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# Canned Food Consumption – Swiss Survey 2001

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## Introduction

Knowledge of food consumption is essential to manage two areas of public health: nutrition and food safety. One of the objective of food safety is to assess the risk raised by the consumption of contaminated food. For this, it is necessary to evaluate the exposure of the population to the contaminants. Level of contamination (i.e. concentration in the food), amount and frequency at which the contaminated food is eaten, are key variables to measure the exposure. By comparing the exposure with toxicological data it is possible to determine a contamination level below which consumer's health is protected. Such a value is set afterwards as a limit in the legislation.

In Switzerland, the part of principal foods in the diet is deduced from domestic production, importation and exportation data (1). This information is often insufficient in order to establish an accurate risk assessment of contamination. Effectively, diet obtained from economic data only reports an averaged estimate of the consumption but does not reveal the real, complete image of food intake. Besides standard consumers, there are individuals who significantly eat less and others who eat more than the average. Yet, the legislation is supposed to protect everyone. Therefore it is fundamental to measure not only the *per capita* consumption, but also the extremes of dietary intake.

Contamination related to packaging represents a special case in risk assessment of contaminated food. Different packaging materials are used to pack a given foodstuff and a definite contaminant is not specific to a particular food. New developments in packaging technology as well as marketing trends induce rapid changes in the packaging systems in use. Therefore, it is often difficult to follow the pathway of a particular migrant in the diet and consequently to assess the real exposure. To manage this difficulty the European legislation utilises a worst-case estimate of the exposure. The legislation postulates that, in the case of a migration from a package

to the food, the consumer eats daily one kilogram of this possibly adulterated food during his lifetime. This assumption is used to define the *specific migration limit* (SML is the maximum concentration of the contaminant tolerated in the food) that is set in the legislation. It is evident that in most cases this assumption overestimates the real consumption value (e.g. for fatty foods). Canned food is one example where a 1 kg daily intake is recognised to be too high. European experts are evaluating presently the possibility to introduce correction or reduction factors (2, 3) for given foods and specific packaging systems in order to correct the inaccuracy of the regulation concept.

The primary goal of this survey was to determine the distribution of the consumption of canned food in Switzerland in order to check the new correction factors under discussion for an improved food packaging legislation. A secondary objective was to gain experience on the possibilities and difficulties of a survey carried out entirely by electronic means. This point will not be discussed in this paper.

## Methodology

### Collective

The participants were recruited in the federal administration. They were free to register and no registration was rejected. The study also included the family of each registered participant, the family was defined as all persons living in the household (regardless of relationship) and sharing the meals. Infants too young to eat canned food and family members away from the household for more than three days during the observation period were excluded from the survey. Information on the objectives of the study as well as detailed documentation on the procedure of the survey were provided to the subjects prior to their registration.

### Study protocol

The survey was carried out in September 2001. Participants had to report the overall number of food cans used by the family during seven consecutive days. Only metallic food cans were recorded. Glass jars and canned beverages were excluded from the study. Canned food was classified in eight different categories: *vegetables, fruits, meat, fish, soups, ready-to-eat meals, milk products and other foods*. Only cans used at home or taken from home for lunch were considered for the survey.

The following information was also requested: age and gender of each participant in the family, the number of inhabitants in the municipality of residence. In addition to the family intake, participants were asked to estimate their individual consumption compared to the family average. Participants could declare themselves as "*normal consumers*", "*low consumers*" or "*high consumers*". They reported the intake frequency (9 choices) and the category of canned food most frequently eaten (for "*high consumers*").

## Recording of results

The survey was carried out exclusively by electronic means (E-mail and Internet) and data transfer was fully automated. The School of Engineering of Fribourg (Switzerland), Department of Telecommunication, developed the computer application and programs used in this study.

Each federal employee having an E-mail address was contacted (ca. 20000 addresses) with a brief invitation to participate. This message contained the address of an Internet site accessible in French, Italian and German. Information on the study objectives and documentation of the survey protocol could also be downloaded. The site was divided in two sections: *Registration* and *Results*. The two sections were not opened simultaneously to avoid possible mistakes. Registration was only possible between 4 and 12 of September and transmission of the collected information between 14 and the 28 of September. An E-mail address was accessible to the participants during the survey allowing them to report their problems and to ask questions. After registration, each participant received, per E-mail, a confirmation of her/his enrolment together with a *User Identification-code* (UID). This UID was necessary to enter the *Results* section and to transmit the observed data. The UID could only serve for one data transmission. This process guaranteed the complete anonymity of the participants and protected the study against multiple, false entries. The figures of each participant were automatically added to a data file (CSV format), which was used for the statistical analysis.

