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Sugar sweetened beverages' association with hyperinsulinemia among aboriginal youth population

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Type 2 diabetes mellitus - a major public health concern -

- **Epidemic proportions**

- 2.4% in 1943 → 16% in 2003 → 21.4% in 2009 (CDIS, 2010)

- **Alarming rates and disparities** with non-aboriginal counterparts

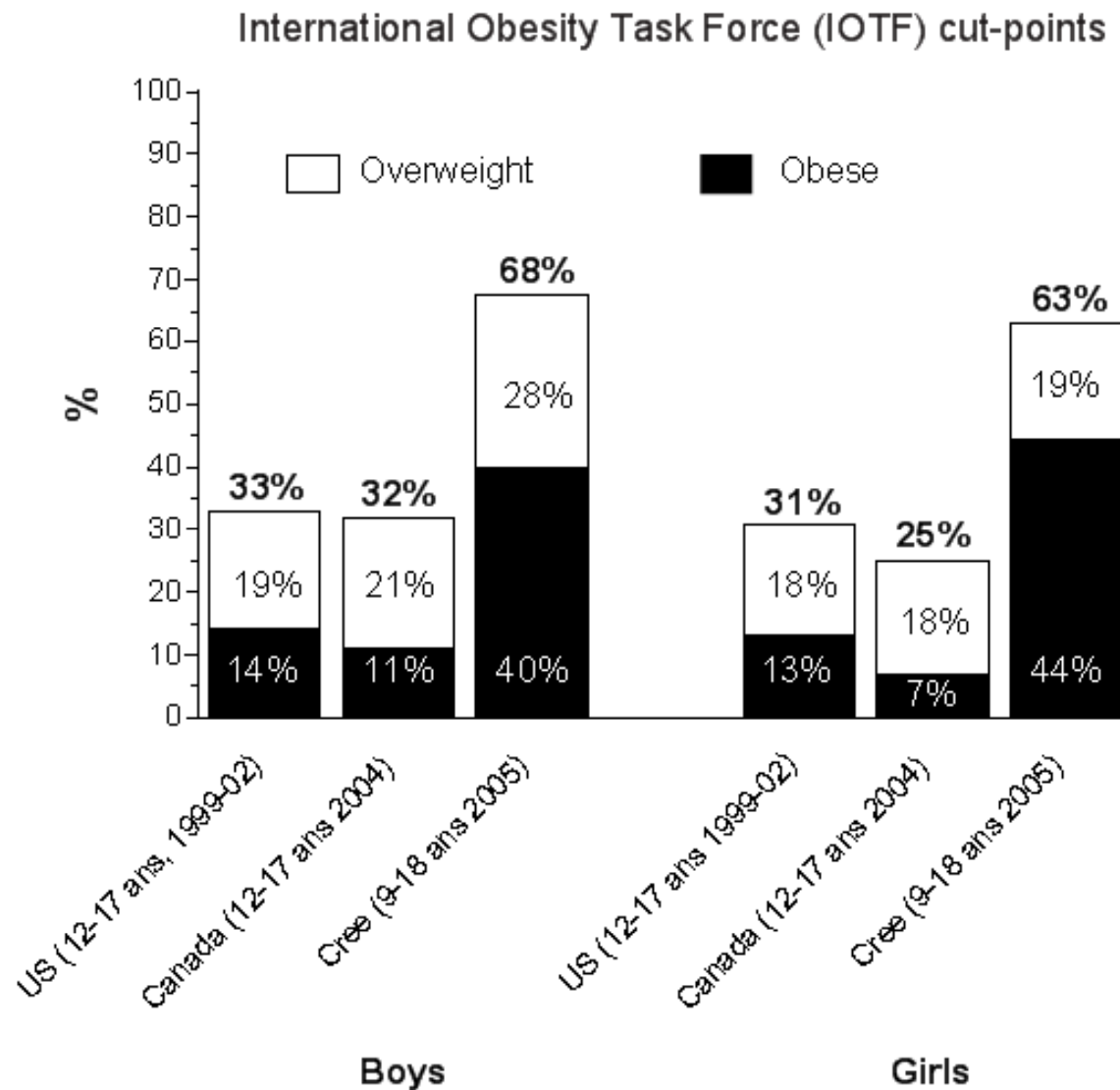
- 3.5 times higher than in the general population (CDIS, 2012)

