

INTRODUCTION

Enquiries received by the Royal Society of Chemistry indicate that there is a need for basic information about any greater susceptibility of children than adults to the toxic effects of chemicals in light of the general concern about the harmfulness of chemicals. Concerns include chemicals encountered in the home or environment, and perhaps more specifically chemicals encountered when at school or college. This may occur in a wide range of contexts such as science laboratories or technology workshops. This Note is designed to answer this need. It does not pretend to be a full or definitive guide to the subject and readers are urged to obtain more detailed guidance if this is required. It does not deal with specific First Aid measures.

HOW CAN EXPOSURE OCCUR?

Children, like adults, encounter a wide range of chemical substances in the home and in their general environment. These exposures can be intentional or accidental. The list is endless but some examples include:

- domestic cleaning materials e.g. disinfectants, laundry powder
- personal care products e.g. shampoos and decorative cosmetics
- construction materials including paints and glues
- pharmaceuticals
- hobby or art-related products
- toys
- garden chemicals
- spillages from work sites or vehicles
- Food

As children grow and develop, they will encounter chemicals not only at home but also at school or college, particularly when studying scientific subjects, art or technology.

The routes for chemical exposure of children are the same as for adults and include ingestion, percutaneous absorption or inhalation. The risk of systemic ill-effects, allergic or local irritation responses depend on both the exposure and the degree of harmfulness (hazard or toxicity), and both parameters must be considered when assessing the risk likely from a chemical exposure. In addition, account should be taken of any dilutions.

Yet children differ from adults. Being smaller, young children have a greater surface area per body weight ratio and this means a relatively larger area available for dermal absorption or irritation. Also, per unit body weight, children may eat more and breathe more air than adults and have incompletely developed metabolic and physiological systems. It should also be remembered that the potential for exposure to chemicals may be greater for children than for adults, not only because of their smaller size, but also as result of their more inquisitive, imprudent behaviour especially in very young children.

If you are concerned about possible exposure of children to particular chemicals, it is important to consider the type of product, and to study the information available, including that on the label and any accompanying data sheet. Unless stated otherwise, any precautions etc. are likely to be aimed primarily at adults but

This Note was produced by a Working Party of the Environment, Health and Safety Committee [EHSC] of the Royal Society of Chemistry.

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Version 3 28 May 2010

the guidance given in this Note may help you to extrapolate them to children. Consumer products, for example, have a requirement to not cause harm when appropriately packaged, labelled and used. The presence of any particular chemical in an ingredient listing, for example, should not necessarily be a cause for concern unless a child has a known response, such as a skin allergy, to such an ingredient. Toys and cosmetic products, in particular, are obliged by law to have undergone a formal safety assessment before sale and, unless deliberately abused or misused, are unlikely to pose a significant risk to health of consumers. Importers should take particular care when they do not have direct control over product manufacture. As a consequence, consumers can generally have confidence in these types of products. Deliberate misuse or abuse of chemicals is outside the scope of this paper. Specific first aid measures are not covered in this paper though guidance would normally be included in a data sheet if one was available.

HOW SUSCEPTIBLE ARE OLDER CHILDREN?

Once a child has reached the age of about 5 years, metabolic and physiological systems in the body have generally reached maturity. Exceptions include those hormone-controlled systems which change around the age of puberty, brain and lung development which continues into adulthood and, perhaps, rapidly dividing tissues such as bone marrow. Metabolic rates peak between the ages of 8 and 10 then decline to adult levels around puberty.

It seems a reasonable assumption that most chemicals will, after the age of about 5 years, show roughly similar toxicity per unit body weight as to adults with the exception of those few materials which may affect hormone status or brain development before puberty, including endocrine disrupting chemicals, or may affect rapidly dividing tissues such as the bone marrow (e.g. benzene). The relationship with body weight means that, for example, a 4-stone child would need, on average, about a third of the dose of a chemical than a 12-stone adult to cause the same effect.

ARE YOUNGER CHILDREN MORE SUSCEPTIBLE?