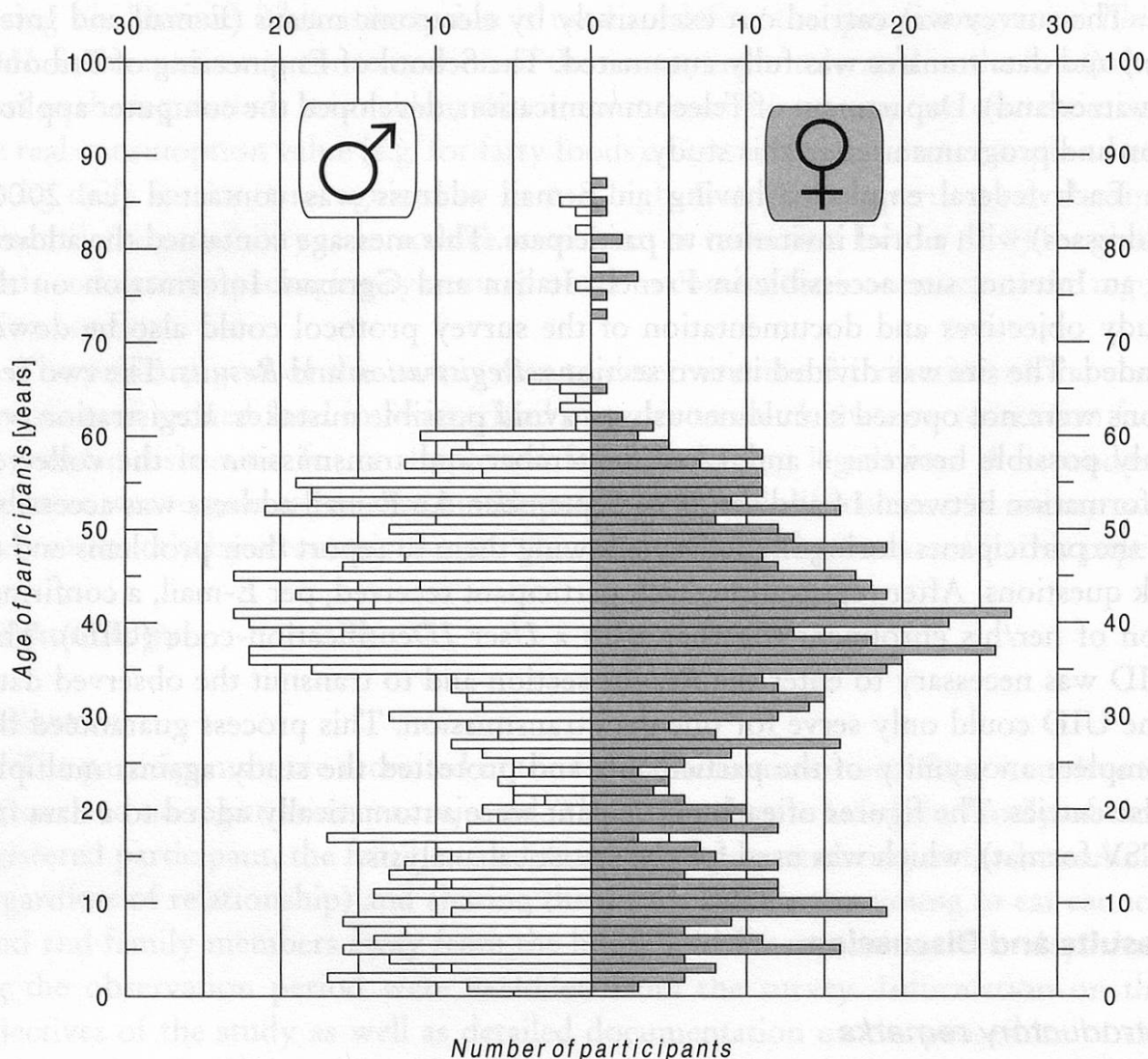
## Results and Discussion

### Introductory remarks

This survey intended to determine an initial profile of canned food consumption in Switzerland. The participants were not selected according to specific criteria usual in statistical surveys. Therefore, results should not be interpreted as typical for the Swiss population without caution. Moreover, these reported data reflect only the mathematical analysis of the numbers reported to us. They do not include any positive or negative judgement on the diet patterns of the participants.

