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Prenatal exposure to environmental contaminants and body composition at age 7–9 years

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ABSTRACT

The study aim was to investigate the association between prenatal exposure to endocrine disrupting chemicals (EDCs) and the body composition of 7 to 9 year old Flemish children. The subjects were 114 Flemish children (50% boys) that took part in the first Flemish Environment and Health Study (2002–2006). Cadmium, PCBs, dioxins, p,p′-DDE and HCB were analysed in cord blood/plasma. When the child reached 7–9 years, height, weight, waist circumference and skinfolds were measured. Significant associations between prenatal exposure to EDCs and indicators of body composition were only found in girls. After adjustment for confounders and covariates, a significant negative association was found in girls between prenatal cadmium exposure and weight, BMI and waist circumference (indicator of abdominal fat) and the sum of four skinfolds (indicator of subcutaneous fat). In contrast, a significant positive association (after adjustment for confounders/covariates) was found between prenatal p,p′-DDE exposure and waist circumference as well as waist/height ratio in girls (indicators of abdominal fat). No significant associations were found for prenatal PCBs, dioxins and HCB exposure after adjustment for confounders/covariates. This study suggests a positive association between prenatal p,p′-DDE exposure and indicators of abdominal fat and a negative association between prenatal cadmium exposure and indicators of both abdominal as well as subcutaneous fat in girls between 7 and 9 years old.

1. Introduction

Obesity in children is an important health problem since most obese and overweight children grow up to be obese adults (Guo et al., 2002). Prevention of overweight and obesity in children is a priority because these diseases are linked to a number of severe health problems such as diabetes mellitus type 2, cardiovascular diseases and certain cancers (Collins, 2005). Besides genetic, behavioural and dietary factors, also environmental factors, e.g. exposure to endocrine disrupting chemicals (EDCs) may be risk factors for developing obesity. EDCs can interfere with the human endocrine system, potentially playing a role in the development of obesity (Newbold, 2010; Tang-Peronard et al., 2011). Polychlorinated biphenyls (PCBs), dioxins (polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans), para,para-dichlorodiphenyldichloroethylene (p,p′-DDE), hexachlorobenzene (HCB) and heavy metals like cadmium are all considered to act as EDCs. Studies have indicated that dioxins can bind the aryl hydrocarbon receptor, induce the cytochrome P450 1A enzyme and have an antiestrogenic action, while PCBs induce the pregnane X receptor and the constitutive androstane receptor and induce thyroid hormone disruption. HCB and p,p′-DDE are thought to have an antiandrogenic function (Legler et al., 2011). Cadmium can affect the secretory patterns of pituitary hormones and the synthesis of progesterone (Iavicoli et al., 2009). Recent epidemiological studies suggest that EDCs exposure during the critical period of foetal development is associated with overweight and obesity later in life. Results of these studies are summarized in Table 1. This table is limited to studies with children in the age range between 4.5 and 16 years old.

Abbreviations: EDCs, endocrine disrupting chemicals; PCBs, polychlorinated biphenyls; p,p′-DDE, para,para-dichlorodiphenyldichloroethylene; HCB, hexachlorobenzene; BMI, body mass index; FLEHS, Flemish Environment and Health Study; LOD, limit of detection

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Table 1
Available data in literature on the effect of prenatal exposure to EDCs and anthropometric parameters in later life.

EDC	Reference	Age (years)	Number of study participants	Level of exposure			Anthropometric parameter	Result	Significant
				In cord blood(B)/serum(S)	In maternal blood(B)/serum(S)	In placenta			
Cd	Tian et al. (2009)	4.5	106	Median 1.8 μg/L (B)	Median 0.60 μg/L	0.15 g/g dry weight	Height	Decrease	S
		4.5	106	Median 1.8 μg/L (B)	Median 0.60 μg/L	0.15 g/g dry weight	Weight	Decrease	NS
Dioxins	Su et al. (2010)	5	149			Median dioxins/PCB Teq 15.15 pg/g lipid	Height	Increase	S
		5	149			Median dioxins/PCB Teq 15.15 pg/g lipid	Weight	Increase	NS
		5	149			Median dioxins/PCB Teq 15.15 pg/g lipid	BMI	Increase	NS
PCB	Valvi et al. (2012)	6.5	344	Mean (±SD) 0.75 (±1.70) μg/L (S)			BMI	Increase	S[a]
	Gladen et al. (2000)	10–15	594	Median <4.27 ppb=<4.27 μg/L (S)	Median 9.06 ppb=9.06 μg/L (S)	Median <12 ppb=<12 μg/L (S)	Weight adjusted for height	Increase	S[b]
		10–15	594	Median <4.27 ppb=<4.27 μg/L (S)	Median 9.06 ppb=9.06 μg/L (S)	Median <12 ppb=<12 μg/L (S)	Height	Increase	NS
p,p′-DDE	Valvi et al (2012)	6.5	343	Mean (±SD) 1.06 (±2.45) ng/mL (S)			BMI	Increase	S[c]
	Gladen et al. (2000)	10–16	594	Median 3.95 ppb=3.95 μg/L (S)	Median 12.60 ppb (S)	Median 6.77 ppb (S)	Weight adjusted for height	Increase	S[d]
		10–16	594	Median 3.95 ppb=3.95 μg/L (S)	Median 12.60 (S)	Median 6.77 (S)	Height	Increase	NS
	Ribas-Fito et al. (2002)	7	1371		Median 24.4 μg/L (S)		Height	Decrease	S
	Gladen et al. (2004)	10–20	304 (only males)		Median 5.7 μg/g lipid (S)		Height, weight, BMI, skinfolds	No association	
	Warner et al. (2013)	7	270		Mean (±SD) 1.42 (±0.003) μg/g lipid (S)		BMI	Increase	NS
		7	270		Mean (±SD) 1.42 (±0.003) μg/g lipid (S)		Waist circumference	No association	
HCB	Smink et al. (2008)	6.5	405	Median 0.68 μg/L (S)			Height	No association	
		6.5	405	Median 0.68 μg/L (S)			Weight	Increase	NS
		6.5	405	Median 0.68 μg/L (S)			BMI	Increase	S

Significant for girls only.
EDC=endocrine disrupting chemical.

[a] Significant for third tertile, but not for second tertile.
[b] Significant for white girls only.
[c] Significant for second tertile, but not third tertile.
[d] Significant for boys only; S=significant; NS=non-significant.