Packaged food intake by British children aged 0 to 16 years g per kg body weight

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Packaged food intake by British children aged 0 to 6 years

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Abstract

The European Union (EU) approach to assessing exposure to chemical migrants from plastic Food Contact Materials (FCMs) has been to assume an intake of 1 kg of food in contact with a particular material, per 60 kg person per day, which equates to 16.7 g/kg body weight. A food packaging surface area to food mass ratio of 6dm^2/1kg is assumed, equivalent to 0.1dm^2/kg of body weight. Children may be at increased risk to exposure from migrants as they have higher intakes of food per kg body weight compared with adults. In addition, much of the food marketed for/to children is in small portions and therefore the FCM area to food mass ratio is relatively high. To determine if, and how, the EU model might be modified to ensure specific protection against chemical migration into food marketed for children, data on 4-day food intakes of 297 children aged 0 to 6 years were collected including information on pack size, pack type and FCM area to food mass ratio. The 297 children consumed a total of 1,646 kg of food and drink (including tap water) of which 978 kg (59%) was packaged with 67% of this packaged in plastics. Mean intakes of food packaged in plastic ranged from 27g per kg body weight (for the infants under 1 year) to 51 g per kg body weight (for the 1-4 year olds). This was higher than the 16.7 g/kg body weight derived from the EU convention. The mean area of packaging in contact with the food consumed daily per kg body weight were 0.65 dm2/kg for the infants under one, 0,81 dm2/kg for the 1-4 year olds and 0.66 dm2/kg for the 4-6 year olds. All 297 children had intakes which exceeded 0.1dm2 of packaging per kg of body weight assumption.

Keywords: Exposure assessment, Children, Food packaging, Packaging migration

Introduction

Trends in food purchasing

Food purchasing patterns have changed dramatically over the past 50 years. There has been a move away from the daily purchase of fresh food, stored in boxes and baskets wrapped in paper on purchase and stored in ceramic or glass containers at home, to today's pre-prepared and/or highly packaged food provision. It is now difficult to purchase food that has not, at some time, been stored in a container such as a plastic crate or packaging made from a variety of materials such as plastic, paper and board or metal.

The consumer drive towards convenience has resulted not only in more packaged food items being sold but also reduced time allocated to food preparation and cooking [Foster and Lund 2007]. This has resulted in a demand for items which can be quickly cooked in pack such as microwave meals, part baked bread and individual portions of foods such as rice pudding [Huxley 2006].

Role of packaging

Packaging food has a number of key purposes. The packaging protects food from spoilage for example by oxidation, moisture, pests, mould and micro-organisms or contamination from foreign materials thereby prolonging the shelf life of food and protecting the health of the consumer. Packaging can aid transport and storage of foods and can also be used to inform and attract the consumer.

Migration

The transfer of constituents from the food contact material into food may occur by a process known as migration and may have an effect on the quality and safety of the food [Barnes et al. 2007]. The extent of migration is determined by several factors including the temperature of storage; the length of time the food is in contact with the food contact material; the type of food - aqueous, acidic, alcoholic or fatty; the nature of the food - solid, liquid or dry; whether the food is processed or cooked in the container; the type of food contact material e.g. plastic, paper or coated can; the type of possible chemical migrant including molecular weight, volatility, concentration in the material, diffusion through the food packaging material and the contact area of the

food contact material:food mass ratio [Goulas et al. 1998; Anderson et al. 2003, Quinto-Fernandez et al. 2003]

Examples of substances that have been found to migrate from food contact materials or articles in recent years include: semicarbazide from seals used in the 'press-on, twist off' metal lids on glass jars [Nestmann et al. 2005]; 2-isopropylthioxanthone (ITX) as a set-off from printing into infant formula and fruit juices [Rothenbacher et al. 2007]; formaldehyde from melamine ware [Bradley et al. 2005]; and benzophenone from printed packaging [Food Standards Agency 2006]. These are substances for which a specific safety assessment was required following notification through the EU Rapid Alert System for food and feed.

It is essential that legislation on food packaging protects the consumer from any potential harmful effects of migrants whilst ensuring that the correct use of packaging minimises any health risks due to contamination of the foodstuff.