- **Precocity** of onset

- Mean age of diagnosis

48 years old in 1989 → 41 years old in 2009 (CDIS, 2009)

Susceptibility of James Bay Cree youth



SSBs

- a potential modifiable risk factor -

■ SSBs and obesity

- Systematic review and meta-analysis of RCT and cohort studies (Morenga et al. 2013)
 - Global OR: 1.55 (1.32, 1.82)
- NEJM: two recent randomized trials (Ruyter et al., 2012; Ebbeling et al., 2012)
 - ↓ SSBs consumption, replacement with non-caloric sweetened beverages
→ reduced weight gain

■ SSBs and type 2 diabetes

- Meta-analysis of 8 prospective cohort studies (Malik et al., 2010)
 - RR = 1.26 ; IC 95% (1.12-1.41)



THIS STUDY

- Few studies have addressed SSB consumption and IR in children & adolescents
- However, studies among **aboriginal youth** populations are **scarce**

MAIN OBJECTIVE

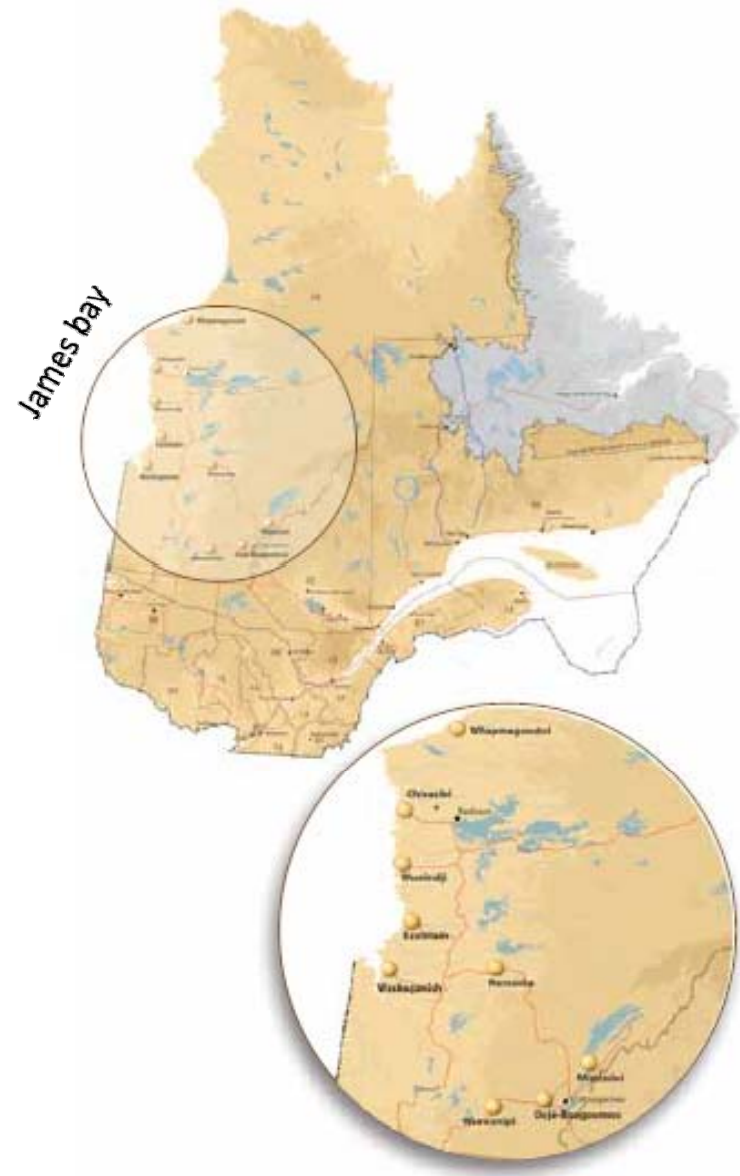
- To evaluate the association between SSBs and hyperinsulinemia (HI) among Québec James Bay Cree youth



