Children's propensity to consume sugar and fat predicts regular alcohol intake in adolescence

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on behalf of the IDEFICS and I.Family Consortia

Background

- Adolescence is a sensitive period for initiation to alcohol; alcohol use in adolescence is linked to later alcohol abuse

  Pagan 2006, Huure 2010

- Alcohol dependence runs in families

  (30-50% of individual risk attributed to genetics)

  Cservenka 2016

- Prevention: legal age, availability, identification of modifiable risk factors, e.g. diet

Background

- Animal studies link excessive sugar consumption to addictive-like behavior regarding alcohol

  Avena 2009, Vendruscolo 2010, Murray 2015

- In humans, a greater sweet preference is seen in individuals with alcohol addiction, and in healthy subjects with familial history of alcoholism

  Eiler 2018

Background

- Sugar addiction?

Fortuna 2010, Lustig 2013, Ahmed 2013, Bray 2016

Signs of addiction	Alcohol	Sugar
Reward	x	x
Craving / loss of control	x	x
Tolerance	x	?
Withdrawal	x	?

Benton 2010

Background

- Addiction to palatable foods, e.g. high in sugar and fat

  Levine 2003, Blumenthal 2010, Gearhardt 2011, Benton 2013

- Eating addiction

  Hebebrand 2014

Aim of the study

To identify childhood risk factors for adolescent alcohol use that are potentially modifiable, specifically children's over-consumption of sugar-rich and high-fat foods

Challenges in observational epidemiology

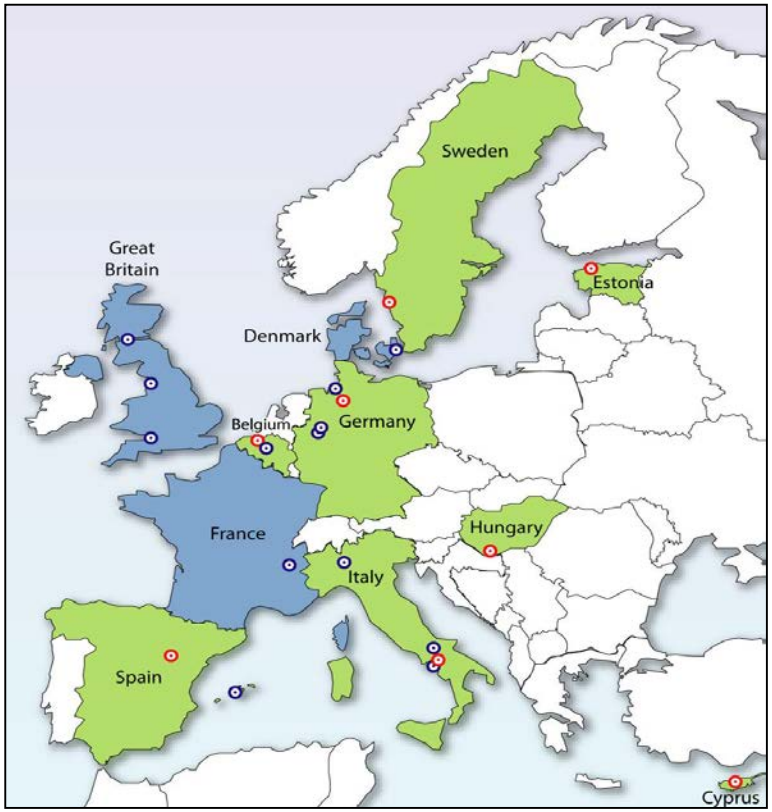
Difficult to investigate the influence of single nutrients because