Legislation

Within the European Union all food contact materials and articles are controlled by the Framework Regulation (EC) 1935/2004. Article 3 of this Regulation states that 'materials and articles, including active and intelligent material and articles, shall be manufactured in compliance with good manufacturing practice so that, under normal or foreseeable conditions of use, they do not transfer their constituents to food in quantities which could: a) endanger human health; or b) bring about an unacceptable change in the composition of the food; or c) bring about a deterioration in the organoleptic characteristics thereof.' [European Regulation No. 1935/2004]. To ensure the protection of the health of the consumer and avoid adulteration of the foodstuff two types of migration limits have been established in the area of plastic materials [European Directive 2002/72/EC]: an Overall Migration Limit (OML) of 60mg (of substances)/kg (of foodstuff or food simulants) that applies to all substances that can migrate from the food contact material to the foodstuff and a Specific Migration Limit (SML) which applies to individual authorised substances and is fixed on the basis of the toxicological evaluation of the substance.

The SML is generally established according to Acceptable Daily Intake (ADI) or the Tolerable Daily Intake (TDI) set by the Scientific Committee on Food (SCF) now

replaced by the European Food Safety Authority (EFSA). To set the limit, it is assumed that, every day throughout his/her lifetime, a person of 60kg bodyweight eats 1kg of food packed in plastics containing the relevant substance at the maximum permitted quantity . This is equivalent to 16.7g/ kg body weight. A food packaging surface area to food mass ratio of 6dm$_2$/1kg is assumed, equivalent to a packaging surface area of 0.1dm2/kg of body weight.

The packaged food intake of the British population is unknown. The National Diet and Nutrition Surveys provide comprehensive data on the nutritional intake of British adults and children measured by weighed food intake [Finch et al 1998, Gregory et al. 1993, Gregory and Lowe 2000, Ruston et al. 2004] but the method of collection of these data does not allow extraction of information on intakes of packaged food. No established method is available by which to measure packaged food intake. For plastics, the intake of packaged food by adults, on which the specific migration limits (SML) are based, relies on the assumptions mentioned above.

Current knowledge of packaged food intakes

In the absence of detailed data on individual intakes of packaged food, exposure estimates are often made using per capita consumption and production statistics. For example Dionisi et al. (2002) used the production statistics from EU can manufacturers, together with import and export statistics, to estimate exposure to substances migrating from canned foods and beverages. This method assumes that the adjusted production is equal to consumption and gives an estimate of average individual consumption. However, without data on individual intakes it is not possible to identify and characterise high (and low) consumers which is important to ensure that consumers with high intakes are protected. Duffy et al. (2007) suggest using the upper percentiles of food intake to estimate exposure and stress the need to link the use of a particular type of food packaging to the consumption of a specific item of food.

Franz *et al.* discuss that statistical data on food consumption and packaging use can be used to estimate exposure more realistically [Franz, 2005]. Holmes *et al.* used dietary records collected during the National Diet and Nutrition Survey to provide data on actual body weight and variation in food consumption amongst individuals for use in

a 2 dimensional probabilistic model, along with 'best estimates' of packaging materials, to provide a better estimate of the 'true' exposure of the population and to identify those at higher risk [Holmes et al. 2005].

Why children are potentially at increased risk

An important issue in exposure assessment is the food intake of children. Children consume more food per unit of body weight than adults due to their additional energy and nutrient needs for growth. On supermarket shelves some food products are targeted specifically at/ for children. Much of this food is in small portions and thus the food packaging to food mass ratio may be higher than the conventional 6 square decimetres (dm^2) of packaging used for plastic materials and articles per kg of food.

In a study of 594 Irish children Duffy et al. (2007, 2006a, 2006b) created the first database linking food consumption data (collected using a 7-day weighed food diary) with information on food packaging. This study included chemical characterisation of food contact materials but did not measure the surface area of the packaging in contact with the food. Their study demonstrated that intakes in this population were in excess of the assumed 16.7g/kg body weight.

Aim

The current European approach for the authorisation and control of substances used in food contact materials and articles is intended to be cautious in relation to the estimation of potential exposure of the consumer to these substances with respect to an average adult. The purpose of this study was to quantify the intake of packaged food and thereby the use of associated food contact materials by British children aged 1 to 6 years. The aim was to determine if, and how, the current EU model of 1 kg of packaged food per 60 kg person per day might need to be modified to ensure specific protection against chemical migration into food marketed for children

Materials and Methods

Recruitment

The aim was to recruit a sample of children which were representative of the UK population as a whole in terms of socio-economic status, urban- rural mix and ethnicity. Participants were selected from the volunteers based on these criteria. Socio-economic status was assessed using Index of Multiple Deprivation (IMD). The IMD is based on lower level super output areas and incorporates aspects such as

health, crime, barriers to entering society, employment and the local environment [Communities and Local Government, 2007].