### Participants

A total of 1477 people registered and received an UID. Out of this number, 562 result-forms were sent back. With all members of the families, the number of participants was 1466 persons (712 women and 754 men). The pyramid of ages depicted in figure 1 enables a better visualisation of the participants. It appears remarkably symmetrical; up to 65 years (retirement age) all ages are represented more or less equally with a small deficit between the 20–30 years. Figure 2 depicts the distribution of the family size. With ca. 40 %, homes with two members represent the majority of participants. Homes with more than five members represent

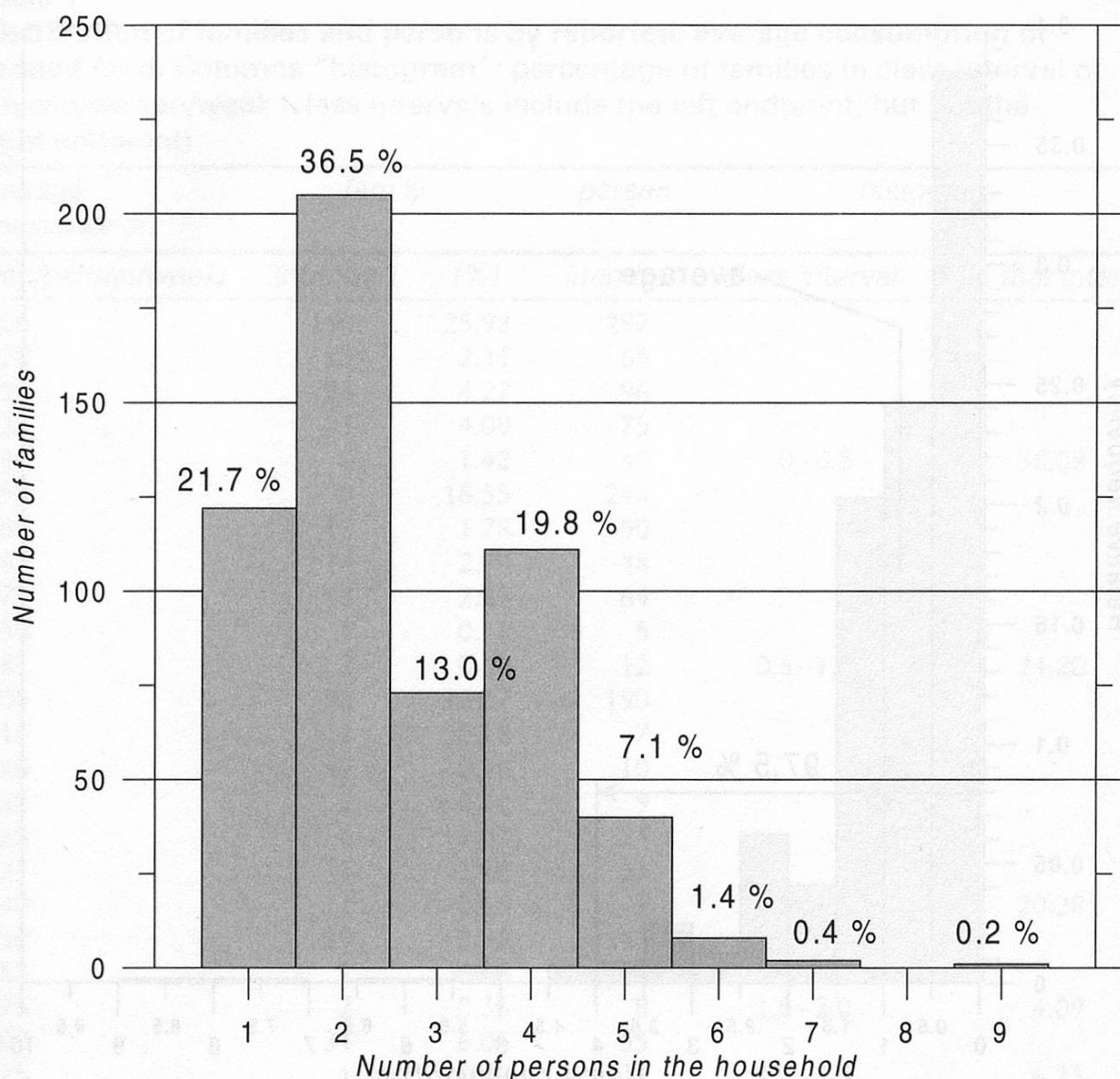


**Figure 1 Number of male and female participants by class of age**

only 2 % of the answers. This fact is not surprising as it reflects the situation of the family size in Switzerland.