- no non-exposure
- consumed together

Critical covarying factors

- parents' alcohol use (family history of alcoholism)
- parenting style
- …

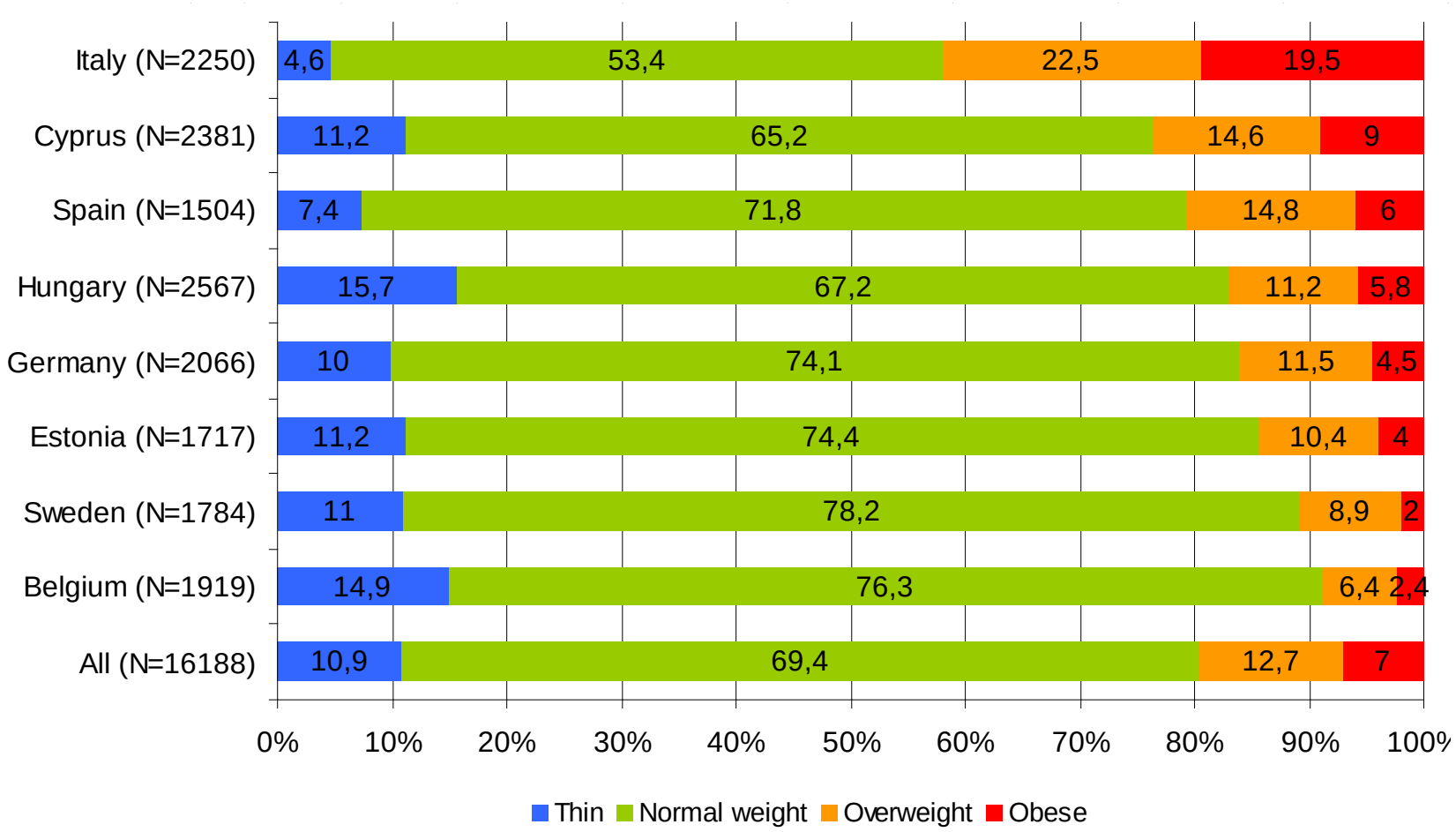
IDEFICS multicenter study



- **I**dentification and prevention of **D**ietary- and lifestyle-induced health **EF**fects **I**n **C**hildren and infant**S**
- 16,188 children from 8 European countries examined at ages 2-9
- Parental proxy food frequency questionnaire (FFQ)
- Not representative but large variation of exposures
- Information on potential confounders

Distribution of BMI classes (IOTF)

16,188 children, (2-9 years)



The I.Family Study

- 6 years later, examined IDEFICS index children, together with siblings and parents.
- Food frequency questionnaire self-administered by 11-16 year olds, including alcohol
- 2263 children aged 5-9 at baseline and 11-16 at followup and were included in this sub-study

ifamily

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SEVENTH FRAMEWORK PROGRAMME

Estimating alcohol intake in adolescents and parents

In the last month...	Never/ less than once a week	1-3 times a week	4-6 times a week	1 time per day	2 times per day	3 times per day	4 or more times per day
Drinks							
Artificially sweetened drinks, not carbonated (e.g. diet ice tea, diet fruit syrup, diet sports drinks, <local examples> etc.)	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7
Coffee and similar (give local examples):							
a) unsweetened	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7
b) sweetened (e.g. addition of sugar, honey etc.)	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7
Tea, herbal tea and similar (give local examples):							
a) unsweetened	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7
b) sweetened (e.g. addition of sugar, honey etc.)	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7
Alcoholic beverages	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7