METHODS

Study population and design

- **Cross-sectional**
- **307** Cree youth from **7** Cree communities of Eastern James Bay (Canada)
- Inclusion criteria
 - Aged **9-18** years old
- Exclusion criteria
 - Diagnosis of diabetes, pregnancy, missing data for fasting blood insulin, weight, height or waist circumference



METHODS

Data collection and variables

- Exposure – SSBs

- “SSBs are beverages that contain **added caloric sweeteners** such as sucrose, HFCS” (Hu et al., 2010)

- ✓ soft drinks
- ✓ fruit drinks
- ✓ energy and vitamin water drinks
- ✓ sports drinks
- ✓ sweetened iced tea

- ✗ 100% fruit juice
- ✗ diet drinks

METHODS

Data collection and variables

- In this study

Sugary beverages	=	SSBs + real fruit juice
SSBs	=	soft drinks + fruit drinks + sports drinks + iced tea
Real fruit juice	=	100% pure, bottled or frozen fruit juice
ASB*	=	diet soft drinks + diet ice tea

*ASB: Artificially Sweetened Beverages

METHODS

Data collection and variables

- Intakes of SSBs obtained from food frequency questionnaire (FFQ)
 - “Mean daily frequency over past month”

How often did you drink these beverages in last 30 days?		
Beverages	Last 30 days	
	Frequency	D-W-M
25. Soft drinks What is your usual choice? (select one): 1 <input type="checkbox"/> Regular 2 <input type="checkbox"/> Diet		
26. Ice tea What is your usual choice? (select one): 1 <input type="checkbox"/> Regular 2 <input type="checkbox"/> Diet		
27. Fruit drinks or Sports drinks (Tang, punch, Kool-Aid, Sunny D, Gatorade)		
28. Real fruit juice (100% pure, bottled or frozen)		

- Categorization

Intake levels of SSB (times/day)			
0 - <0.5	0.5 - <1	1 - <2	2+
(n=93)	(n=53)	(n=78)	(n=83)



METHODS

Data collection and variables

- Outcome – Hyperinsulinemia (HI)
 - Blood sample collected after an overnight fast, by a research nurse
- Categorization
 - HI = fasting insulin ≥ 90 pmol/L

METHODS

Data collection and variables

- Mediator – obesity
 - General obesity
 - International Obesity Task Force (IOTF) criteria
 - Abdominal obesity
 - Age and sex specific waist circumference (WC) percentiles
 - Waist-to-height ratio (WHtR)

STATISTICAL ANALYSIS

- Odds ratio of HI were estimated using **multiple logistic regression** analysis
- Models
 - ¹Adjusted for
age (9-12, 13-18) and sex
 - ²Adjusted for age (9-12, 13-18), sex,
moderate physical activity and walking (<60 min/d / >=60 min/d), vigorous physical activity (<60 min/d / >=60 min/d), smoking (never, occasional, current), oral contraceptive use (yes/no)
 - ³Additionally adjusted for
fiber intake (g/day, quartiles), magnesium intake (mg/day, quartiles), vitamin D intake (IU/day, quartiles), alcohol (yes/no), coffee (yes/no), trans fatty acids (% of total fat intake)
 - **Intermediate variables**
 - + BMI
 - + WC
 - + WHtR