All recruitment took place in Newcastle and the North Tyneside area. Newcastle has been reported to be a representative city for the UK [Charles et al. 1999], the population spans the spectrum of socio-economic status and ethnicity can be represented by the inclusion of schools city wide (ranging from 0-98% ethnicity). The National Diet and Nutrition Survey of young people aged 4 to 16 years found no significant differences between the North and other regions except for higher than average consumption of carbonated drinks in the Northern region [Gregory and Lowe, 2000].

Five nurseries, nine primary schools and one family centre were recruited to take part in the study. Parental consent was sought for participation in the study. Recruitment of preschool children, cared for at home, took place through posters in libraries, leisure centres, supermarkets and local shops. The aim was to complete the study with 100 children in each of three age groups, under 1 year (infants), 1-4 years (preschool) and 4 to 6 years (primary). The distinction between 4 year olds in the middle and upper age groups was based on their attendance at primary school.

Dietary data collection

Food diary

Packaged food intake of all study participants was measured for 4 consecutive days (including both weekend days) using a specially developed food diary. Information was collected on the date and time food or drink was consumed, the brand, pack size and a description of the food. A prospectively recorded food diary with estimated weights was chosen as the method of data collection due to the extensive nature of the information required on food packaging. This required prospective recording in which the subject's carer was required to record pack size and product details at the time of preparation/ consumption of the food.

Estimation of the weight of food consumed using food photographs was selected to minimise the burden on the subject. There is extensive evidence that requiring subjects to weigh and record all food and drink consumed results in changes to

habitual diet [Livingstone et al. 1992]. It was concluded that, given the additional information required on packaging, asking subjects to complete a weighed food diary would over burden them and so be likely to result in reduced response rate and in dietary change over the recording period. To quantify food intake, a combination of food photographs developed specifically for use with children [Foster et al. 2008] and the adult food atlas [Nelson et al. 1997] was used to estimate the amount of food served and amount of food leftover.

Collection of packaging

In addition to the diary, subject's carers were provided with a sealable storage container and asked to keep the packaging of all foods and beverages the child consumed during the recording period. In addition, where samples of food packaging for foods consumed were not collected by the participants, these foods were purchased so that the packaging information could be obtained.

In school/ nursery observations

Children attending nursery or school on the recording days were observed by the research team at every occasion during the day when food was provided. Where possible the food was weighed as it was served to the child and any food leftover was weighed to determine actual consumption. In the school dining hall weighing the food as it was served to the child was not possible due to the number of children being served in a short space of time. In this situation school meals were purchased from the school and an example of the meal selected by each child was used to obtain a weight for each food served. The children's trays were collected at the end of the meal and any food leftover was weighed to determine consumption.

Interview

An interview was conducted with each subject's parent or guardian in their home to obtain estimates of the amount of food consumed, whilst the child was in their care, using food photographs. The interviewer reviewed all entries with the parent or guardian and collected details on the type of packaging for each food, pack size, brand and whether the item was cooked in its pack.

The children's height was measured to the nearest cm using a stadiometer and weight was measured to the nearest 100g using Tanita digital scales, by trained staff following the protocol used in the National Diet and Nutrition Survey [Gregory and Lowe, 2000]. For babies, length was measured using a standard tape measure with the baby in the supine position.

Food packaging database

The type of packaging was identified where possible by visual examination including assistance from industry experts where necessary. Where possible all components of any multilayer materials were identified. A photographic record was taken of each item of food packaging collected. Surface area and food contact material to food mass ratios were calculated for all complete packaging which had been collected. The surface area calculated was the total internal surface area and included any part of the packaging which could be in contact with the food. For example for a yogurt pot the underside of the lid was included in the surface area calculation as this may come into contact with the food depending on the method of storage and transit.

Details from the packaging were entered onto an ACCESS database. This included information on the brand, food name, pack size, pack type, fat content per 100g, food contact material to food mass ratio and whether the food was acidic, alcoholic, aqueous, fatty or dry. Information on packaging type was recorded on three levels:

Main category e.g. glass, plastic, metal, paper/board

Sub category e.g. Polystyrenes, paper, board

Product e.g. HIPS, LDPE, HDPE, PET, recycled board/paper, metal lids with or without gaskets.

