The impact of diet on insulin dynamics over a 2 year period in children with a family history of obesity

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Background

• Despite extensive evidence in adults that lifestyle modification, including a healthy diet, may prevent the onset of type 2 diabetes, studies examining the impact of chronic dietary exposures on insulin dynamics in at-risk children are lacking.

• The aim of our study was to assess how dietary intake predicts insulin sensitivity and secretion over a two year period in children with a family history of obesity.

Results

Table 1: Baseline characteristics	Baseline (n= 630)	Follow-up (n= 564)	Correlation time 1 to time 2
Age (years), mean (SD)	9.6 (0.9)	11.7 (0.9)	
Sex, % male	54.4	55.5	
BMI category, % *			
Underweight	1.1	2.3	
Normal weight	50.8	48.8	
Overweight	13.2	15.6	
Obese	34.9	33.0	
Pubertal, %	21.5	66.8	
Percent fat mass (%)	25.3 (17.4, 35.2)	27.8 (19.4, 33.4)	0.90
MVPA (min/day)	47.7 (31.3, 65.3)	39.3 (26.6, 55.9)	0.57
Screen time (hrs/day)	2.2 (1.3, 3.7)	2.9 (1.9, 4.4)	0.42
Total kilocalorie intake (kcal/day)	1656 (1410, 1936)		
Carbohydrate, %	53.2 (48.9, 56.9)		
Fat,%	32.3 (29.0, 35.3)		
Saturated fat, %	11.3 (9.7, 13.1)		
Protein, %	15.7 (13.9, 17.9)		
Fiber, g/day	12.7 (10.4, 15.6)		
Sugar-sweetened beverages, mls/day	78.1 (0, 309.8)		
Fruits and vegetables, portions	4.1 (2.9, 5.4)		
Matsuda- ISI	9.3 (6.1, 12.8)	6.6 (4.4, 9.6)	0.63
AUC I/G 30 min	26.4 (17.8, 41.1)	35.7 (24.2, 53.5)	0.63
AUC I/G 120 min	27.2 (19.7, 41.2)	36.3 (24.8, 55.4)	0.63

Note: All results are expressed as median (IQR), except where specified. BMI = body mass index; overweight defined as BMI ≥ 85th percentile and obesity defined as BMI ≥ 97th percentile. Pubertal refers to Tanner stages 2, 3, 4. MVPA = moderate-to-vigorous physical activity. AUC I/G = area under the curve insulin/glucose

Table 2: Dietary habits at 8-10 years of age and prediction of insulin sensitivity 2 years later (QUALITY cohort)

Dietary component	Matsuda-ISI		
	Beta-coefficient*	95% CI	*p* value
Carbohydrates (%)	0.6	(-0.05, 1.3)	0.071
Fat (%)	-0.8	(-1.6, 0.03)	0.058
Saturated fat (%)	-1.6	(-3.2, -0.07)	**0.041**
Protein (%)	0.07	(-1.1, 1.3)	0.906
Fiber (g/day)	0.3	(-0.9, 1.5)	0.616
Sugar sweetened beverage (mls/day)	-0.02	(-0.05, 0.01)	0.188
Fruits and vegetables (portions)	2.4	(0.4, 4.4)	**0.021**

For Tables 2, 3 and 4:

• Beta coefficient interpretation (*): % difference in outcome measure for every 1 unit increase in exposure

• All models are adjusted for age, sex, Tanner stage, MVPA, season, screen time and adiposity; in addition, models including sugar-sweetened beverage intake and fruits and vegetable portions were adjusted for total kcal intake; Matsuda-ISI was adjusted for in all models with insulin secretion as outcome

• Note that adiposity is highly predictive of both insulin sensitivity and insulin secretion in all models

Methods

• Data from 630 children living in Quebec, Canada, with at least one biological parent with obesity (QUALITY cohort) were collected at both 8-10 years (time 1) and 10-12 years (time 2).The characteristics of the cohort at both time points appear in Table 1.

• Macronutrients (including %carbohydrates, %fat, %saturated fat, %protein, fiber, sugar-sweetened beverages, portions of fruits and vegetables) were assessed at baseline using 3 non-consecutive 24-hr dietary recalls.

• Insulin sensitivity, assessed by Matsuda Index, and insulin secretion, assessed by the ratio of the AUC of insulin:glucose at 30min (AUC30) and at 120min (AUC120) after an oral glucose tolerance test (OGTT), were carried out both at baseline and 2 years later.

• Physical activity (PA) was evaluated by 7day accelerometry; screen time was self-reported. Percent fat mass was measured by DXA scan.

• Regression analysis with smoothing splines for non-linearity were used and models were minimally adjusted for age, sex, PA, screen time, adiposity, season and pubertal stage. We accounted for missing data using multiple imputation.

Table 3: Dietary habits at 8-10 years of age and prediction of 1st phase insulin secretion (AUC I/G 30 min) 2 years later (QUALITY cohort)

Dietary component	AUC I/G 30 min		
	Beta-coefficient *	95% CI	*p* value
Carbohydrates (%)	-0.01	(-0.5, 0.5)	0.962
Fat (%)	0.5	(-0.4, 0.8)	0.514
Saturated fat (%)	0.3	(-1.0, 1.5)	0.671
Protein (%)	-0.3	(-1.2, 0.7)	0.547
Fiber (g/day)	0.01	(-0.9, 0.9)	0.979
Sugar sweetened beverage (mls/day)	-0.009	(-0.03, 0.01)	0.454
Fruits and vegetables (portions)	-0.7	(-2.2, 0.9)	0.411

Table 4: Dietary habits at 8-10 years of age and prediction of 2nd phase insulin secretion (AUC I/G 120 min) 2 years later (QUALITY cohort)

Dietary component	AUC I/G 120 min		
	Beta-coefficient*	95% CI	*p* value
Carbohydrates (%)	0.1	(-0.3, 0.5)	0.624
Fat (%)	-0.2	(-0.7, 0.3)	0.49
Saturated fat (%)	-0.02	(-1.1, 1.0)	0.967
Protein (%)	-0.4	(-1.2, 0.4)	0.305
Fiber (g/day)	0.5	(-0.3, 1.3)	0.232
Sugar sweetened beverage (mls/day)	-0.02	(-0.04, 0.002)	0.086
Fruits and vegetables (portions)	0.3	(-1.0, 1.7)	0.614

Conclusions

• In youth with a family history of obesity, diets low in saturated fat and high in fruits and vegetables improved insulin sensitivity, while no dietary component predicted insulin secretion

• These dietary strategies may contribute to preventing the later development of type 2 diabetes in at-risk youth.

55ESPE 213--P1

Diabetes

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DOI: 10.3252/pso.eu.55ESPE.2016

Poster presented at: ESPE 2016 PARIS

PosterSessionOnline.com