RESULTS

Table 1. Characteristics of the participants according to SSB intake

	Intake levels of SSB (times/day)			
	0 - <0.5 (n=93)	0.5 - <1 (n=53)	1 - <2 (n=78)	2+ (n=83)
Age (y)	13.6 ± 2.9 ¹	13.1 ± 2.8	12.8 ± 2.8	13.5 ± 2.8
Girls (%)	50.5	47.2	48.7	47.0
Fasting blood insulin (pmol/L)	123.3 (105.7, 143.8) ²	115.4 (97.7, 136.3)	129.5 (114.0, 147.0)	135.1 (117.7, 155.0)
Hyperinsulinemia (%)	59.1	66.0	71.8	77.1
Fasting blood glucose (mmol/L)	5.14 ± 1.00	4.97 ± 0.48	5.14 ± 0.39	5.23 ± 0.71
HOMA-IR	4.02 (3.39, 4.75)	3.65 (3.07, 4.35)	4.24 (3.71, 4.85)	4.49 (3.85, 5.23)
Weight (Kg)	71.5 ± 25.2	65.8 ± 20.9	66.9 ± 23.1	70.0 ± 20.7
BMI (Kg/m ²)	26.1 ± 7.0	25.1 ± 6.2	25.4 ± 5.8	26.1 ± 5.9
Normal weight (%)	39.8	34.0	29.5	33.7
Overweight (%)	17.2	28.3	29.5	21.7
Obese (%)	43.0	37.7	41.0	44.6
WC (cm)	91.3 ± 18.2	88.8 ± 15.8	88 ± 17.0	91.3 ± 16.1
High WC (%) ³	49.5	50.9	55.1	51.8
High WHtR (≥0.05) (%)	90.3	88.7	91.0	92.8

Abbreviations: SSB, sugar sweetened beverages; BMI, body mass index; WC, waist circumference; WHtR, waist-to-height ratio; ASB, artificially sweetened beverages

¹Mean ± SD (all such values)

²Geometric mean (IC) (all such values)