### ***Consumption: average and extremes***

Altogether, the 1466 participants ate 1126 food cans during the one-week survey. This corresponds to a per capita consumption of 0.77 can per person and per week. This number matches quite well with the average consumption in Europe (1 can per person and per week) reported by the industry based on market data (4). Each of the 562 participating families reported the total number of food cans used during a week by its members. With this data it is not possible to get an average consumption for each individual, but only an average for the family. By grouping the averages in class intervals of 0.5 (can/person/week) and drawing them in a histogram, one obtains the distribution curve of the consumption (fig. 3). The distribution is

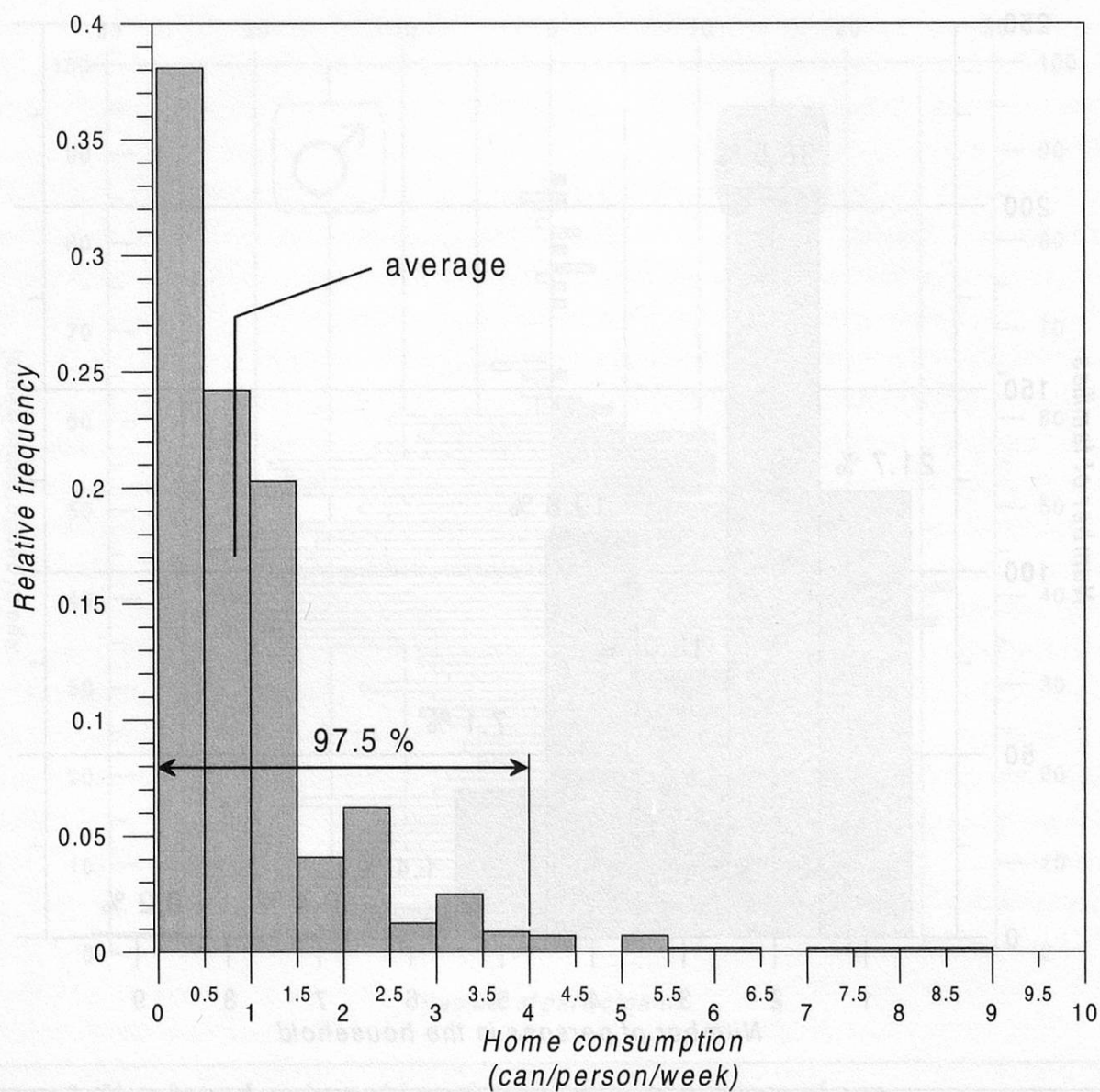


**Figure 2 Distribution of families by size**

strongly left skewed with the median (50 % percentile) at 0.47 can/person/week. The average home consumption is 0.85 can/person/week with a standard deviation of 1.1. This home consumption should not be confused with the per capita consumption. It is the arithmetic mean of the average consumptions reported by the 562 families. The histogram is balanced (at equilibrium) at that point. This value gives a more exact image of the real average consumption because a can is not necessarily a portion but shared by the family members during the meals.

The histogram was plotted with 18 equal class intervals in order to make it more informative. Table 1 reports the complete set of the measured consumptions. From these data the following additional information can be obtained:

- 26 % of the families did not eat canned food
- the highest measured consumption is nine cans per person and per week
- the 97.5 percentile of the histogram is located at four cans per person and per week.



**Figure 3 Distribution of can consumption in family (histogram built up with left endpoint convention)**

It is generally accepted as a rule that, for staple foods, the 97.5 percentile deviates from the mean consumption by a factor of 3. The histogram indicates clearly that for canned food the distribution curve is more stretched with a factor 5 and 10! for the 97.5 and 99 percentile respectively.

The average consumptions given in table 1 show distinct peaks for values of 1, 1.5, 2, 2.5 and 3 can/person/week. This is purely incidental and due to the fact that both, the family size and the number of cans reported in the survey are discrete variables. Both variables increase by fixed amount of 1, 2 and so on. Although the average consumption is a continuous variable, some values are not possible whereas others are favoured: e.g. a family of two persons could eat food from 1, 2, 3, or 4 cans,

Table 1

**Distribution of families and persons by reported, average consumption of canned food.** Columns "histogram": percentage of families in class interval of 0.5 can/person/week (class intervals include the left endpoint, but not the right endpoint)

| average<br>consumption | family   |       | person   | histogram      |                    |
|------------------------|----------|-------|----------|----------------|--------------------|
| (can/person/week)      | (number) | (%)   | (number) | class interval | % in that interval |
| 0.00                   | 146      | 25.98 | 297      |                |                    |
| 0.20                   | 13       | 2.31  | 65       |                |                    |
