

# Food contamination from the food packaging metals aluminum and tin: estimation of their dietary exposure in an Italian adult community

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## Introduction

Aluminum and tin are metals widely used by humans as food packaging material and in the general population the dietary intake it one of the most common source of exposure. The concentration in foods is variable and depends on the original food content and to through contamination from food packaging containers and

cookware. High metal exposure and in particular to aluminum has been suggested to play a role in the neuronal toxicity leading to Alzheimer’s Dementia. This study aims at estimating the aluminum and tin dietary intake of an Italian adult population.

## Methods

We assessed dietary habits of a Norther Italian community though the validated EPIC questionnaire, a semi-quantitative food frequency questionnaire (FFQ) specifically developed for the Central-Northern Italy population. We collected food samples during the period from October 2016 to February 2017, and we measured aluminum and tin content using inductively coupled plasma-mass spectrometry. We then reported the concentrations of investigated trace elements according

to the food consumption patterns and food categories typical of this Italian population, as assessed though the EPIC FFQ. We combined data on the estimated trace elements in foods and the EPIC FFQ to compute total daily trace element intake using the equation in Box 1. Accordingly, we estimated the daily dietary aluminum and tin intake for the total diet and for each food category by reporting median and interquartile ranges of intake.

Daily dietary exposure  $\left(\frac{\mu g}{day}\right) = \sum \frac{element\ food\ content\ \left(\frac{\mu g}{kg}\right) \times food\ intake\ \left(\frac{g}{day}\right)}{1000}$

Box 1. Equation for element daily intake estimation

Food (N)	Aluminum (µg/kg)		Tin (µg/kg)	
	50 <sup>th</sup>	(IQR)	50 <sup>th</sup>	(IQR)
Cereals (112)	2470.36	(1466.80 - 5685.81)	3.60	(0.97 - 8.58)
Meat (86)	584.59	(367.16 - 1181.77)	5.73	(3.00 - 12.37)
Milk & dairy products (72)	442.54	(218.02 - 1117.32)	3.28	(1.53 - 6.11)
Eggs (9)	127.59	(77.54 - 168.41)	0.45	(0.26 - 0.97)
Fish & seafood (62)	973.05	(432.43 - 2948.74)	4.31	(2.25 - 14.55)
Vegetables (201)	858.22	(283.84 - 2732.59)	3.79	(1.26 - 13.01)
Legumes (43)	7370.23	(1231.42 - 15515.08)	1.65	(0.00 - 4.99)
Potatoes (14)	471.93	(336.16 - 1225.13)	2.19	(1.32 - 4.89)
Fresh fruits (60)	353.20	(177.85 - 706.13)	1.58	(1.04 - 2.52)
Dry fruits (45)	1303.11	(571.52 - 3226.65)	4.53	(2.37 - 8.21)
Sweets (64)	4387.24	(1349.90 - 7949.51)	6.01	(3.14 - 10.21)
Oils and fats (23)	308.76	(167.71 - 449.64)	2.04	(1.00 - 39.95)
Beverages (102)	364.73	(91.96 - 885.03)	1.11	(0.45 - 3.09)

Table 1. Levels of aluminum and tin in analyzed samples divided according to food categories. N: number of samples, IQR: interquartile range.

## Results

We collected a pooled sample of 908 foods. The highest levels were found for aluminum in sweets, ereals and vegetables, and for tin in sweets, meats, fish and seafood. The median estimated daily dietary intake of aluminum was 6133.5 µg/day (Interquartile range - IQR: 3903.3 -

18.231.1 µg/day), with major contribution from beverages and vegetables, followed by cereals. For tin, we estimated a median intake of 68.1 µg/day (IQR: 47.7-94.5 µg/day) with major contribution from vegetables and fruits, followed by meat and dairy products.

Food	Aluminum (µg/day)		Tin (µg/day)	
	50 <sup>th</sup>	(IQR)	50 <sup>th</sup>	(IQR)
Total	6133.49	(3903.25 - 18231.06)	68.07	(47.72 - 94.45)
Cereals	693.05	(430.42 - 1031.53)	2.46	(1.60 - 3.46)
Meat	90.95	(60.16 - 127.91)	7.67	(4.36 - 12.65)
Milk & dairy products	52.96	(31.81 - 78.9)	8.29	(4.08 - 14.78)
Eggs	1.77	(0.96 - 2.78)	0.01	(0.00 - 0.01)
Fish & seafood	68.38	(31.53 - 170.46)	0.75	(0.40 - 1.22)
Vegetables	1032.95	(671.34 - 1598.96)	20.26	(9.29 - 38.41)
Legumes	139.59	(64.66 - 259.68)	0.21	(0.10 - 0.40)
Potatoes	13.66	(8.12 - 24.29)	0.19	(0.11 - 0.33)
Fresh fruits	145.18	(92.04 - 210.48)	10.32	(5.17 - 14.88)
Dry fruits	2.44	(1.44 - 12.22)	0.003	(0.002 - 0.014)
Sweets	283.39	(147.38 - 480.23)	0.54	(0.30 - 0.91)
Oils and fats	8.10	(6.00 - 10.97)	4.41	(1.37 - 10.26)
Beverages	2636.60	(1097.43 - 14956.93)	1.81	(0.95 - 3.44)

Table 2. Estimated dietary intake of aluminum and tin. Values in µg/day.