These categories were developed in collaboration with industry experts. If more than one material was used in the packaging of a single item, the above information was recorded for each material.

Each unique item consumed was given a unique package food code within the database. An item was considered to be unique if it was a different food type, a different brand, a different pack type or a different pack size. For example Asda mayonnaise was given a different code from Asda tomato ketchup, and tomato ketchup from Asda was given a different code from that for tomato ketchup from

Tesco. A plastic bottle of tomato ketchup from Tesco was given a different code from a glass bottle and a 500g bottle was given a different code from an 800g bottle.

Codes were established for non-packaged items including tap water and loose fruit and vegetables and deli-counter items where the food was loose at the point of purchase and transferred into a paper or plastic bag to hand to the consumer. In addition an 'unknown' category was created and used for items consumed outside the home such as at restaurants, fast food outlets and at friends' or relatives' homes where sufficient information on the packaging type and pack size could not be collected. This code was also used for foods which had been decanted into storage jars and the original packaging discarded before the study began, and where the respondent could not recall the details required.

Coding of individual food diaries

The food diaries were coded using unique product codes in an ACCESS database so that an individual's data on the type and amount of food consumed, along with age, gender, socio-economic status (SES) and anthropometry could be linked with the product information including packaging type, FCM area:foodmass and fat content.

Data analysis

Mean daily intakes of total, packaged and non packaged foods were calculated in g/kg body weight. Mean daily intake of packaged foods was also calculated by pack type in g/kg body weight. Mean intakes were calculated first on an individual basis and then as mean values for each age group.

In order to calculate the total area of packaging to which a child was exposed per day per kg body weight the following equation was used:

$$AB/CD$$

Where A is the mass of a particular food consumed by a child during the survey, B is the FCM for that food expressed in area of contact per mass of food, C is the mass of the child and D is the duration of the survey.

Then a single numerical indicator of possible contamination from the particular food would be:

{(A1B1+A2B2+...+AkBk)/C}/D.

This was used to give the total area of packaging to which the child was exposed per day, per kg body weight.

This numerical indicator increases the greater the amount eaten, the smaller the child and the greater the food contact to food mass ratio.

Results and Discussion

Recruitment

Data on the 4-day food intakes of 297 children, approximately 100 from each age group, were collected (Table 1). The distribution of IMDs in the sample population was very similar to the national sample for age group 1. For age groups 2 and 3 we slightly over-recruited subjects from households with a high IMD indicating that our study population for these age groups has a slightly higher level of deprivation compared with the national average. However, 5.7% of the sample could not be categorised by IMD as they lived in newly built owner occupied houses – the IMD for these houses is likely to be low, that is not deprived. Data were collected on whether subjects lived in an urban or rural setting. Across all age groups 11% of our sample lived in a rural location; nationally 11.2% of people live in a rural location (Table 2) [Office for National Statistics, 2001].

We also collected data on whether our subjects were from an ethnic minority background. Across all age groups, 7.7% of our sample was from ethnic minority origins compared with 7.9 % at the national level (Table 2) [Office for National Statistics, 2001]. The information collected in terms of socio-economic status and the proportion of children from ethnic minority backgrounds clearly supports the conclusion that the sample is unbiased and that Newcastle is a typical UK city. The observed intake of packaged food can therefore be taken to represent packaged food intake in UK children.

Database of packaged foods

During the course of the study, data were collected on 6615 unique food items and entered into the database. Of the 6615 items, 6159 (93%) were packaged products

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with the remainder including non-packaged items such as loose fruit and vegetables, tap water, meat bought loose from butchers and deli counter items.

Children's intakes of packaged foods

The mean total food intake in kg per day for the 1 to 4 year old age group were found to be 1.4kg which is very close to the mean intakes of 1.5kg food per child per day for 1½ to 4½ year olds in the National Diet and Nutrition Survey [Gregory et al. 2000].

Table 3 shows the mean daily intakes per kg body weight for each age group of packaged foods (and drinks), total food, non-packaged items and items where packaging information was not known. As age increased, food intake/kg body weight fell. Infants aged 0-1 years consumed 136.9g/kg body weight, children of 1-4 years consumed 99.9g/kg body weight and children aged 4-6 years consumed 70.4g/kg body weight. Children aged 1-4 years had the highest intake of packaged food/kg body weight at 67.6g/kg, with infants (0-1 years) and children aged 4-6 years having very similar intakes (49.5g/kg and 48.0g/kg respectively).