| 0.25                   | 24       | 4.27  | 96       |                |                    |
| 0.33                   | 23       | 4.09  | 75       |                |                    |
| 0.40                   | 8        | 1.42  | 40       | 0–0.5          | 38.08              |
| 0.50                   | 93       | 16.55 | 248      |                |                    |
| 0.60                   | 10       | 1.78  | 50       |                |                    |
| 0.67                   | 14       | 2.49  | 48       |                |                    |
| 0.75                   | 16       | 2.85  | 64       |                |                    |
| 0.80                   | 1        | 0.18  | 5        |                |                    |
| 0.83                   | 2        | 0.36  | 12       | 0.5–1.0        | 24.20              |
| 1.00                   | 92       | 16.37 | 190      |                |                    |
| 1.14                   | 1        | 0.18  | 7        |                |                    |
| 1.20                   | 2        | 0.36  | 10       |                |                    |
| 1.22                   | 1        | 0.18  | 9        |                |                    |
| 1.25                   | 6        | 1.07  | 24       |                |                    |
| 1.33                   | 11       | 1.96  | 33       |                |                    |
| 1.40                   | 1        | 0.18  | 5        | 1.0–1.5        | 20.28              |
| 1.50                   | 19       | 3.38  | 42       |                |                    |
| 1.67                   | 2        | 0.36  | 6        |                |                    |
| 1.75                   | 2        | 0.36  | 8        | 1.5–2.0        | 4.09               |
| 2.00                   | 34       | 6.05  | 55       |                |                    |
| 2.25                   | 1        | 0.18  | 4        | 2.0–2.5        | 6.23               |
| 2.50                   | 6        | 1.07  | 14       |                |                    |
| 2.75                   | 1        | 0.18  | 4        | 2.5–3.0        | 1.25               |
| 3.00                   | 14       | 2.49  | 20       | 3.0–3.5        | 2.49               |
| 3.50                   | 5        | 0.89  | 10       | 3.5–4.0        | 0.89               |
| 4.00                   | 4        | 0.71  | 5        | 4.0–4.5        | 2.49               |
|                        |          |       |          | 4.5–5.0        |                    |
| 5.00                   | 4        | 0.71  | 5        | 5.0–5.5        |                    |
| 5.75                   | 1        | 0.18  | 4        | 5.5–6.0        |                    |
| 6.00                   | 1        | 0.18  | 1        | 6.0–6.5        |                    |
|                        |          |       |          | 6.5–7.0        |                    |
| 7.33                   | 1        | 0.18  | 3        | 7.0–7.5        |                    |
| 7.50                   | 1        | 0.18  | 4        | 7.5–8.0        |                    |
| 8.00                   | 1        | 0.18  | 2        | 8.0–8.5        |                    |
| 9.00                   | 1        | 0.18  | 1        | 8.5–over       |                    |
| total                  | 562      | 100   | 1466     |                | 100                |

