

Tas1r3 and Ucn2 transcript levels in peripheral blood cells are associated with sugary and fatty food consumption and with excess of fat accumulation in children

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Introduction

New types of robust biomarkers of dietary exposure and function are needed to implement strategies for obesity prevention in children.

Of special interest are those biomarkers of consumption of food rich in simple sugars and fat, as their intake has been associated with obesity development. Peripheral blood cells (PBCs) represent a new promising tool for identifying novel transcript-based biomarkers. We studied the potential associations between the expression levels of *Tas1r3* and *Ucn2* genes in PBCs and the frequency of sugary, fatty, and junk food consumption.



Food category	Frequency consumption		Types of food
	25th	75th	
Sugary food	15	33	Fruit juices, sweetened drinks, sugar added cereals, sweetened milk, sweetened yoghurt, and four types of snacks, like chocolate bars, candies, cakes, or ice cream
Fatty food	2	7	Fried potatoes, fried fish, fried meat, fried or scrambled eggs
Junk food	4	12	Sweetened drinks, chocolate or nut based spreads, and three types of snacks, like crisps, chocolate bars, or candies

Table 1. Frequencies of consumption of sugary, fatty and junk food expressed in times per week, corresponding to the 25th and 75th percentiles in the study population. The types of foods included in each category is indicated.

Subjects and Methods

Design, setting and participants: 463 children from the IDEFICS cohort selected to include similar number of boys and girls, with normal-weight and overweight, belonging to eight European countries.

Main outcome measures: Anthropometric parameters (measured at baseline and in a subset of 193 children after two years), food consumption frequency (estimated by the Children's Eating Habits Questionnaire) and expression levels of genes in PBCs (analyzed by RT-qPCR).

Selected candidate genes:

-Taste receptor type 1 member 3 (Tas1r3), which codifies for a sweet taste receptor (TAS1R3).

- Urocortin II (Ucn2); the protein encoded by this gene is a member of the corticotrophinreleasing factor family of peptides, with an important role in the control of food intake.

Results



Tas1r3 mRNA levels

Fatty food frequency (percentile)

<25th

25-75th

<25th 25-75th >75th Junk food frequency (percentile)

Figure 1. Expression levels of Tas1r3 (A, B) and Ucn2 (C, D) in peripheral blood cells in the study population spread according to consumption frequencies (<25th, 25-75th and >75th percentiles) of sugary and junk food (for Tas1r3, taste receptor type 1 member 3) and fatty and junk food (for Ucn2, urocortin II). Results are mean \pm standard error of the mean expressed in arbitrary units (AU). The number of children in each group in indicated. Statistics: $a \neq b$ by LSD post-hoc analysis; p-values of one-way ANOVA are indicated. Association studies between gene expression in PBCs and food consumption frequency

Children with low frequency of consumption of sugary foods displayed higher *Tas1r3* expression levels with respect to those with intermediate or high frequency; furthermore, children with high consumption frequency of junk food showed lower transcript levels of this gene with respect to those with low or intermediate frequency. In turn, children with high frequency of consumption of fatty foods showed lower *Ucn2* expression levels with respect to those with low or intermediate frequency.

Association studies between gene expression in PBCs and anthropometric parameters in a two-year follow-up

The expression levels of *Tas1r3* in PBCs of children (divided into three categories according to percentiles) were significantly associated with the two-year variation of some anthropometric parameters



Association studies between gene expression in PBCs and anthropometric parameters.

>75th

No significant differences were found concerning BMI, percentage of body fat, waist circumference and sum of triceps and subscapular skin-folds among the three categories of children classified according to percentiles of expression of *Tas1r3* and of *Ucn2*. However, as expected, frequencies of sugary and of junk food consumption were different among groups classified according to *Tas1r3* mRNA expression, and frequencies of fatty food consumption were different among groups classified according to *Ucn2* mRNA expression

Tas1r3 mRNA levels Ucn2 mRNA levels high high intermediate intermediate low low (>75th) (>75th) (<25th) (25-75th) (25-75th) (<25th) Anthropometric parameters BMI (kg m-2) 18.3 (0.4) | 19.3 (0.4) 18.6 (0.3) 19.3 (0.4) 18.9 (0.3) 19.1 (0.4) Body fat (%) 34.5 (0.7) 32.9 (0.9) 35.5 (1.0) 33.6 (0.6) 34.6 (0.9) 35.0 (0.9) Waist circumference (cm) 62.3 (0.8) 60.4 (1.1) 63.0 (1.1) 61.7 (0.8) 62.4 (1.0) 63.6 (1.1) Sum of skinfolds (mm) 23.2 (1.2) 27.5 (1.3) 24.4 (0.9) 25.5 (1.2) 27.2 (1.3) 25.5 (0.9) Food intake frequency (times per week) Sugary food 28.6 (1.7) a 25.7 (1.0) a 19.7 (1.4) b 24.9 (1.5) 25.6 (1.1) 24.2 (1.7) Fatty food 5.7 (0.4) 5.4 (0.3) 4.6 (0.4) 6.1 (0.4) a 5.3 (0.3) a 4.0 (0.3) b Junk food 11.6 (1.0) a 8.5 (0.6) b 6.1 (0.6) c 8.6 (0.9) 9.2 (0.6) 8.0 (0.7)

Table 2. Anthropometric parameters and food intake frequencies of consumption of sugary, fatty, and junk food of the study population spread according to expression levels (<25th, 25-75th and >75th percentiles) of Tas1r3 (taste receptor type 1 member 3) and of Ucn2 (urocortin II). Results are mean and standard error of the mean (in brackets). Statistics: $a \neq b \neq c$ by LSD post-hoc analysis.

Figure 2. Changes (Δ) in anthropometric parameters (A: body mass index (BMI); B: percentage of body fat; C: waist circumference; and D: sum of skin-folds) over 2 years in a subset of the study population spread according to expression levels of taste receptor type 1 member 3 (Tas1r3) (<25th, 25-75th and >75th percentiles). Results are mean \pm standard error of the mean. The number of children in each group in indicated. Statistics: a \neq b by LSD post-hoc analysis; p-values of one-way ANOVA are indicated.

Conclusion

Transcript levels of *Tas1r3* and *Ucn2* in PBCs may be considered as potential biomarkers of consumption of sugary, fatty, or junk food, to complement data of food intake questionnaires.

Affiliations

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