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1	Prenatal organochlorine pesticide exposure and the disruption of steroids and
2	reproductive hormones in cord blood: The Hokkaido Study
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# 41 Abstract

Certain organochlorine pesticides (OCPs) are designated as persistent organic pollutants and are regulated in many countries. The effects of OCPs on pediatric endocrinology are a concern; however, only limited data exist from human studies on maternal OCP exposure and its effects on infants' hormone levels. This study was conducted as part of the Hokkaido Study Sapporo Cohort, a prospective birth cohort study in Japan. Participants included 514 women who enrolled at 23–35 weeks of gestation between 2002 and 2005; maternal blood samples were collected in late pregnancy, and 29 OCPs were measured. Reproductive and steroid hormone levels in cord blood were also determined. Characteristics of mothers and their infants were obtained from self-administered questionnaires and medical records. Ultimately, 232 samples with both OCP and hormone data were analyzed. Fifteen of 29 investigated OCPs were detected in over 80% of the samples, with p,p'-dichlorodiphenyldichloroethylene showing the highest concentration (median value: 619 pg/g-wet). The association between OCPs and sex hormone levels varied by sex. Linear regression models after sex stratification showed that chlordanes, cis-hexachlorobenzene, heptachlor epoxide, Mirex, and toxaphenes in maternal blood were inversely associated with testosterone, cortisol, cortisone, sex hormone-binding globin, prolactin, and androstenedione-dehydroepiandrosterone (DHEA) and testosterone-androstenediones ratios among boys. Furthermore, these OCPs were positively correlated with DHEA, follicle stimulating hormone (FSH), and adrenal androgen-glucocorticoid and FSH-inhibin B ratios among boys. In categorical quartile models, testosterone and DHEA were inversely and positively associated with OCPs, respectively. Estradiol-testosterone and adrenal androgen-glucocorticoid ratios tended to increase with increasing OCP concentrations

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182	65	in the higher quantile while the testesteres on dreater adiana ratio tended to decrease
183	63	in the higher quartile, while the testosterone-androstenedione ratio tended to decrease.
184 185	66	Sex hormone-binding globulin and prolactin showed an inverse association with OCPs.
186 187	67	Among girls, the linear regression model showed that only $p,p'$ -
188		
189 190	68	dichlorodiphenyltrichloroethane was inversely associated with the level of DHEA and
191 192	69	the adrenal androgen-glucocorticoid ratio, but was positively associated with cortisone
193 194	70	levels. However, no associations were observed using the quartile categorical model.
195 196	71	These results suggest that prenatal exposure to OCPs disrupt reproductive hormones of
197 198	72	fetuses in utero among boys, even at relatively low levels.
199 200	73	
201		
202	74	Key Words: Organochlorine pesticides; reproductive hormones; steroidal hormones;
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204	/5	prenatal exposure; cord blood; birth cohort
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207 208	77	Abbraviations
200	//	Abbi eviations.
210	78	CL confidence interval
211	70	
212	79	CYP11A1, cytochrome P450 family 11 subfamily A member 1
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214 215	80	CYP17A1, cytochrome P450 family 17 subfamily A member 1
216 217	81	CYP19A1, cytochrome P450 family 19 subfamily A member 1
218 219	82	DDD, dichlorodiphenyldichloroethane
220 221	83	DDE, dichlorodiphenyldichloroethylene
222	84	DDT, dichlorodiphenyltrichloroethane
224 225 226	85	HCB, hexachlorobenzene
227 228	86	HCE, heptachlor epoxide
229 230	87	HCH, hexachlorocyclohexane
231	0.0	
232	88	HSD1/B1, hydroxysteroid 1/-beta dehydrogenase 1
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242	89	HSD3B1, hydroxy-delta-5-steroid dehydrogenase, 3 beta- and steroid delta-isomerase 1
243		
244	90	IRMA, immunoradiometric assay
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246	91	DHEA, dehydroepiandrosterone
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248	92	EIA, enzyme immunoassay
249		
250	93	ELISA, enzyme-linked immunosorbent assay
251		
252 253	94	FSH, follicle stimulation hormone
254	05	
255	95	INSL3, insulin-like factor 3
256	06	LC MEME liquid characteremetry tou down more an extreme star
257	90	LC-MSMS, inquid chromatography-tandem mass spectrometry
258	07	I H luteinizing hormone
259	)1	
260	98	LSM least square mean
262	20	
263	99	OCP, organochlorine pesticides
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265	100	SHBG, sex hormone-binding globulin
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267	101	StAR, steroidogenic acute regulatory protein
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# **1. Introduction**

Organochlorine pesticides (OCPs) are chlorinated hydrocarbons used extensively in the 1940s for agriculture and pesticide control, and are now designated as persistent organic pollutants by the Stockholm Convention (http://chm.pops.int). Although the Stockholm Convention has issued an exemption for the production and public health use of dichlorodiphenyltrichloroethane (DDT) to control vector-borne diseases, most OCPs were banned in the United States, Europe, and many other countries in the early 1970s (WHO, 2012). The use of OCPs has been eliminated or restricted in Japan since the 1970's (Kanazawa et al. 2012). Although most OCPs have been prohibited for over 30 years, they are still detected in the environment and in human populations. According to Japanese monitoring data, the levels of DDT and its metabolites in water and sediment have decreased since 1990 and have consistently remained low since 2000; however, they are still detectable (Ministry of Environment, Japan 2006). Heptachlor epoxide (HCE), hexachlorocyclohexane (HCH), Mirex, Parlar-26, and Parlar-50 are also above detectable levels in water and sediments, even though the latter three have never been used in Japan (Ministry of Environment, Japan 2006).