For the three age groups combined, 54% of the total weight of food consumed was derived from packaged items. Non-packaged items included tap water and fruit and vegetables purchased loose. The infants (under one year) had a much lower proportion of their intake from packaged foods mostly due to their consumption of breast milk or formula reconstituted with tap water but also because a number of infants were fed puréed fruits and vegetables which had been purchased loose. The children aged 1-4 years and 4-6 years both derived 68% of their intake from packaged foods. There was a large variation in individual intakes ranging from 2.5g per kg body weight, for an infant fed formula milk and puréed fruit and vegetables purchased loose, to 182.5 g per kg body weight for a 2 year old child fed predominantly pre-prepared packaged foods. Overall only 3% of intake/kg body weight was of unknown packaging ranging from 1% for infants (under one year) to 4% for children aged 1-4 years.

Table 4 shows the mean daily intake of packaged food by age group and by main packaging category (e.g. plastic, glass, metal and alloys). For all age groups, foods packaged in the main category 'plastic' represented the greatest proportion of

packaged foods consumed (67%). Infants (under one year) had the lowest proportion of intake from foods packaged in plastic, due mainly to high consumption of commercial baby foods which are generally packaged in glass jars, small food cans and/or multilayer packets. Children in age group 1-4 yrs had the highest intake of foods packaged in plastic/kg body weight (mean = 50.5g/kg).

Figure 1 shows that the mean intakes of foods packaged in plastic per kg body weight for children of all ages were greater than the 16.7g per kg body weight assumed in the EU model. Some individual children's intakes greatly exceeded this level and for the 1-4 year old children no child had an intake of foods packaged in plastic per kg body weight below 16.7g per kg body weight, 63% of the infants (under one year) and 97% of the 4 to 6 year olds had intakes in excess of this level.

Multilayer packaging was the second most commonly used main category of packaging for food consumed with an overall average of 12% of the packaged foods consumed/kg body weight packed in multilayer packaging. Examples of this type of packaging included fresh fruit juice cartons, packets of dry mixes for sauces and pasta meals and multilayer cylinders for snacks. Intake of foods packaged in multilayer items varied across the age groups being highest for children aged 4-6years (15% of all packaged items/kg body weight).

Metal and alloys and glass were the other main categories of packaging making a significant contribution to the children's intakes especially for the infants (under one year) where metal and alloys were the second most important main category of packaging of food consumed (17% of all packaged items/kg body weight). Across all age groups metal and alloys accounted for 9% and glass 8% of all packaged foods consumed .

Foods packaged in paper and board, paraffin and microcrystalline waxes, textiles and wood made a minimal contribution to the children's diets. Examples of items packaged in these pack types include raisins (paper and board), babybel cheese (paraffin and microcrystalline waxes), rice (textiles) and balsamic vinegar (cork stopper).

Food contact material area:food mass ratio was calculated for 92.6% of the weight of food consumed by the children. For a further 3.6% FCM area:food mass ratios were imputed from mean values for that food and packaging type and pack size. This could not be done for 3.8% of the weight of food consumed and these foods were excluded from the analysis of FCM:food mass ratio presented in Table 5 which refers to 96.2% of foods consumed. Table 5 shows the average surface area of packaging in contact with the food consumed daily for each age group. For all age groups combined, an average 10.7dm^2 of packaging was in contact with the food consumed per day. This equated to 0.7dm^2 of packaging per kg body weight and 7.7dm^2 of packaging per kg of food consumed. Again, there were large variations in individual intakes with mean daily packaging in contact with the food consumed ranging from 0.8dm^2 to 37.9dm^2. The surface area of packaging in contact with daily food consumed, expressed per kg body weight, ranged from 0.1dm^2 to 2.5dm^2 and the area of packaging per kg food consumed ranged from 0.8dm^2 to 20.8 dm^2. The 4-6 year old age group had the highest mean area of packaging in contact with the food consumed (14 dm^2) and the greatest mean surface area of packaging per kg of food consumed (9.7dm^2). The infants (under one year) had the lowest mean surface area of packaging in contact with the food consumed due to the large amount of non-packaged items consumed by this group. The surface area of the packaging in contact with the food exceeded 6 dm^2 per kg of food for both the 1-4 year old and the 4-6 year old age groups. All children taking part in the study had intakes which exceeded 0.1dm2 of packaging per kg of body weight assumption.

