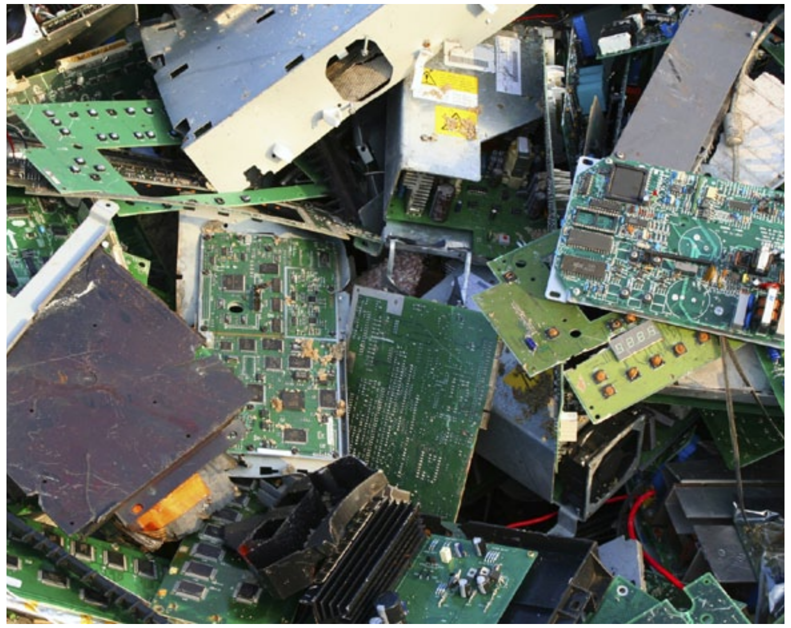
	Component of electrical and electronic equipment	Ecological source of exposure	Route of exposure
Persistent organic pollutants			
Brominated flame retardants Polybrominated diphenyl ethers	Fire retardants for electronic equipment	Air, dust, food, water, and soil	Ingestion, inhalation, and transplacental
Polychlorinated biphenyls	Dielectric fluids, lubricants and coolants in generators, capacitors and transformers, fluorescent lighting, ceiling fans, dishwashers, and electric motors	Air, dust, soil, and food (bio-accumulative in fish and seafood)	Ingestion, inhalation or dermal contact, and transplacental
Dioxins			
Polychlorinated dibenzodioxins and dibenzofurans	Released as combustion byproduct	Air, dust, soil, food, water, and vapour	Ingestion, inhalation, dermal contact, and transplacental
Dioxin-like polychlorinated biphenyls	Released as a combustion byproduct but also found in dielectric fluids, lubricants and coolants in generators, capacitors and transformers, fluorescent lighting, ceiling fans, dishwashers, and electric motors	Released as combustion byproduct, air, dust, soil, and food (bioaccumulative in fish and seafood)	Ingestion, inhalation, and dermal absorption
Perfluroalkyls	Fluoropolymers in electronics	Water, food, soil, dust, and air	Ingestion, dermal contact, inhalation, and transplacental
Polyaromatic hydrocarbons			
Acenaphthene, acenaphthylene, anthracene, benz[a] anthracene, benzo[a]pyrene, benzo[e]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo[j] fluoranthene, benzo[k]fluoranthene, chrysene, dibenz[a,h]anthracene, fluoranthene, fluorene, indeno[1,2,3-c,d]pyrene, phenanthrene, and pyrene	Released as combustion byproduct	Released as combustion byproduct, air, dust, soil, and food	Ingestion, inhalation, and dermal contact
Elements			
Lead	Printed circuit boards, cathode ray tubes, light bulbs, televisions (1·5–2·0 kg per monitor), and batteries	Air, dust, water, and soil	Inhalation, ingestion, and dermal contact
Chromium or hexavalent chromium	Anticorrosion coatings, data tapes, and floppy disks	Air, dust, water, and soil	Inhalation and ingestion
Cadmium	Switches, springs, connectors, printed circuit boards, batteries, infrared detectors, semi-conductor chips, ink or toner photocopying machines, cathode ray tubes, and mobile phones	Air, dust, soil, water, and food (especially rice and vegetables)	Ingestion and inhalation
Mercury	Thermostats, sensors, monitors, cells, printed circuit boards, and cold cathode fluorescent lamps (1–2 g per device)	Air, vapour, water, soil, and food (bioaccumulative in fish)	Inhalation, ingestion, and dermal contact
Zinc	Cathode ray tubes, and metal coatings	Air, water, and soil	Ingestion and inhalation
Nickel	Batteries	Air, soil, water, and food (plants)	Inhalation, ingestion, dermal contact, and transplacental
Lithium	Batteries	Air, soil, water, and food (plants)	Inhalation, ingestion, and dermal contact
Barium	Cathode ray tubes, and fluorescent lamps	Air, water, soil, and food	Ingestion, inhalation and dermal contact
Beryllium	Power supply boxes, computers, x-ray machines, ceramic components of electronics	Air, food, and water	Inhalation, ingestion, and transplacental

How Does E-Waste Affect Human Health?

Specific chemical elements and compounds are associated with e-waste, either as components of the equipment or released during the recycling process (Table 1). Persistent organic pollutants are a group of lipophilic, bioaccumulative substances that are very resistant to breakdown because of long half-lives. Common persistent organic pollutants found in electrical and electronic equipment components include: brominated flame retardants (polybrominated diphenyl ethers), polybrominated diphenyls, dibrominated diphenyl ethers, polychlorinated biphenyls, polychlorinated or polybrominated dioxins and dibenzofurans dioxins, hexabromocyclododecanes, and perfluroalkyls. Persistent organic pollutants released during dismantling, typically from incineration and smelting, include polychlorinated dibenzodioxins, polychlorinated dibenzofurans, and dioxin-like polychlorinated biphenyls. Polycyclic aromatic hydrocarbons are naturally occurring, hydrophobic substances that are formed during incomplete combustion of coal, gas, oil, meat, tobacco, incense, and wood.These hydrocarbons are formed and released into the environment during the burning of e-waste materials. Potentially hazardous chemical elements are also components of electrical and electronic equipment; the most common are lead, cadmium, chromium, mercury, copper, manganese, nickel, arsenic, zinc, iron, and aluminium.