In practical terms, younger children may be divided into two groups, those younger than 1 year old and those between 1 and 5 years of age. Those under 1 year are likely to be particularly at risk because of the different nature of their exploratory learning behaviour. For example, infants can be expected to mouth toys and other articles and to have an appetite for non-nutritive substances. Toddlers who have not mastered walking will have different sources of exposure, e.g. to carpet associated materials (off-gassed chemicals from carpet manufacture), than their older counterparts. However babies and infants in both groups may have incompletely developed metabolic and physiological systems. Responses to chemicals in younger children may therefore be quantitatively or even qualitatively different from those of adults because of differences in metabolism and excretion of the chemical or differences in the physiology of the target organ. The net result may be greater or lesser toxicity than would be expected in adults but this is very difficult to predict with the present state of knowledge. Conversely, the greater inquisitiveness and exposure gives greater opportunity to build up immunity to common allergens. However, those in the intermediate age group often metabolise better than older children. For instance, babies are disproportionately very susceptible to the effects of nitrates (blue baby syndrome) and lead, and to the narcotic effects of ethanol, but are thought to be proportionately less susceptible to paracetamol than adults. Following skin contact, babies may absorb chemicals more readily than do adults, though this may partly be a reflection of their relative surface area/body weight ratio, rather than a markedly reduced or weaker skin barrier.

Because of these uncertainties it is particularly important that babies and infants, who may thus be hypersusceptible, are protected from unnecessary exposure to chemicals in the home or environment even if proportionate exposures do not cause adverse effects in adults.

WHAT ABOUT IRRITANTS AND SENSITISERS?

Many materials can irritate the skin, eyes, respiratory tract or other mucous membranes, or cause sensitisation leading to allergic effects (such as skin rashes and asthma) when exposure occurs above threshold concentrations. Since the tissues at risk are more delicate in young children than in adults, irritancy effects may be more pronounced or occur at lower concentrations, and scarring is more likely. Older children are likely to be closer to adults in their responses to irritants and sensitizers. If allergic effects do develop, further exposure to the causative chemical must be prevented. Those strongly irritant household products (e.g. dishwasher tablets, bleach, oven cleaner) which are clearly not for dermal contact or oral ingestion should therefore be kept away from easy access by children.

WHAT CAN WE CONCLUDE?

Children can be exposed to a wide range of chemical substances in the home and in their general environment, and it should be remembered that children are not small adults. Babies and infants up to the age of about 5 years may show greater or lesser susceptibility to chemicals than adults. These differences are often unpredictable. It is therefore particularly important that babies and infants are protected from unnecessary exposure to chemicals in the home or general environment. Younger children may be more susceptible than adults to irritant materials. Parents or guardians should therefore ensure that potentially hazardous products are kept away from vulnerable children.

In general it is thought older children have similar susceptibility to most chemicals as adults when account is taken of bodyweight differences. Exceptions may include materials affecting hormone status before and around puberty, brain maturation or those which may affect the bone marrow. Properly approved or supervised activities involving use of chemicals (such as in school science classes) should pose little risk to older children. Such use of chemicals would have been subject to risk assessment and be considered appropriate to the age of the children. Educational toys which contain chemical substances which are bought for children, e.g. chemistry sets, should be appropriate for the age of the children likely to use them and adequately supervised. Other sources of potential exposure (such as from household products) need careful consideration and management so that health and safety risks can be minimised. Account should be taken of all appropriate precautions and information, including that on labels and in health and safety datasheets.

This paper does not deal with specific first aid measures. However, if despite all care, poisoning is suspected it is important to know how to proceed. In the event of an accident, help should be sought in the first instance by contacting NHS Direct (England and Wales) or NHS 24 (Scotland), alternatively seek medical advice from the general practitioner, or possibly from the accident and emergency department of the local hospital (if the exposure is thought to be severe). It would also be helpful to keep the container or label for the product involved in the exposure and, if possible, a record of the quantity swallowed or which came into contact with the skin to help medical personnel.

FURTHER READING

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Hazcards, 2000, CLEAPSS (*Consortium of Local Education Authorities for the Provision of Science Services is an advisory service supporting practical science and technology in schools and colleges*).

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RSC Environment, Health and Safety Committee (EHSC) gratefully acknowledges the assistance and input of the Health Protection Agency's Children's Environmental Health Strategy Team in revising the latest version of this Note. This Note was prepared by a Working Party of the RSC Environment, Health and Safety Committee.

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