³≥90th age and sex specific percentiles

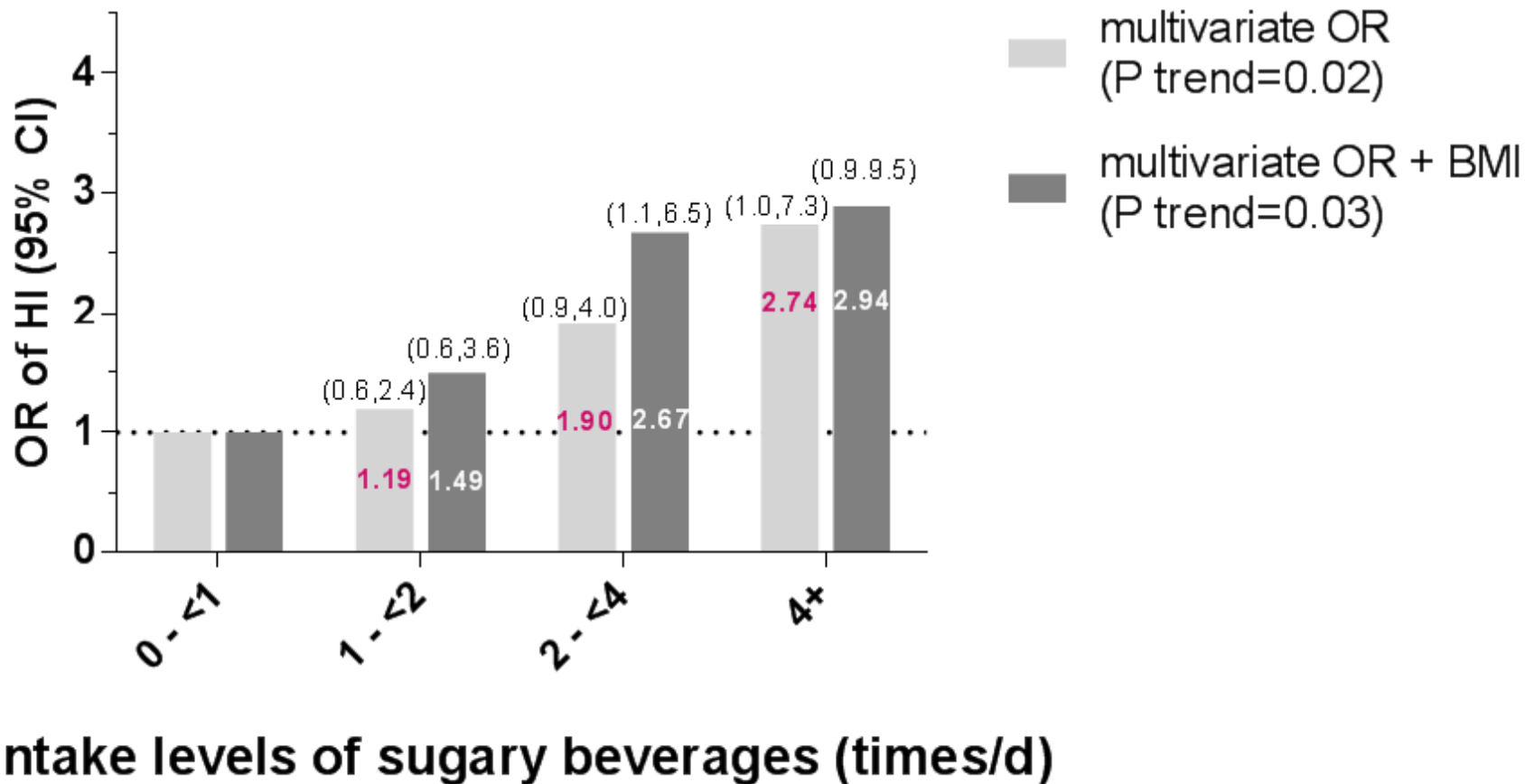
RESULTS

Table 2. Spearman correlation coefficient for beverage consumption

	SSB	Soft drinks	Ice tea	Fruit or sports drinks	Real fruit juice	ASB
Sugary beverages	0.79 (<.0001)	0.45 (<.0001)	0.36 (<.0001)	0.45 (<.0001)	0.59 (<.0001)	-0.25 (<.0001)
SSB	1.00	0.58 (<.0001)	0.44 (<.0001)	0.61 (<.0001)	0.12 (0.06)	-0.38 (<.0001)
Soft drinks		1.00	0.12 (0.04)	0.08 (0.15)	0.04 (0.52)	-0.68 (<.0001)
Regular ice tea			1.00	0.03 (0.59)	0.10 (0.09)	-0.22 (<.0001)
Fruit or sports drinks				1.00	0.08 (0.16)	0.00 (0.97)
Real fruit juice					1.00	0.02 (0.69)