generating a consumption of 0.5, 1, 1.5 and 2 respectively. The use of class intervals of 0.5 can/person/week masks this effect in the histogram.

Food cans on the market are available in many different sizes but this information was not considered during the survey to keep it simple. The size factor could possibly bias the reported results because a meal could be prepared with a foodstuff from several small cans or from one big "family-can". However, the amount of canned food used in the meal preparation is supposed to be similar in both examples. To estimate the intake of canned food by weight and not by number of cans, the average can size needs to be guessed. A can of 400 g (dimensions: Ø 75 mm, h 110 mm) can be considered as a large can and consequently as a worst case for the calculation. This leads to the result that 97.5 % of the consumers eat less than 230 g of canned food per day (4 cans of 400 g per week). It follows that an intake of 1 kg exaggerates the real consumption by a factor of 5 for the majority of consumers. For the very few, extreme consumers (9 cans/week), the factor is still 2.

The participants were asked to give an estimate of their individual canned food intake. The reason for this was to reveal individuals with extreme consumption habits whose records could have been hidden in the average consumption of the family. 323 families declared "non average" consumers: 686 low consumers (disseminated in 293 families) and 57 high consumers (in 30 families). Analysis of data suggests that the canned food consumption is rather homogeneous within the family, i.e. all persons in a family have the same consumption habits. Effectively, 7 % of these 323 families include both "normal" and "non-average" consumers in the same family (only 1.2 % with both "low" and "high consumers"). The majority of the families consists of persons with a similar eating habit. Table 2 gives the number of "extreme" consumers by the frequency of intake. It is not possible to directly compare these figures with average data reported for the family (table 1). The average values are real, counted data whereas the individuals answers are the result of an estimate. However, some limited information can be drawn. It is evident that the 32 persons, who declare to never eat canned food, do match the 297 persons (26 % of participants) with an intake of 0 can/week during the survey. This indicates that

**Table 2**  
**Repartition of individual consumers by periodicity of intake**

| <i>Periodicity</i> | <i>Low consumers</i> | <i>Average consumers</i> | <i>high consumers</i> |
|--------------------|----------------------|--------------------------|-----------------------|
| never              | 32                   |                          |                       |
| <1× per 3 months   | 50                   |                          |                       |
| <1× month          | 158                  |                          |                       |
| <1× week           | 446                  |                          |                       |
| 1× a week          |                      |                          | 4                     |
| 2× week            |                      |                          | 12                    |
| 3× week            |                      |                          | 24                    |
| 1× day             |                      |                          | 17                    |
| >1× day            |                      |                          | 0                     |
| total              | 686                  | 723                      | 57                    |

real “non-consumers” are a minority in the group of participants. The distribution of the consumption (histogram) misses precision in that range of intake probably because the time of survey is too short compared to the intake frequency of the consumers. For high range, it is interesting to see that the highest value reported is one can/day. This appreciation corresponds well with the highest measured intake of nine cans/week and consequently can be taken with confidence as the most extreme intake for canned food.