Sample from 59-item
Food Frequency Questionnaire

Dichotomization in adolescents:

- Weekly or more 5%
- Less than weekly/never 95%
- 107 consumers / 2263 total

Parental alcohol consumption:

- Mean (SD) 1.6 (3.5) times/week

Estimating fat and sugar propensities in childhood

44-item Food Frequency Questionnaire including:

13 high sugar items
fruit juice, jam, honey, chocolate or nut-based spread, and sweet snacks, and the following food items if they contained added sugar: fresh fruit, drinks, milk, yoghurt, and breakfast cereals

19 high fat items
fried potatoes, high fat milk and yoghurt, fried fish, meat products, fried eggs, mayonnaise, cheese, chocolate or nut-based spread, butter and margarine, nuts, savory snacks, chocolate, cake and biscuits, and ice cream.

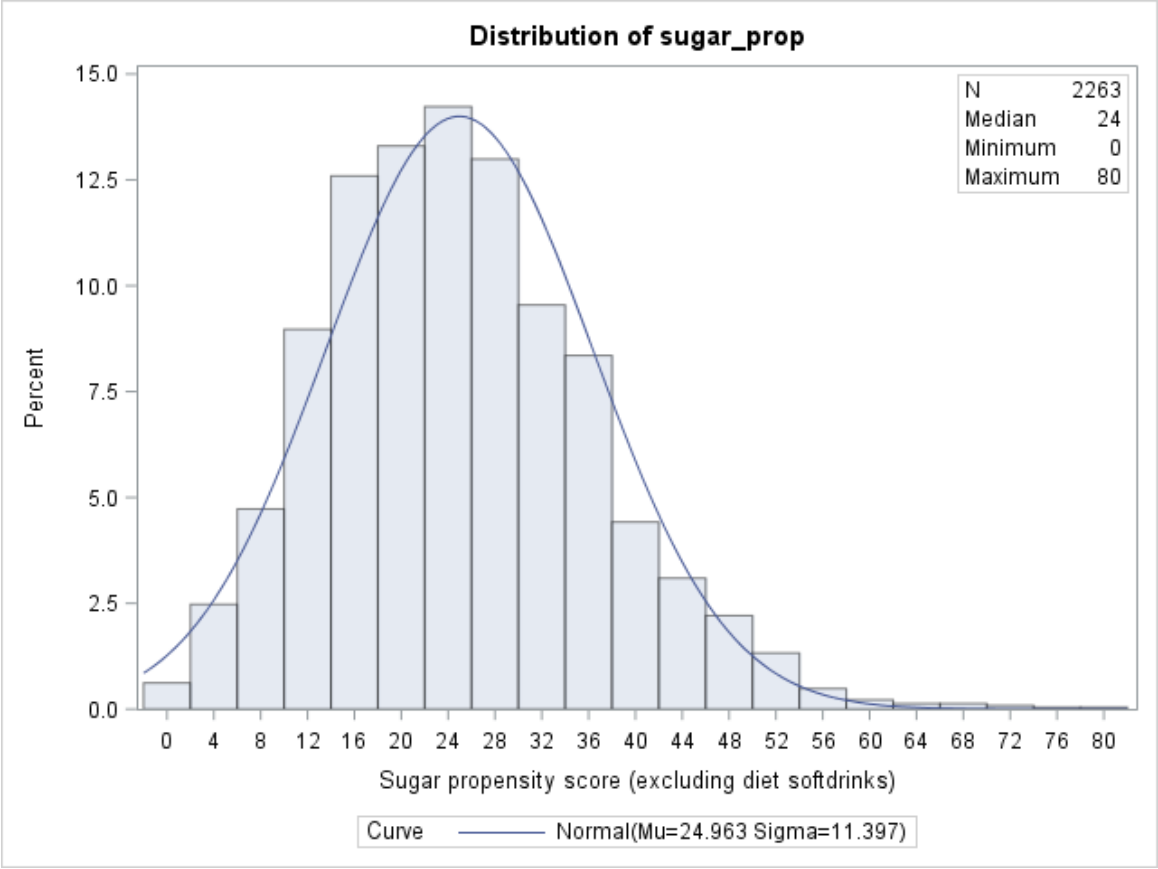
How frequently does a child consume a high-sugar food over all of his/her other food choices?

