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ASSOCIATION BETWEEN CHANGES IN ANTHROPOMETRIC MEASURES THROUGH ADOLESCENCE AND CARDIOVASCULAR RISK FACTORS AT 17 YEARS OF AGE

INTRODUCTION

Childhood and adolescent obesity has been associated with the tracking of obesity into adulthood. Additionally, it is also associated with cardiovascular risk factors, such as dyslipidemia, insulin resistance and hypertension even during young ages. However, it is not clear how changes in adiposity during adolescence are related with those cardiovascular risk factors.

OBJECTIVE

We aimed to study the association of changes in body mass index (BMI) and waist circumference (WC) during adolescence with cardiovascular risk factors in late adolescence.

METHODS

In 2003/2004 we evaluated 2160 adolescents (77.5% participation rate) as part of a Portuguese population-based cohort (EPITeen)[1]. Eligible participants were enrolled at public and private schools in Porto, Portugal, and were born in 1990. The second study wave took place in the 2007/2008 school year and 1716 (79.4%) adolescents were re-evaluated.

We included in this analysis 1574 adolescents with complete information on BMI, WC and systolic (SBP) and diastolic blood pressure (DBP) in both study waves. Additionally, a fasting blood sample was drawn in 861 adolescents to evaluate triglycerides, low density lipoprotein cholesterol (LDLc), high density lipoprotein cholesterol (HDLc), glucose and insulin.

Weight and height were measured and age- and sex-specific BMI z-scores were calculated based on CDC growth charts[2]. WC was classified as below the 75th percentile and at or above it, considering the reference for European-American children and adolescents[3].

We computed odds ratio (OR) and 95% confidence intervals (95%CI) using logistic regression to study the association between changes in BMI and in WC from 13 to 17 years and outcomes at 17 years. The outcomes were defined as high SBP ≥130mmHg and high DBP ≥85mmHg[4]; low HDLc if values <1st quartile and high triglycerides, high LDLc, high glucose and high insulin if values >4th quartile for each parameter.

References
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[3] Fernandez JR, Redden DT, Pietrobelli A, Allison DB. Waist circumference percentiles in nationally representative samples of African-American, European-American, and Mexican-American children and adolescents. J Pediatr. 2004;145(4):439-44.
[4] Zimmet P, Alberti G, Kaufman F, Tajima N, Silink M, Arslanian S, et al. The metabolic syndrome in children and adolescents. Lancet. 2007;369(9579):2059-61.

RESULTS

From 13 to 17 years of age 13.3% of females and 16.9% of males remained overweight or obese. A small proportion of adolescents changed from overweight or obese classes to normal weight (8.2% of females and 10.0% of males) and 2.2% of females and 3.7% of males increased their BMI to a higher category.

In crude analysis, comparing with adolescents who remained normal weight in both study waves, those who remained overweight/obese and those who changed to overweight/obese presented higher values of the cardiovascular risk factors evaluated. However, after adjustment for BMI z-score at age 13 the associations lost statistical significance (table 1). The adjustment for other potential confounders (height, age at menarche, parental education, parental BMI, sedentary and physical activities) did not change those estimates.

Table 1: Association between changes in BMI between 13 and 17 years of age and cardiovascular risk factors at 17 years.

Changes in BMI (13y / 17y)	High SBP	High DBP	High triglycerides	High LDLc	Low HDLc	High glucose	High insulin
	Adjusted* odds ratio (95%CI) for females						
Normal at both	1	1	1	1	1	1	1
Overweight-obese/normal	0.21 (0.03-1.73)	----	1.34 (0.55-3.28)	1.08 (0.45-2.63)	0.69 (0.26-1.80)	0.92 (0.33-2.60)	1.11 (0.45-2.74)
Normal/overweight-obese	3.15 (0.83-11.87)	2.38 (0.28-19.99)	2.51 (0.76-8.36)	1.48 (0.42-5.16)	0.28 (0.04-2.26)	1.98 (0.56-6.97)	4.76 (1.43-15.85)
Overweight-obese at both	2.43 (0.86-6.84)	3.34 (0.79-14.03)	1.68 (0.71-3.95)	0.54 (0.21-1.38)	1.76 (0.75-4.10)	2.17 (0.91-5.17)	1.64 (0.69-3.89)
Changes in BMI (13y / 17y)	Adjusted* odds ratio (95%CI) for males						
Normal at both	1	1	1	1	1	1	1
Overweight-obese/normal	1.09 (0.50-2.37)	1.96 (0.61-6.34)	1.05 (0.40-2.78)	0.41 (0.15-1.13)	0.43 (0.16-1.17)	0.78 (0.30-2.00)	0.45 (0.17-1.15)
Normal/overweight-obese	2.20 (0.90-5.40)	3.68 (1.10-12.34)	5.73 (1.96-16.74)	0.65 (0.17-2.42)	2.20 (0.76-6.39)	1.50 (0.49-4.62)	1.81 (0.62-5.26)
Overweight-obese at both	1.72 (0.81-3.63)	0.94 (0.59-1.51)	3.56 (1.57-8.10)	1.68 (0.72-3.89)	1.00 (0.43-2.34)	1.37 (0.61-3.07)	0.74 (0.31-1.77)

* Adjusted for BMI z-score at 13y.