### *Types of food eaten*

The participants reported the total number of cans eaten classified in eight different categories of food. Table 3 shows that vegetables, accounting for 41 % of all cans, represent the largest fraction. Fish (17 %) and fruits (15 %) come in second and third rank, respectively. Besides this trio, the consumption of other food types appears to be limited. This information is important to understand the exposure to migrants. Effectively, vegetables and fruits are aqueous and acidic type of foods and fish can be considered as fatty food. The migrants, which could possibly diffuse from can coatings into foodstuff, change accordingly with the solubility characteristics of the food. However, these results should take into account the fact that the survey was carried out in September. It is likely that the intake of vegetables and fruits are governed by a seasonal variation.

**Table 3**  
**Repartition of canned food eaten by category. (a) from ref. 4 (1997 data)**

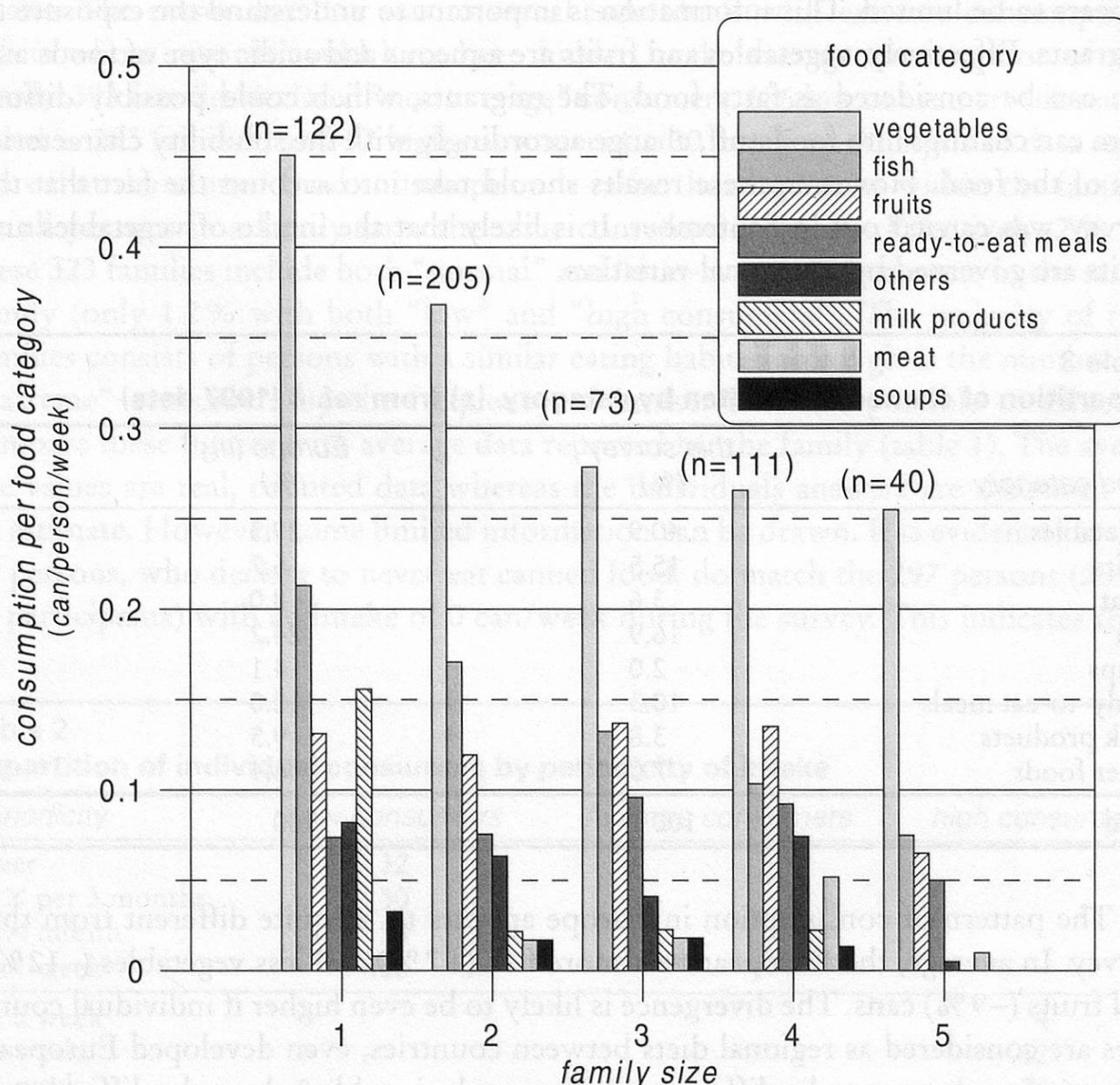
| <i>food category</i> | <i>this survey</i><br>(%) | <i>Europe (a)</i><br>(%) |
|----------------------|---------------------------|--------------------------|
| vegetables           | 40.9                      | 29.2                     |
| fruits               | 15.5                      | 6.7                      |
| meat                 | 3.6                       | 8.0                      |
| fish                 | 16.9                      | 24.2                     |
| soups                | 2.0                       | 4.1                      |
| ready-to-eat meals   | 10.3                      | 12.0                     |
| milk products        | 3.8                       | 9.5                      |
| other foods          | 7.0                       | 6.4                      |
| total                | 100                       | 100                      |