Sugar/fat propensity
= Σ food items high in sugar/fat (times/day) / Σ all food items (times/day) x 100%

High relative validity wrt. repeated 24-h recalls
Lanfer 2011, Lissner 2012

Analyzed continuously, categorized at median and tertile cutpoints

r = 0.12***



Selected covariates

Baseline	Low sugar < 24.0 %	High sugar ≥ 24.0 %	Low fat < 24.6 %	High fat ≥ 24.6 %
Parenting style: permissive	11%	15%*	12%	14%
somewhat strict	51%	53%	50%	54%
strict¶	38%	32%	38%	31%
High parental education	55%	44%**	50%	49%
High parental income	42%	32%	37%	38%
HRQoL (Kindl-R, 12-48)	39.8	39.2	39.9	39.1***

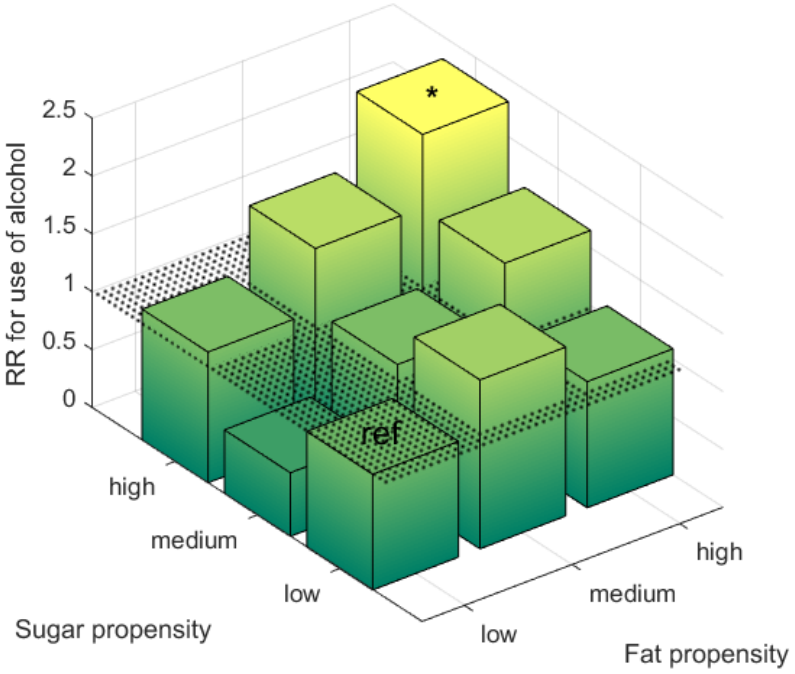
¶ *At our home it is laid down quite clearly what is allowed and what is not*

Selected covariates

6-year follow-up	≥ weekly alcohol use	
	no (n = 2156)	yes (n = 107)
HRQoL (Kindl-R, 12-48)	38.4	37.2*
Impulsivity score (tendency to rash action, 12-48)	24.7	28.4***
Current smoking	2%	12%***
Parents' drinks per week	1.5	2.6*
Sugar propensity	22.4	27.2***
Fat propensity	27.5	31.6***

Results

- Relative risk for ≥ weekly use of alcohol in adolescence by tertiles of fat and sugar propensities in childhood
- RR = 2.3 (1.2 – 4.6) in highest tertiles of both fat and sugar, compared to lowest tertiles



Log-binomial regression adjusted for age, sex, country
Tested interaction between fat and sugar propensity, n.s.

- Fat and sugar propensity scores dichotomised at median
- More than 2-fold risk for the combination of high sugar and high fat propensity
- Attenuation to 1.79 with additional covariate adjustment

RR (95% CI)	Categories of dichotomized sugar and fat propensity score			
	Low sugar Low fat	High sugar Low fat	Low sugar High fat	High sugar High fat
Total (number of alcohol consumers)	619 (19)	511 (21)	514 (21)	619 (46)
Adjusted for age, sex, country (n = 2263)	1 (ref)	1.27 (0.70, 2.29)	1.40 (0.77, 2.54)	**2.46*** (1.47, 4.12)**
Further adjusted for HRQoL, parental income, education, strict parenting style (n = 1931)	1 (ref)	1.25 (0.68, 2.29)	1.36 (0.74, 2.49)	**1.79* (1.03, 3.11)**