About WC, 10.3% of females and 11.2% of males remained above the 75th percentile and 13.6% of females and 12.9% of males changed for the class <75th percentile. On the contrary, 2.6% of females and 2.9% shift to the class ≥75th percentile.

Adolescents who remained or changed to the higher WC class presented a worse cardiovascular profile (table 2). The association was strong among males, particularly with regard to blood pressure and triglycerides. Among females, the parameters related with glucose metabolism were those that presented stronger effect. However, the associations were partly explained by BMI at 13 years.

Table 2: Association between changes in WC between 13 and 17 years of age and cardiovascular risk factors at 17 years.

Changes in WC (13y/17y)	High SBP	High DBP	High triglycerides	High LDLc	Low HDLc	High glucose	High insulin
	Crude odds ratio (95%CI) for females						
<75th at both	1	1	1	1	1	1	1
≥75th / <75th	0.29 (0.07-1.21)	0.63 (0.14-2.76)	1.59 (0.90-2.81)	0.98 (0.54-1.79)	1.49 (0.83-2.67)	0.71 (0.37-1.36)	1.64 (0.91-2.95)
<75th / ≥75th	1.65 (0.37-7.34)	1.71 (0.22-13.50)	2.42 (0.75-7.86)	1.00 (0.26-3.79)	0.33 (0.04-2.61)	2.18 (0.67-7.06)	5.62 (1.73-18.30)
≥75th at both	3.13 (1.61-6.08)	2.17 (0.78-6.04)	1.13 (0.57-2.23)	0.63 (0.29-1.35)	2.68 (1.45-4.93)	1.24 (0.64-2.38)	2.94 (1.59-5.45)
	Adjusted* odds ratio (95%CI) for females						
<75th at both	1	1	1	1	1	1	1
≥75th / <75th	0.18 (0.04-0.83)	0.66 (0.13-3.36)	1.50 (0.76-2.98)	1.07 (0.52-2.17)	1.52 (0.75-3.06)	1.26 (0.59-2.70)	1.58 (0.78-3.21)
<75th / ≥75th	1.30 (0.29-5.92)	1.76 (0.22-14.36)	2.35 (0.71-7.77)	1.05 (0.27-4.02)	0.34 (0.04-2.67)	3.05 (0.91-10.20)	5.52 (1.66-18.31)
≥75th at both	1.59 (0.59-4.27)	2.32 (0.55-9.82)	1.04 (0.42-2.55)	0.72 (0.27-1.86)	2.76 (1.17-6.50)	3.07 (1.26-7.49)	2.79 (1.18-6.63)
Changes in WC (13y/17y)	Crude odds ratio (95%CI) for males						
<75th at both	1	1	1	1	1	1	1
≥75th / <75th	1.69 (0.98-2.93)	1.01 (0.38-2.68)	1.10 (0.54-2.20)	1.03 (0.51-2.06)	1.11 (0.56-2.20)	1.03 (0.52-2.02)	1.67 (0.88-3.16)
<75th / ≥75th	2.47 (0.94-6.52)	5.52 (1.90-16.06)	4.10 (1.38-12.17)	2.14 (0.69-6.62)	2.10 (0.68-6.48)	1.93 (0.63-5.96)	2.18 (0.71-6.77)
≥75th at both	3.07 (1.83-5.15)	2.22 (1.01-4.90)	4.45 (2.38-8.32)	3.85 (2.06-7.18)	2.12 (1.12-4.03)	1.96 (1.03-3.71)	3.09 (1.65-5.78)
	Adjusted *ratio (95%CI) for males						
<75th at both	1	1	1	1	1	1	1
≥75th / <75th	0.95 (0.49-1.86)	0.82 (0.26-2.53)	1.12 (0.50-2.52)	0.60 (0.26-1.36)	0.76 (0.34-1.70)	1.35 (0.62-2.94)	0.99 (0.46-2.12)
<75th / ≥75th	1.69 (0.62-4.61)	4.78 (1.54-14.83)	4.17 (1.37-12.71)	1.58 (0.50-5.01)	1.68 (0.53-5.34)	2.29 (0.72-7.27)	1.62 (0.51-5.15)
≥75th at both	1.42 (0.68-2.93)	1.66 (0.55-5.03)	4.61 (2.02-10.49)	1.90 (0.82-4.38)	1.29 (0.55-2.99)	2.82 (1.24-6.40)	1.54 (0.67-3.56)

* Adjusted for BMI z-score at 13y.

CONCLUSIONS

Remaining or changing to higher categories of BMI or WC in adolescence period was associated with worse cardiovascular risk profile later in adolescence.