• Workers' exposure in developing countries
The e-waste recycling sector in developing countries is largely unregulated and the process of recovering valuable materials takes place in small workshops using simple recycling methods. The main components of interest for recyclers are materials containing copper (wires and cables, CRT yokes), steel (internal computer frames, power supply housings, printer parts), plastics (housings of computers, printers, faxes, phones, monitors), aluminium (printer parts), printer toners and printed circuit boards.

• Child labour at e-waste recycling sites
Children are a particularly sensitive group because of additional routes of exposure (e.g., breastfeeding and placental exposures), high-risk behaviours (e.g., hand-to-mouth activities in early years and high risk-taking behaviours in adolescence), and their changing physiology (e.g., high intakes of air, water, and food, and low rates of toxin elimination). The children of e-waste recycling workers also face take-home contamination from their



parents' clothes and skin and direct high-level exposure if recycling is taking place in their homes.

• Long-term effects on human health and the environment
The degree of hazard posed to workers and the environment varies greatly depending on the individuals involved and the nature of operations. What is known is that the pollution generated by e-waste processing brings about toxic or genotoxic effects on the human body, threatening the health not only of workers but also of current residents and future generations living in the local environment.

Long-range transport of pollutants has also been observed, which suggests a risk of secondary exposure in remote areas. Atmospheric pollution due to burning and dismantling activities seems to be the main cause of occupational and secondary exposure. Informal sector e-waste activities are also a crucial source of environment-to food- chain contamination, as contaminants may accumulate in agricultural lands and be available for uptake by grazing livestock. In addition, most chemicals of concern have a slow metabolic rate in animals, and may bioaccumulate in tissues and be excreted in edible products such as eggs and milk. E-waste-related toxic effects can be exacerbated throughout a person's lifetime and across generations. E-waste therefore constitutes a significant global environmental and health emergency, with implications far broader than occupational exposure and involving vulnerable groups and generations to come.

Health Side Effects

Overall, human health risks from e-waste include breathing difficulties, respiratory irritation, coughing, choking, pneumonitis, tremors, neuropsychiatric problems, convulsions, coma and even death. E-waste workers are also exposed to other hazards leading to physical injuries and chronic ailments such as asthma, skin diseases, eye irritations and stomach disease. Particulate matter collected from e-waste recycling areas can lead to inflammatory response, oxidative stress and DNA damage.

Existing Legislations and Policy Related to E-Waste

There is no universal policy on e-waste, although some parts of computers could be considered as hazardous waste. However, in September 2007, there was the Basel convention as part of the United Nations Environment Protection Act initiated in 1986. Such a convention "|controls" the Trans boundary Movement of Hazardous.

Conclusion

Regional intergovernmental organisations, international organisations, national governments, and non-governmental organisations have actively worked to address the practical application of e-waste regulations and initiatives to prevent negative effects on health from the informal recycling of e-waste. However, the focus of e-waste policies and initiatives is only now beginning to shift from a mainly environmental emphasis to one that includes health. New challenges are emerging, and international conventions will struggle to effectively address growing domestic e-waste streams in developing countries. Evidence of the human health effects of e-waste exposure will be key to the development of effective protective policies in the near future.

Infos

Hyperactivité: Les Médicaments pour Enfants Sont-Ils Responsables?

On a retrouvé dans certains médicaments pour enfants des additifs pouvant avoir des effets indésirables sur l'activité et l'attention chez les enfants.

Six colorants et un additif déjà sous haute surveillance dans l'alimentation sont pointés du doigt par un groupe de pression britannique qui estime qu'il y a un lien entre la prise de médicaments par les jeunes enfants et le risque de développement d'un trouble du déficit de l'attention.

Les chercheurs de l'Université de Southampton, en Grande-Bretagne, qui ont mené cette étude, ont en effet découvert des traces de ces additifs dans certains médicaments pédiatriques. Or, la présence de tartrazine (E102), de jaune de quinoléine (E104), de jaune soleil (E110), de carmoisine (E122), de rouge ponceau (E124) et de rouge allura (E129) doit normalement être accompagnée d'une mention précisant qu'il y a « risque d'effets indésirables sur l'activité et l'attention chez les enfants ». Idem pour le benzoate de sodium, un agent conservateur, qui est également impliqué dans un grand nombre de cas de syndrome d'hyperactivité chez l'enfant.

" L'utilisation de colorants artificiels dans les aliments, en particulier ceux destinés aux nourrissons et aux jeunes enfants âgés de moins de 36 mois, est interdite dans l'Union européenne depuis plus de 20 ans et lorsque ces colorants sont utilisés dans la pâtisserie, les yaourts ou certains sirops, cela doit être accompagné d'avertissements sur les effets néfastes pour la santé. Mais, comme le souligne le groupe de pression, ces additifs n'obéissent pas à la même réglementation lorsqu'ils sont utilisés dans les médicaments. La Haute autorité de santé britannique (la NHS) vient donc de s'emparer du dossier pour encourager les laboratoires pharmaceutiques à supprimer purement et simplement ces colorants de leurs médicaments pédiatriques. " Trois des six colorants incriminés ont été associés à des mutations génétiques dans des études portant sur des animaux.