Confounding

- better HRQoL related to lower fat propensity in childhood*** and less alcohol consumption in adolescence

  RR = 0.81 (0.67 – 0.98)* per 5 units

- High parental income correlated with lower sugar and lower fat propensity (ns), and with less alcohol use in adolescence

  RR = 0.64 (0.38 – 1.07)

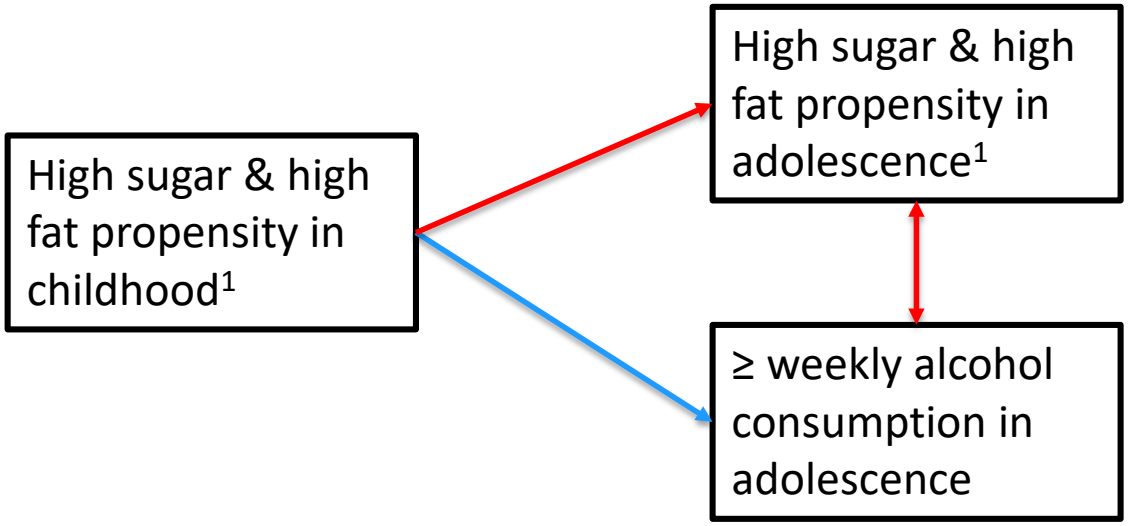
- Stricter parenting style was associated with lower sugar propensity in childhood* and less alcohol use in adolescence

  RR = 0.73 (0.44 – 1.23) somewhat strict vs. permissive

  RR = 0.68 (0.38 – 1.21) strict vs. permissive

Mediation analysis

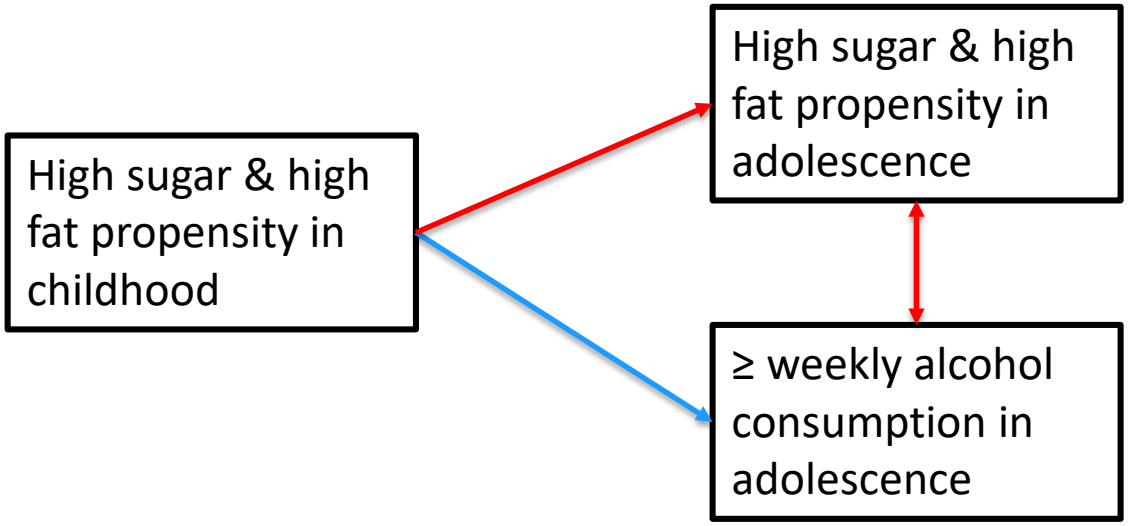
- to decompose the total effect of high sugar & high fat propensity in childhood on subsequent alcohol consumption into direct and indirect effects