The 297 children consumed a total of 978kg of packaged food and drink between them over the 4 days during which they recorded their dietary intake. Of these foods, 38% were classified as aqueous, 27% as dry, 23% as acidic, 12% as fatty and 0.01% as alcoholic (from wine used in cooking). As fatty foods have a higher migration potential this means that 88% of the food and drink consumed had a lower migration potential.

This study has shown that, probably because of their higher intakes of food per kg body weight, children consume higher intakes of packaged foods per kg body weight than **assumed** adult intakes. Here we report data on intake of food per kg body weight for specific age groups and the proportion of that food which was packaged for

a sample of children who were representative of the wider UK population in terms of ethnic origin, socioeconomic status and rural:urban mix [Office for National Statistics, 2001]. Mean intakes of food packaged in plastic ranged from 27g per kg body weight (for the infants under 1 year) to 51 g per kg body weight (for the 1-4 year olds). This was significantly higher than the 16.7 g/kg body weight derived from the convention that a person of 60 kg could consume daily up to 1 kg of foodstuffs in contact with a particular plastic.

For Irish children, Duffy *et al* reported similar intakes of total food and drink (overall mean, 1.5kg for 5-12 year old children) compared with those (overall mean, 1.4kg) in this sample of slightly younger UK children [Duffy et al. 2006a]. The fall in intakes of food packaged in plastics (g/kg body weight) with increasing age from 68g/kg body weight for the 1-4 year olds to 48g/kg body weight for the 4-6 year olds in the current study is in line with the mean intakes of 39g/kg body weight reported for the 5-12 year old Irish children [Duffy et al. 2006a]. However, the highest consumers had intakes very much greater than these values - up to169g/kg body weight for the 4-6 year old age group.

The area of food packaging in contact with the foods consumed was measured and the ratio of food contact material area:food mass was calculated. For infants (less than one year old), the mean area of packaging per 1 kg food was less than 6 dm^2 compared with 8.3 dm^2 and 9.7 dm^2 for children aged 1-4 and 4-6 years respectively.. For all age groups together, the mean surface area of packaging associated with 1 kg of food was 7.7 dm^2. There was large variation in the surface area of packaging associated with 1 kg of food ranging from 0.8 dm^2 to 20.8 dm^2.

The results of this study together with those of Duffy et al.(2006a) suggest that the assumptions of the EU legislation in terms of intakes of packaged food per kg body weight and mean surface area of food contact material to food mass ratio may not be as conservative for young children.

This study focused on packaged food as sold to the customer and did not take account of any additional potential exposure due to the transfer of food into food contact materials such as Tupperware, cling film or foil in the home.

The database derived from this study will be used as a source of intake information in the European Commission FP7& FACET project which is looking at consumer exposure to food additives, flavourings and substances migrating from food contact materials.

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Table 1 – Recruitment and Completion

Age group (years)	Target	No. consenting	No. included	Completers	(%)
<1	100	98	98	96	(98%)
1-4	100	131	103	99	(96%)
4-6	100	139	113	102	(90%)
Total	300	368	314	297	(95%)

Table 2 – Characteristics of study sample

Age group (years)	Male:Female	Urban:Rural	% Rural	Ethnicity Majority:Minority	% minority ethnic group	IMD† (National Mn =21.8)
<1	53:43	89:7	7.3	92:4	4.2	21.9
1-4	39:60	81:18	18.0	93:6	6.1	29.5
4-6	52:50	94:8	7.8	89:13	12.7	23.9
All children	144:153	264:33	11.0	275:23	7.7	25.1
National levels*			11.2		7.9	21.8

† - IMD is Index of Multiple Deprivation. The IMD is based on lower level super output areas and incorporates aspects such as health, crime, barriers to entering society, employment and the local environment [Communities and Local Government, 2007].

* - [Office for National Statistics, 2001].