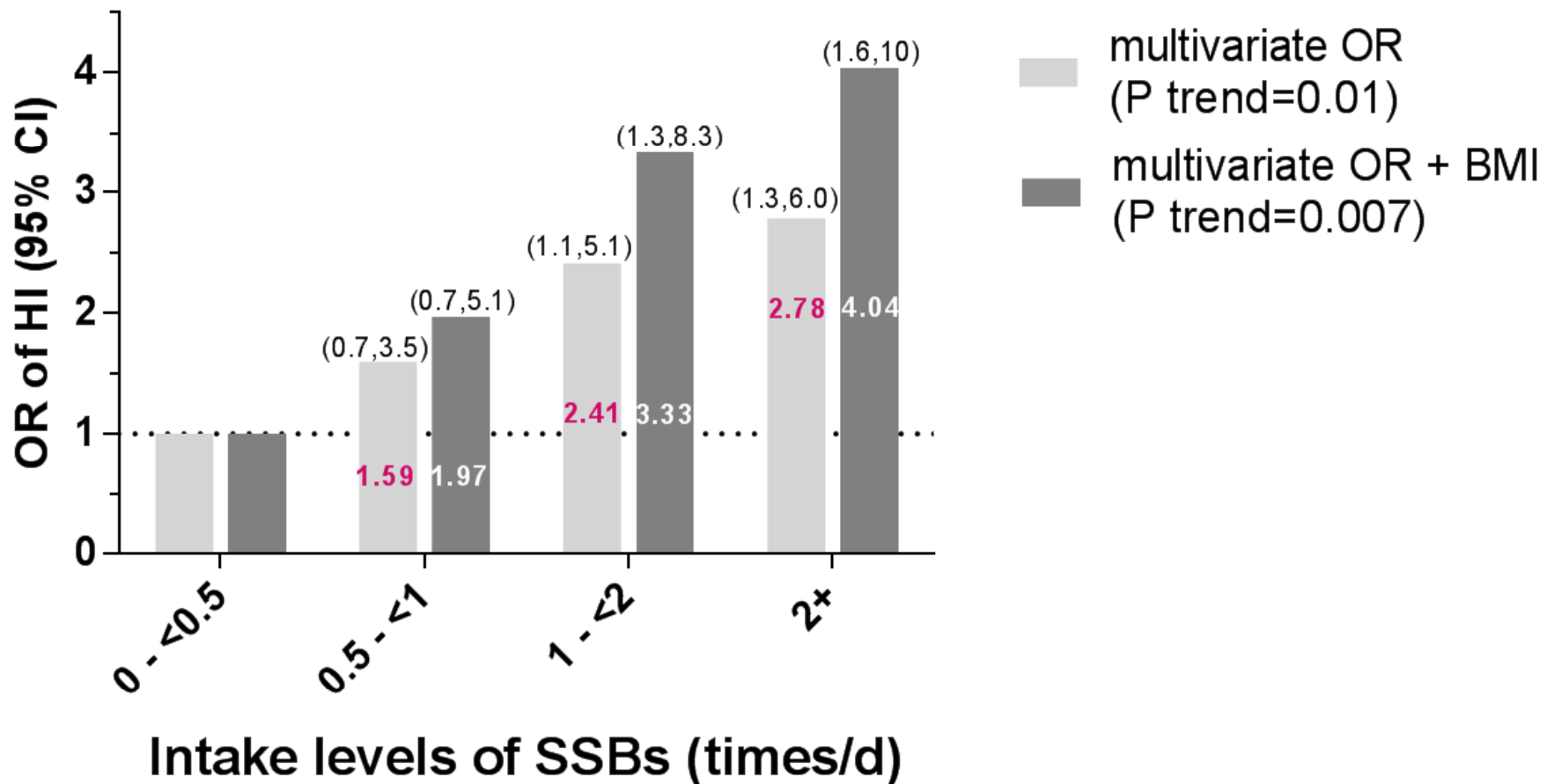
RESULTS

A OR (95% CI) of HI by intake level of sugary beverages



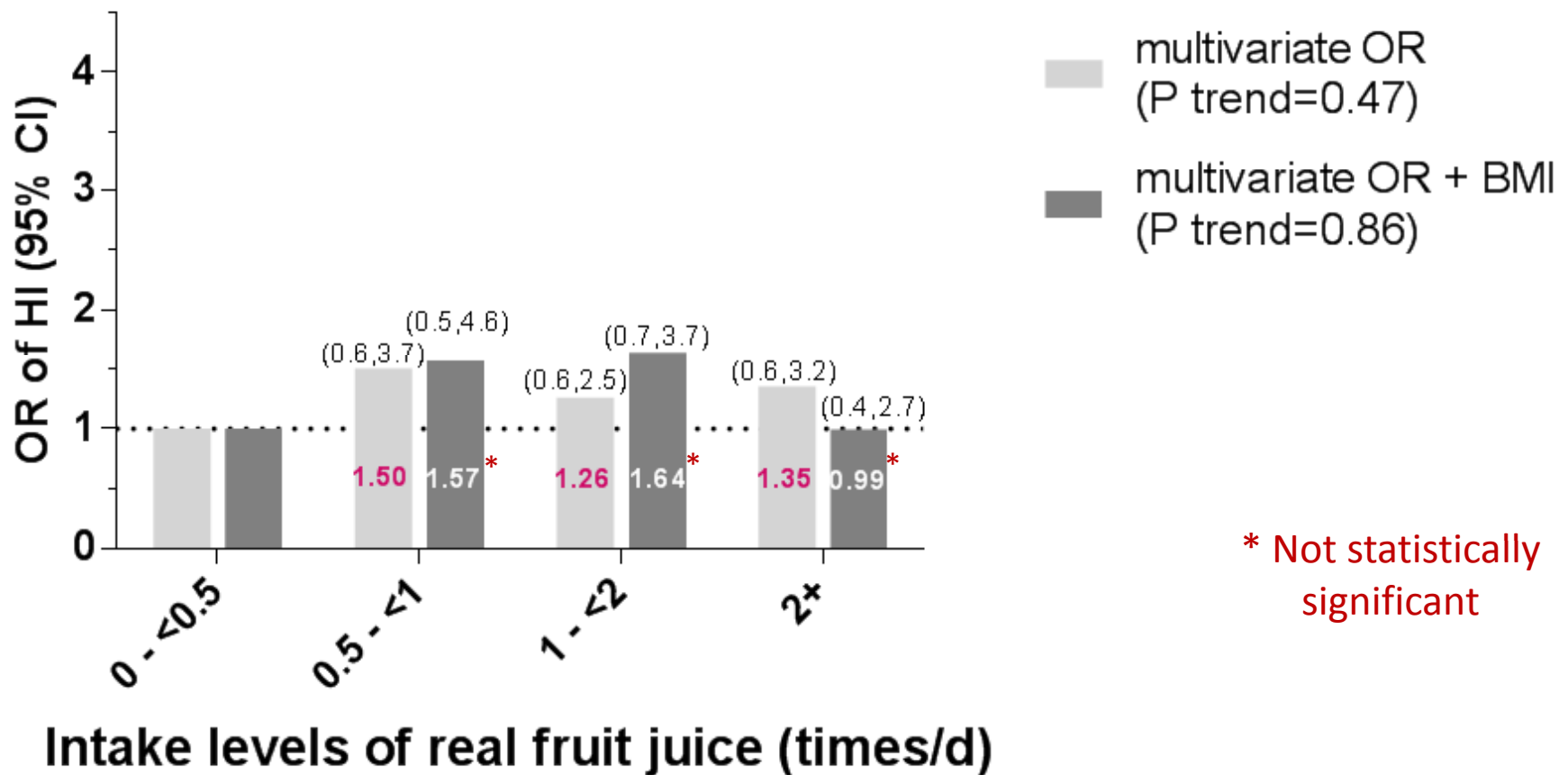
RESULTS

B OR (95% CI) of HI by intake level of SSBs



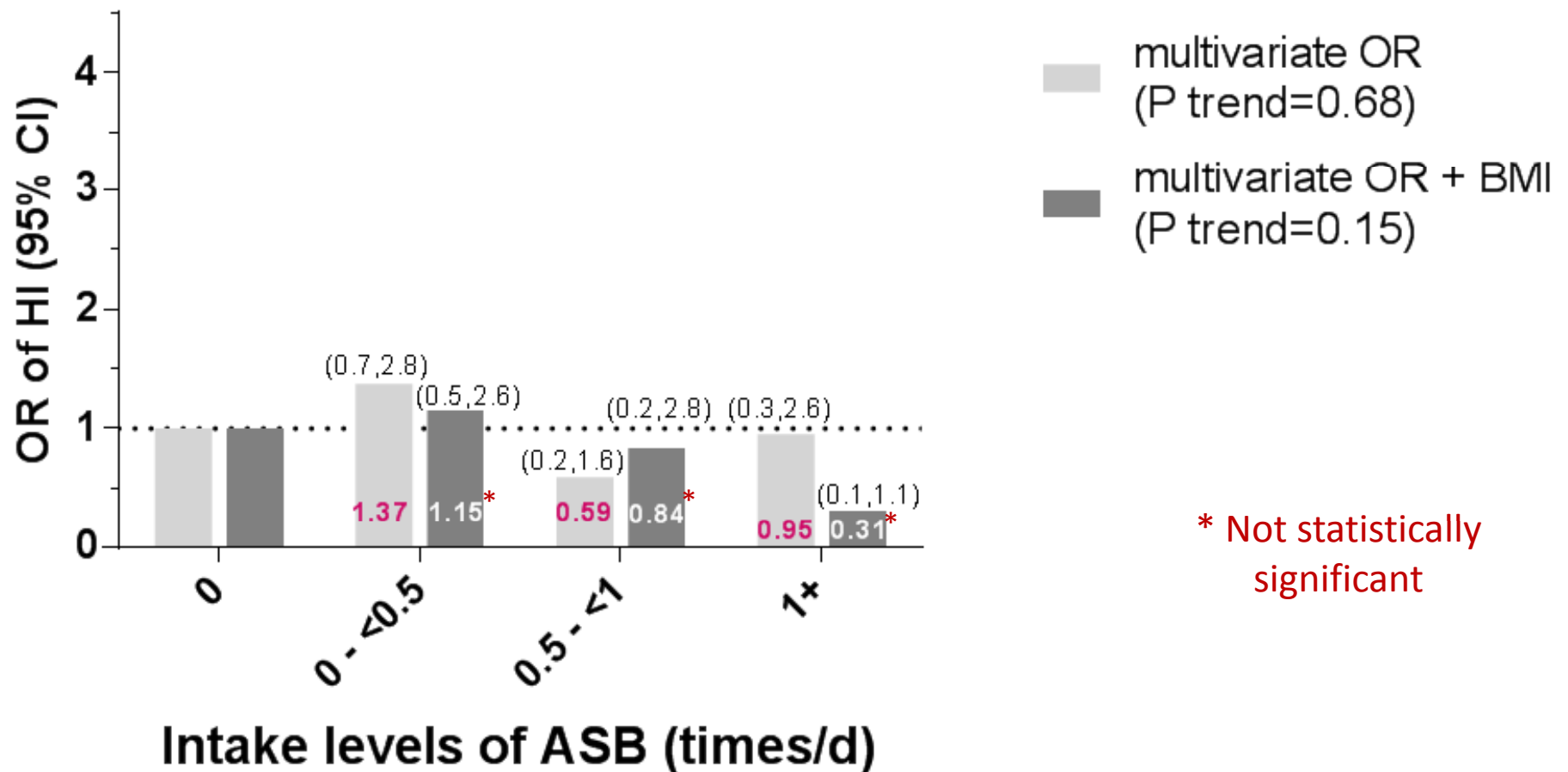
RESULTS

C OR (95% CI) of HI by intake level of real fruit juice



RESULTS

D OR (95% CI) of HI by intake level of ASB



RESULTS

Table 3. OR¹ (95% CI) of HI according to intake levels of SSB by obesity status

		Intake levels of SSB (times/day)				P value for trend
		0 - <0.5 (n=93)	0.5 - <1 (n=53)	1 - <2 (n=78)	2+ (n=83)	
Obese						
Cases	119	36	19	30	34	
Non-cases	10	<u>4</u>	<u>1</u>	<u>2</u>	<u>3</u>	
Multivariate OR		-	-	-	-	-
Non obese						