[1] High sugar & high fat versus all other 3 categories

Mediation analysis

- to decompose the total effect of high sugar & high fat propensity in childhood on subsequent alcohol consumption into direct and indirect effects



RR (95% CI)

1.12 (1.04 – 1.21)**

1.78 (1.22 – 2.60)**

total effect:
1.99 (1.37 – 2.90)***

- Association was only partly mediated by sustained consumption of sugar and fat into adolescence.

Sensitivity analyses

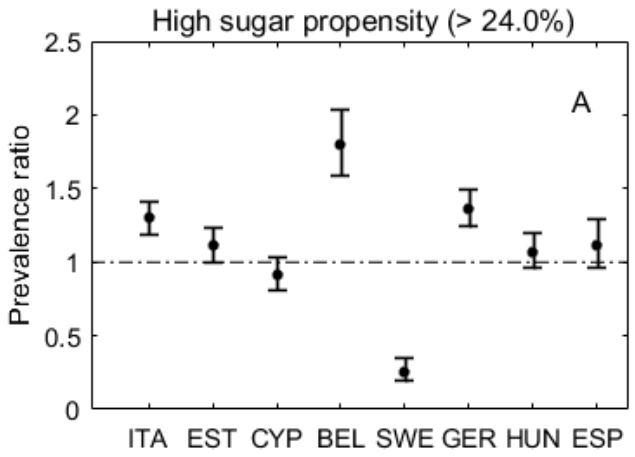
- Results were not explained by adolescents smoking status, impulsivity score, or parental alcohol use
- Independent of childrens sex or weight status

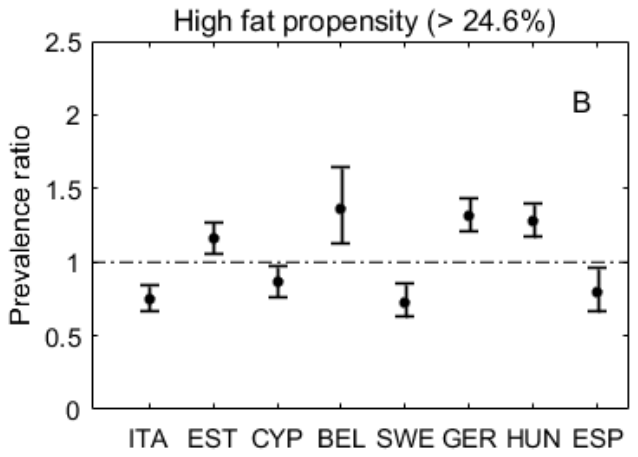
	Total	High sugar & high fat propensity	
	Alcohol users / total	Alcohol users / total	RR (95% CI)
Boys	68 / 1108	27 / 305	1.8* (1.1 – 2.8)
Girls	39 / 1155	19 / 314	2.6** (1.4 – 4.7)
Non-overweight	67 / 1693	33 / 485	1.8** (1.2 – 2.8)
Overweight	30 / 570	13 / 134	2.7** (1.4 – 5.2)

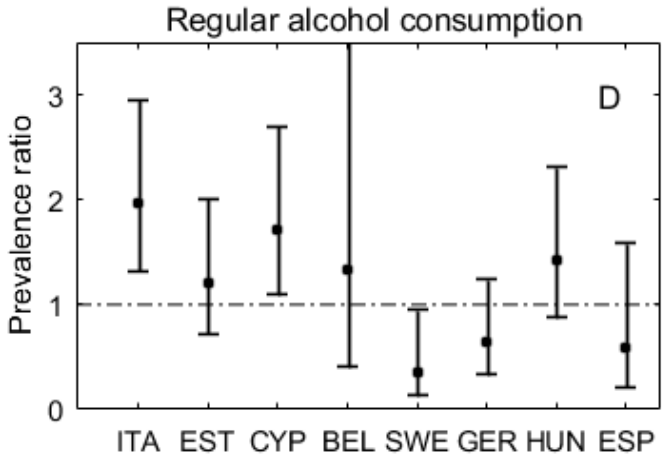
Country-specific results

- Different prevalences of adolescent drinking, 7% Italy, 6% Cyprus, 5% Hungary, 4% Belgium and Estonia, 2% Germany and Spain and 1% Sweden
- Associations with fat and sugar propensities were independent of country