Table 3 – Food intake (g per kg body weight) of packaged and non- packaged foods

Age group (years)		Food intake (g per kg body weight)					
		Total packaged food	Non-Packaged food	Unknown packaging	Deli counter items	Total food	% packaged food
<1	Mean	49.5	85.0	1.6	0.8	136.9	36%
	(SD)	(24.6)	(41.5)	(3.6)	(2.4)	(35.7)	
	Range	2.5-142.9	11.1-200.8	0.0-21.1	0.0-18.3	64.9-238.2	
1-4	Mean	67.6	26.9	4.2	1.1	99.9	68%
	(SD)	(23.4)	(18.6)	(5.0)	(2.2)	(31.5)	
	Range	24.0-182.5	0.0-90.1	0.0-28.3	0.0-14.1	46.0-200.9	
4-6	Mean	48.0	17.4	3.6	1.5	70.4	68%
	(SD)	(16.3)	(10.4)	(4.9)	(2.5)	(21.4)	
	Range	22.9-110.2	1.1-57.9	0.0-35.8	0.0-16.0	36.8-143.5	
Total	Mean	55.0	42.4	3.2	1.1	101.7	54%
	(SD)	(23.4)	(39.8)	(4.7)	(2.4)	(40.4)	
	Range	2.5-182.5	0.0-200.8	0.0-35.8	0.0-18.3	36.8-238.2	

Table 4 – Intake (g per kg body weight of foods) from foods packaged in different packaging types

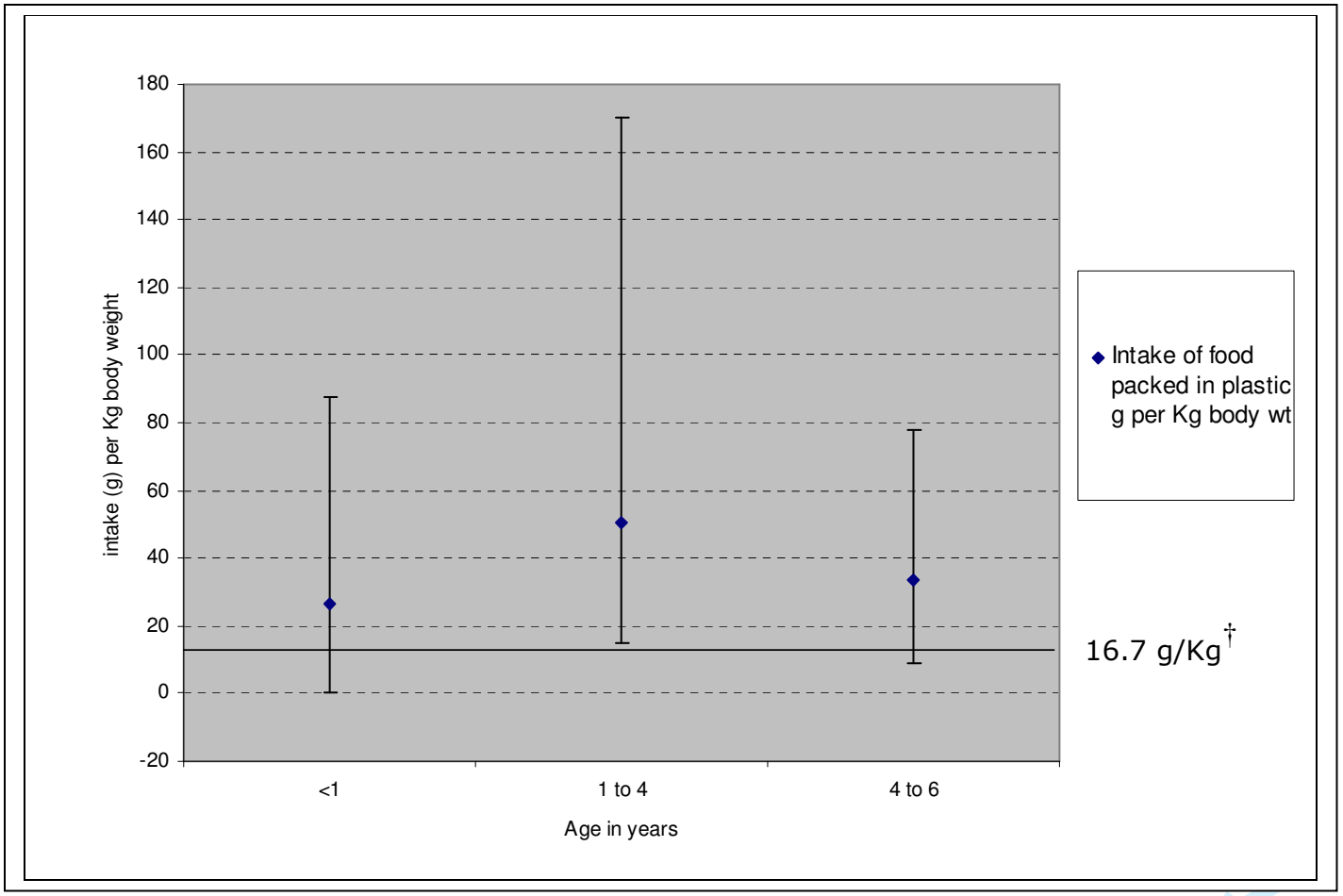
Age group (years)		Mean intake (g) per kg body weight of packaged foods							
		Glass	Metal and alloys	Paper and board	Plastic	Waxes	Textiles	Wood	Multilayer
<1	Mean (%)	6.7 (14%)	8.4 (17%)	0.7 (1.4%)	26.7 (54%)	0 (0%)	0 (0%)	0 (0%)	6.9 (14%)
	(SD)	(8.9)	(8.9)	(1.3)	(19.5)			(0.005)	(13.0)
	Range	0.0-47.8	0.0-43.8	0.0-7.1	0.0-87.6	N/A	N/A	0.0-0.1	0.0-97.9
1-4	Mean (%)	4.0 (6%)	4.5 (7%)	2.2 (3%)	50.5 (75%)	0.1 (0%)	0 (0%)	0.01 (0%)	6.3 (9%)
	(SD)	(6.9)	(3.6)	(2.0)	(23.6)	(0.2)		(0.04)	(6.2)
	Range	0.0-35.4	0.0-15.7	0.0-9.7	14.7-169.8	0-1.3	N/A	0.0-0.2	0.0-25.3
4-6	Mean (%)	2.3 (5%)	2.6 (5%)	1.9 (4%)	33.8 (70%)	0.02 (0%)	0.2 (0%)	0.02 (0%)	7.1 (15%)
	(SD)	(4.4)	2.3	2.0	12.4	(0.07)	(1.6)	(0.04)	(8.4)
	Range	0.0-22.2	0.0-8.9	0.0-12.5	9.1-78.0	0.0-0.4	0.0-15.8	0.0-0.2	0.0-46.7
Total	Mean (%)	4.3 (8%)	5.1 (9%)	1.6 (3%)	37.1 (67%)	0.03 (0%)	0.1 (0%)	0.01 (0%)	6.8 (12%)
	(SD)	(7.2)	(6.1)	(1.9)	(21.4)	(0.1)	(0.9)	(0.03)	(9.5)
	Range	0.0-47.8	0.0-43.8	0.0-12.5	0.0-169.8	0.0-1.3	0.0-15.8	0.0-0.2	0.0-97.9