Cases	91	19	16	26	30	
Non-cases	87	34	17	20	16	
Multivariate OR		1.00	2.38 (0.76,7.48)	4.48 (1.49,13.5)	7.69 (2.28,25.9)	0.001
P value for interaction = 0.02						

¹Odd ratios are adjusted for age (9-12, 13-18), sex, moderate physical activity and walking (<60 min/d / >=60 min/d), vigorous physical activity (<60 min/d / >=60 min/d), smoking (never, occasional, current), oral contraceptive use (yes/no), fiber intake (g/day, quartiles), magnesium intake (mg/day, quartiles), vitamin D intake (IU/day, quartiles), alcohol (yes/no), coffee (yes/no), trans fatty acids (% of total fat intake)

CONCLUSION

- **High prevalence of**
 - Hyperinsulinemia (68.4%)
 - Overweight/obesity (65.5%)
 - WC \geq 90th percentile (51.8%)
 - WHtR \geq 0.5 (90.9%)
- **“Higher intakes of SSBs were associated with hyperinsulinemia risk”, especially among non-obese Cree youth**
- **Further investigations, especially longitudinal and clinical studies, are needed to confirm the findings and to establish more targeted diabetes prevention policies**

Strengths and limitations

■ Limitations

- Cross-sectional design → cannot infer causality
- SSB → marker of an overall unhealthy diet?
- Ceiling effect?
- Desirability bias?
- Reverse causation?

■ Strengths

- Relatively large definition of the exposure variable
- Measured not self reported weight and height

Acknowledgement

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