Early childhood cardiometabolic profiles predict 2-year gains in adiposity

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Introduction

- While most children in Hong Kong have normal weight, many will transition to overweight/obesity by adulthood[1]
- Rates of abdominal obesity and cardiometabolic diseases are as high or higher, and the onset of cardiometabolic risk factors (CMR) earlier in Hong Kong, compared to adult populations from other developed countries[2,3]
- Interventions tend to target fat accrual to prevent cardiometabolic disease, however, early CMR profiles may precede pathological fat accrual
- Early identification of children at-risk for future weight gain and CMR may allow for early interventions.

Purpose

To explore if markers of CMR in childhood could predict adiposity measures two years later.

Methods

Participants

- 272 (girls, n=126) children aged 6-10 years from Hong Kong

Measurements

Baseline: Fasting insulin (µlU/ml); Glucose (mmol/L); Triglycerides (mmol/L); Systolic blood pressure (SBP, mmHg); Diastolic blood pressure (DBP, mmHg); High-density lipoproteins cholesterol (HDL,mmol/L)]

2-year follow-up: Body mass index (BMI,kg/m^2); Triponderal index (TPI,kg/m^3); Waist circumference (WC,cm); Waist-to-height ratio (WHtR,%)]

CMR variables: Sex and age- specific 85th (15th for HDL) centile used to indicate high ('1') versus low ('0') CMR factors groupings; used previously in this cohort to indicate high-risk[4].

Analysis

Paired Samples *t*-tests - between baseline and two-year follow-up.
Pearson's correlation - between baseline CMR, and adiposity variables (BMI, TPI, WC and WHtR).
Linear regression - sex-specific, baseline CMR group (0 or 1) of each variable and baseline BMI, TPI, WC, WHtR.
Multiple regression - sex-specific, baseline CMR group (0 or 1) for each variable and follow-up BMI, TPI, WC and WHtR, controlling for baseline level of the same body composition, age at baseline, and time between baseline and follow-up measures.

Results

Table 1. Sex specific descriptive characteristics at baseline and follow-up, and change in variable between time points.

	Boys			Girls		
	Baseline	Two-Year	Change	Baseline	Two-Year	Change
Age	8.0(1.3)	10.3(1.0)	**2.3****	8.1(1.3)	10.3(1.0)	**2.2****
Height (cm)	126.3(8.5)	139.2(8.4)	**12.8****	126.9(9.3)	140.6(8.9)	**13.7****
Weight (kg)	26.9(6.7)	35.4(9.1)	**8.5****	26.2(6.6)	34.6(8.8)	**8.4****
BMI	16.6(2.7)	18.1(3.4)	**1.4****	16.1(2.34)	17.3(2.9)	**1.2****
OWO	19.2	27.4	**8.2***	31.2	14.4	**16.8****
TPI	13.2(2.0)	17.5(4.2)	**4.3****	12.7(1.7)	16.9(3.8)	**4.3****
WC	56.4(7.3)	65.6(8.9)	**9.3****	55.2(7.7)	62.6(6.8)	**7.5****
WHtR	0.4(0.1)	0.5(0.1)	**0.1****	0.4(0.1)	0.4(0.0)	0.0

Significant difference between baseline and two-year follow-up *p<0.05; **p<0.001
Overweight/obesity (%OWO) defined by IOTF standards; body mass index (BMI, kg/m^2); triponderal index (TPI, kg/m^3); waist circumference (cm); and waist-to-height ratio (WHtR).

Table 2 . Correlation between baseline cardiometabolic risk factors and follow-up body composition by sex.

	Insulin	HDL	SBP	LNDBP	Glucose	LNTG	LDL
Boys							
BMI	**0.29****	NS	**0.41****	**0.34****	NS	NS	NS
TPI	NS	NS	NS	NS	NS	NS	NS
WC	**0.31****	NS	**0.45****	**0.40****	NS	NS	NS
WHtR	**0.25****	**-0.21***	**0.35****	**0.32****	NS	NS	NS
Girls							
BMI	**0.32****	**-0.24****	**0.27****	NS	NS	NS	NS
TPI	NS	**-0.33****	NS	NS	NS	NS	NS
WC	**0.37****	**-0.21****	**0.21***	NS	NS	NS	NS
WHtR	**0.28****	**-0.21****	**NS**	NS	NS	NS	NS

*Significant correlation between baseline CMR and two-year body composition, p<0.05. Define terms. Insulin, fasting insulin (µlU/ml); high-density lipoprotein (HDL, mmol/L); systolic blood pressure (SBP, mmHg); log transformed diastolic blood pressure (LNDBP, mmHg); glucose (mml/L); log transformed triglycerides (LNTG, mml/L); low-density lipoprotein (LDL, mmol/L), body mass index (BMI, kg/m^2); triponderal index (TPI, kg/m^3); waist circumference (cm); and waist-to-height ratio (WHtR, %).

Table 3. Associations of cardiometabolic risk factor group and body composition at baseline (Model A), and cardiometabolic risk factor group at baseline and body composition at follow-up (Model B) controlling for covariates

	Insulin Group (>85th centile)		HDL Group (<15th centile)		SBP Group (>85th centile)		DBP Group (>85th centile)	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Model A								
BMI	**0.33****	**0.32****	NS	NS	**0.47****	NS	**0.47****	NS
TPI	**0.30****	**0.33****	NS	NS	**0.44****	NS	**0.44****	NS
WC	**0.34****	**0.23***	NS	NS	**0.36****	NS	**0.35****	NS
WHtR	**0.28****	**0.20***	NS	NS	**0.30****	NS	**0.30****	NS
Model B								
BMI	NS	**-0.12***	NS	NS	NS	NS	NS	NS
TPI	NS	**-0.11***	NS	NS	NS	NS	**-0.10***	NS
WC	NS	NS	NS	NS	NS	NS	NS	NS
WHtR	NS	**0.19***	**-0.11***	NS	NS	NS	**0.15***	NS

Model A, baseline CMR group as predictor of baseline body composition controlling for baseline age.
Model B, baseline CMR group as predictor of two-year body composition controlling for baseline age, change in time and baseline body composition. * p<0.05, ** p< 0.001

Discussion

- **Girls** with baseline insulin greater than the 85th centile had higher WHtR, and lower BMI and TPI two years later.
- **Boys** with baseline HDL less than, and DBP greater than 85th centile had lower TPI and higher WHtR two years later.
  - Adjusted for baseline age, change in age, and baseline body composition.
- **Higher CMR profile** indicates a disproportionate amount of weight accrued as abdominal fat, and less as lean mass.
  - Supported by Burrows et al. (2015) and Kim et al. (2015) who found low muscle mass predicted metabolic syndrome criterion[5].
  - Asian youth have more central body fat controlling for age, height, weight and gynoid fat[2], and lower skeletal mass compared to black and white children[6].
- Our data corroborate previous findings that question the usefulness of BMI as a marker of risk in Asian children, since body fat is underestimated[7].

Conclusions

Elevated cardiometabolic risk factors may predict future abdominal fat gain, but lower TPI and BMI in Hong Kong children. In addition to the standard overweight screening tool of BMI, monitoring levels of known CMR factors in Asian children, may be a promising tool for predicting future OWO and comorbidities.

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