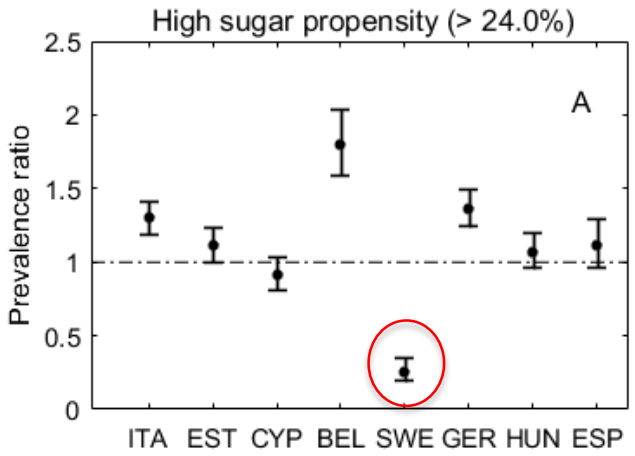
Country-specific results

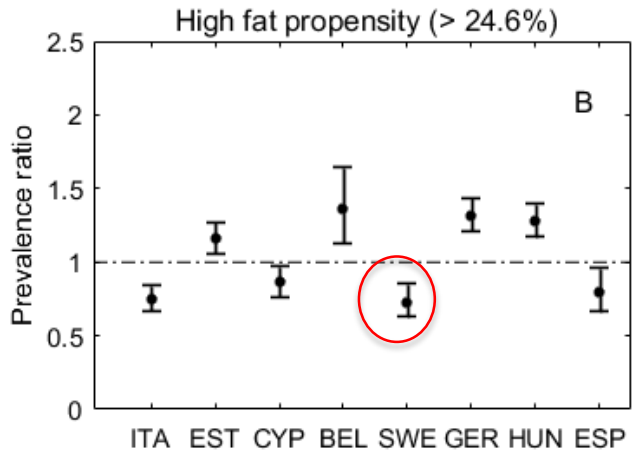


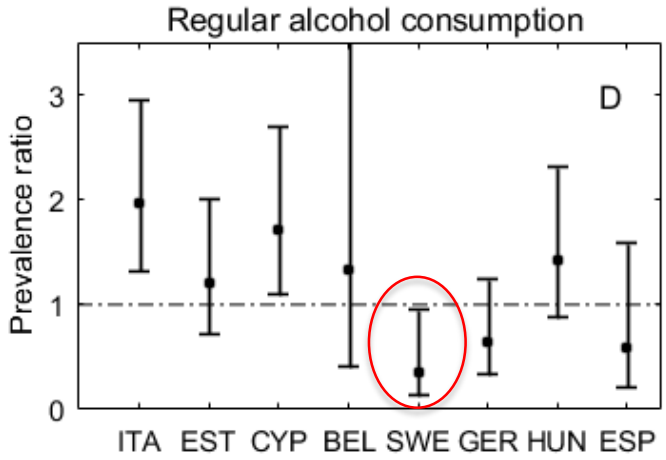




Country-specific observations







Conclusions and some remaining questions

- Observational evidence that propensity to consume sugar-rich and high-fat foods predicted alcohol use in adolescence
  - Could this indicate addiction-like habituation to palatable food that is carried on to later life?
- Conclusions are strengthened by having adjusted for plausible confounders, and mediation analysis.
- Associations with poor well-being and low income indicate the danger of unhealthy coping mechanisms

- These findings suggest that promoting healthy eating has benefits that go beyond weight management