The pattern of consumption in Europe appears to be quite different from this survey. In average, the Europeans eat more fish (+7 %) and less vegetables (–12 %) and fruits (–9 %) cans. The divergence is likely to be even higher if individual countries are considered as regional diets between countries, even developed European countries, are known to be different (5). The results in table 3 show the difficulty of estimating the exposure from global production data because the specificity of regional consumption is not reflected.

Food types preferred by high-consumers are slightly different from the family average. Vegetables with 49 % of the answers come first and are followed by fish (19 %) and ready-to-eat meals (16 %). All other food categories make up less than 10 % of the answers.

### *Influence of family size*

The family size has a direct influence on the consumption of canned food as shown in figure 4: a larger family definitively eats less canned food than a smaller one. There are various reasons to explain this trend, but they were outside the scope of the study and were not further investigated. The tendency is particularly obvious for vegetable and fish cans, which together represent 55 % of all cans. The pattern of



**Figure 4 Consumption of the different food categories by family size. Number in bracket is the number of families in this class**

consumption for the other food categories appears to remain unchanged with the number of persons in the family. The category "milk products" makes exception to the rule: persons living alone consume at least seven times more canned milk products than families with two or more persons.

### **Other observations**

A selection of families composed only by adults (age > 16 years) of the same sex allows to check the influence of the gender on canned food consumption. It appears that women eat less canned food (0.8 can/person/week) than men (1.4 can/person/week). This result should be considered with caution as the size of the subpopulation is small (women:  $n=77$ , men:  $n=82$ ) and other factors may also play a role.

The influence of the place of residence was also investigated. It was not possible to show a difference in the can consumption among families living in an urban or a country community.

### **Conclusions**

For the first time a food consumption survey related to packaging was carried out in Switzerland. The measured average intake is close to the *per capita* consumption reported by the European industry. Although the group of participants was not defined, this fact denotes the quality of estimates and supports the idea that the distribution curve is also representative of the real diet in Switzerland. It is clear that the survey needs to be repeated to increase the confidence in the results and to check the importance of factors such as seasonal or regional variations. However, these first data of the intake of canned food serve as a basis for a better appreciation of exposure to migrants from can coatings.

### **Summary**

The consumption of canned food in Swiss households was recorded in a seven-day survey. The average and the 97.5 percentile intake were measured at 0.85 and four cans per person and week respectively. Vegetables, fish and fruits are the principal food categories and represent 74 % of canned food consumed in this study. The results show that the risk assessment in Europe overestimates canned food intake by approximately a factor 5.

### **Zusammenfassung**

Der schweizerische Verbrauch von Lebensmitteln aus Konservendosen wurde in einer Befragung über sieben Tage ermittelt. Der durchschnittliche Verbrauch und die 97,5-Perzentile betrug 0,85 bzw. vier Dosen pro Person und Woche. Gemüse, Fisch und Früchte sind die wichtigsten Nahrungsmittelkategorien und machen 74 % des betroffenen Gesamtverzehrs aus. Die Resultate zeigen, dass die in der EU

gebräuchliche Modellrechnung das von Konservendosen ausgehende Risiko ca. um einen Faktor 5 überschätzt.

## Résumé

La consommation d'aliments en conserve dans les familles suisses a été mesurée dans une enquête de sept jours. La consommation moyenne ainsi que la valeur à 97,5 % de la courbe de consommation ont été mesurées à 0,85 et quatre conserve/personne et semaine. Les légumes, le poisson et les fruits sont les aliments principaux et représentent 74 % des conserves consommées dans cette enquête. Les résultats indiquent que, dans l'évaluation du risque en Europe, la consommation des conserves est surestimée d'un facteur 5 environ.

## Key words

Food consumption, Food can, Diet, Exposure

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