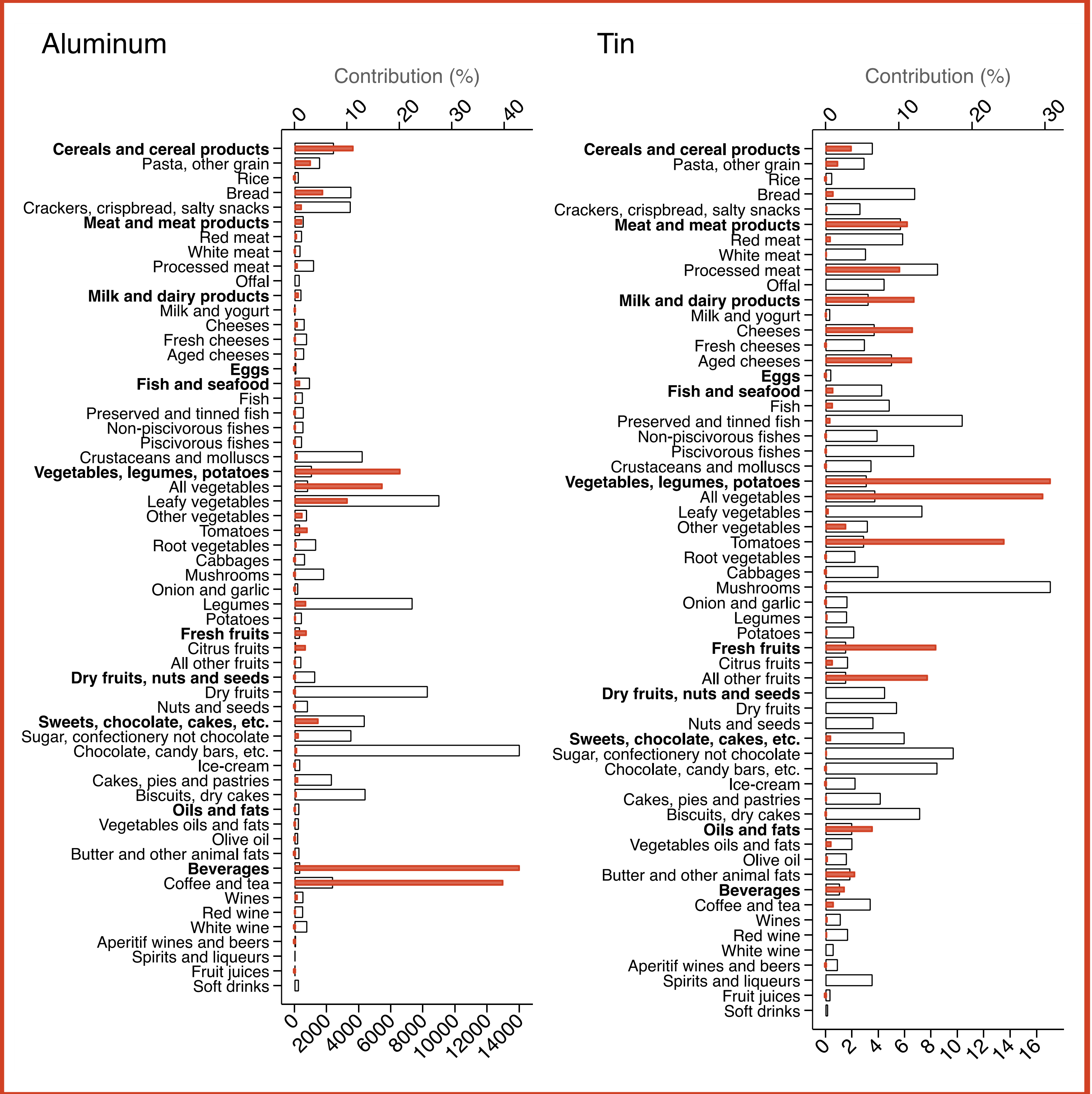



Figure 1. Levels of lead intake (red columns) and contribution of food categories to their intake (white columns).

## Conclusions

Our results provide an estimation of investigation. Finally, the use of a dietary intake of aluminum and tin in an validated food frequency questionnaire Italian community of Northern Italy, in assessing food consumption pattern since the estimation are based on data improved the accuracy of our metals measurements in foods actually updated results.

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