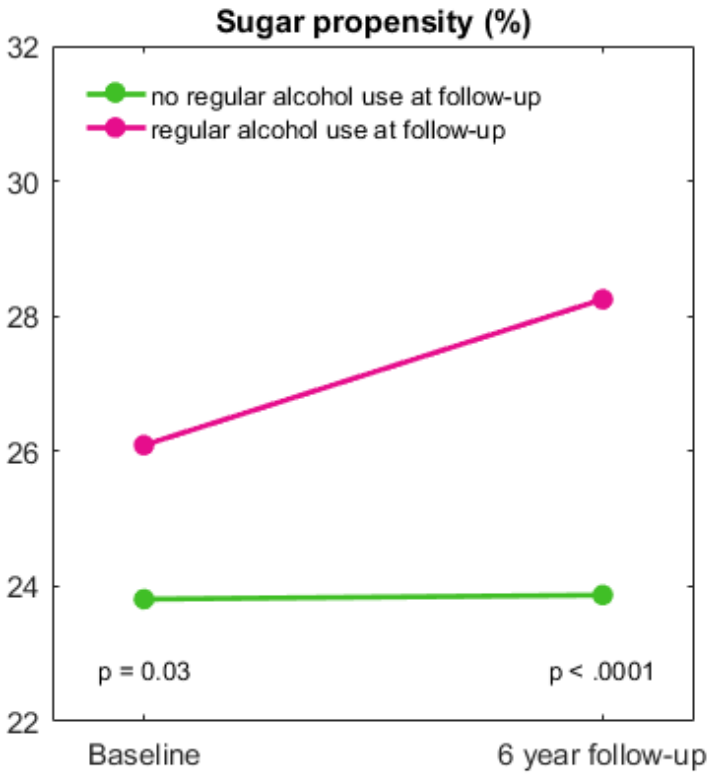
Conclusions and some remaining questions

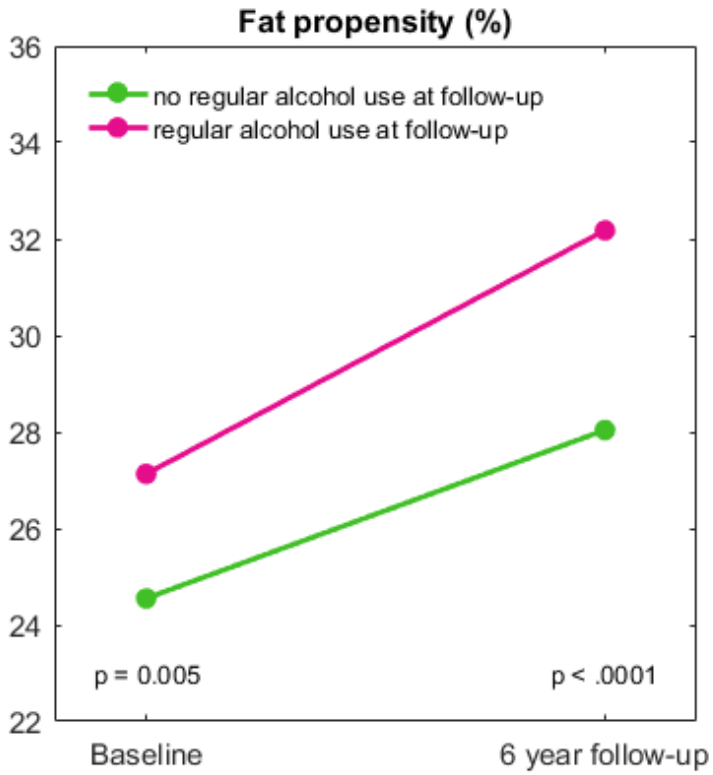
- Major limitations:
  - low prevalence of adolescent alcohol use
  - residual confounding

- Future analyses:
  - Could we learn more by exploiting existing fMRI data in this cohort?
  - Associations with reward-related genotypes?
  - Re-examination of young adults

Legal ages for use and purchase of alcohol

Country	Use	Purchase	Prevalence of ≥ weekly use in this study
Italy	18	18	7 %
Cyprus	17	17	6 %
Hungary	18	18	5 %
Estonia	18	18	4 %
Belgium	None	16 (beer, wine) 18 (spirits)	4 %
Spain	18	18	2 %
Germany	16 (beer, wine) 18 (spirits)	16 (beer, wine) 18 (spirits)	2 %
Sweden	18	20	1 %


Sugar propensity (%)
32
30
28
26
24
22
no regular alcohol use at follow-up
regular alcohol use at follow-up
p = 0.03
p < .0001
Baseline
6 year follow-up


Fat propensity (%)
36
34
32
30
28
26
24
22
no regular alcohol use at follow-up
regular alcohol use at follow-up
p = 0.005
p < .0001
Baseline
6 year follow-up

My co-authors:

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Thank you for your attention!

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