Table 5 Mean surface area of packaging in contact with the food consumed daily.

		Mean daily		
		Area of packaging (dm^2) *	**Area of packaging (dm^2) per kg body weight+**	**Area of packaging (dm^2) per kg of food†**
<1	Mean	5.97	0.65	4.92
	(SD)	(3.011)	(0.325)	(2.25)
	Range	0.8-20.0	0.1-2.3	0.8-11.6
1-4	Mean	11.70	0.81	8.31
	(SD)	(4.712)	(0.316)	(2.548)
	Range	4.5-37.9	0.3-2.5	4.2-18.5
4-6	Mean	14.15	0.66	9.66
	(SD)	(4.826)	(0.224)	(3.015)
	Range	3.0-30.3	0.2-1.4	2.7-20.8
Total	Mean	10.69	0.71	7.68
	(SD)	(5.468)	(0.299)	(3.291)
	Range	0.8-37.9	0.1-2.5	0.8-20.8

*This is the average surface area of packaging (dm^2) in contact with the food consumed daily
+ This is the average surface area of packaging (dm^2) in contact with the food consumed daily expressed per kg body weight
† This is the area (dm^2) of packaging per kg of food consumed

Figure 1 – Mean and range of intakes in g per kg body weight of foods packaged in plastic


180
160
140
120
100
80
60
40
20
0
-20
intake (g) per Kg body weight
<1
1 to 4
4 to 6
Age in years
Intake of food packed in plastic g per Kg body wt
16.7 g/Kg†