119The endocrine disrupting properties of OCPs are considered a health concern. In136120previous cross-sectional studies among adults, heptachlor and o, p'-DDT concentrations138121were associated with lower testosterone levels in men (Freire et al. 2014). In women,140122hexachlorobenzene (HCB), p, p'-DDT, p, p'-dichlorodiphenyldichloroethane (DDD),141123endosulfan, aldrin, and Mirex showed inverse associations with luteinizing hormone144124(LH) and follicle stimulation hormone (FSH) while showing positive associations with145125prolactin (Freire et al. 2014).

Maternal exposure to OCPs may affect fetal hormone levels. Sex steroid hormones including testosterone, progesterone, and estradiol exert their functions predominantly in the gonads, and dehydroepiandrosterone (DHEA) and androstenedione are activated to form androgens and estrogens that have important roles in sex differentiation and maturation (Labrie et al. 2001). Cortisol and cortisone are synthesized within the adrenal cortex, are involved in a wide range of physiological processes, and are essential for regulating and/or modulating homeostasis in metabolism, growth, neurodevelopment, and the immune system (Braun et al. 2013; Reynolds 2010). LH and FSH play critical roles in the development and regulation of numerous body functions via the hypothalamic-pituitary-gonadal (HPG) axis (Kuiri-Hänninen et al. 2014). Inhibin B and insulin-like factor-3 (INSL3) are major products secreted by the Leydig and Sertoli cells, respectively, and the establishment of sufficient numbers of these cells is critical for the production of sperms in adulthood (Ivell et al. 2013; Orth and Boehm 1990). In response to gonadotropins, testosterone (via LH signaling) and inhibin B together act to regulate the secretion of FSH; these constitute the major negative feedback signals that maintain the physiological function of the HPG axis (Carlson, 2009). However, only limited data exist regarding human studies on prenatal exposure to OCPs and their effects on steroids and reproductive hormone levels in offspring. There is only one study in France that found that prenatal  $\alpha$ -endosulfan and HCE increase estradiol and sex hormone-binding globulin (SHBG), whereas these same agents reduce testosterone levels at birth (Warembourg et al. 2016). We have previously reported that 21 of 29 tested OCPs were detected in maternal blood acquired between 2002 and 2005 in Japan (Kanazawa et al. 2012). The impact of relatively low levels of OCP exposure on hormones at birth has still not been 

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418	150	well-investigated in epidemiological studies. In particular, the effects of OCPs other
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421	151	than DDTs are rarely investigated. Thus, we hypothesized that prenatal exposure to
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423	152	even relatively low levels of these agents may alter hormone levels in infants. To that
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425	153	end, the aim of this study was to examine the associations between prenatal OCP
420	154	exposure and cord blood steroid and reproductive hormone levels
428	134	exposure and cord blood steroid and reproductive normone levels.
429	155	
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431	156	2. Methods
432 433		
434	157	2.1 Participants
435	150	This investigation was based on the Senners Cohort of the Helkeide Study on
436	150	This investigation was based on the Sappord Conort of the Hokkaido Study on
437 738	159	Environment and Children's Health. Details of this study, including the population, data
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440	160	collection, sampling of the biological specimens, and contents of the administered
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442	161	questionnaire, were described previously (Kishi et al. 2017; Kishi et al. 2013; Kishi et
443 444	162	al 2011) Briefly Japanese pregnant women who lived in Sapporo City or surrounding
445	102	al. 2011). Brieffy, saparese pregnant women who nyed in Sapporo City of surrounding
446	163	areas were recruited at 23–35 weeks of gestation between July 2002 and October 2005
447		
448 770	164	at an obstetrics and gynecology hospital in Sapporo, Hokkaido, Japan. Among the 1796
450	1.65	
451	165	eligible women approached, 25% were excluded because they were enrolled in the
452	166	Japanese Cord Blood Bank or planned to deliver at another hospital Ultimately 514
453	100	supunese cord brood bank of planned to deriver at another hospital. Ortifiately, 511
404 455	167	pregnant women (28.6% of those approached) were enrolled in this study.
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457	168	
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459 460	169	2.2 OCP measurement
461	170	Maternal blood samples were obtained at the time of patients' hospital examinations
462	170	indernal bloba sumples were boarned at the time of parlents hospital examinations
463	171	following recruitment (n=296). If a blood sample could not be obtained during
464		
405 466	172	pregnancy because of maternal anemia, a sample was collected during post-partum
467	172	$1 - \frac{1}{20} = 120$ All $-\frac{1}{20} = 120$
468	1/3	nosphanzation within a week after derivery ( $n-150$ ). All samples were stored at $-80^{\circ}$ C
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477 478 470	174	until analysis. OCPs in whole blood were measured by gas chromatography/high-
479 480	175	resolution mass spectrometry and gas chromatography/negative-ion chemical-ionization
482	176	mass spectrometry at IDEA Consultants, Inc. (Shizuoka, Japan) The 29 OCPs evaluated
484	177	in this study were 5 chlordanes (cis-chlordane, trans-chlordane, cis-nonachlor, trans-
486 487	178	nonachlor, and oxychlordane), 6 DDTs (o,p'-DDT, p,p'-DDT, o,p'- DDE, p,p'-DDE,
488 489	179	o,p'-DDD, and p,p'-DDD), 3 'drins' (aldrin, dieldrin, and endrin), 3 heptachlors
490 491	180	(heptachlors, <i>cis</i> - HCE, and <i>trans</i> -HCE), HCB, 4 HCH isomers ( $\alpha$ -HCH, $\beta$ -HCH, $\gamma$ -
492 493	181	HCH, and $\delta$ -HCH), Mirex, and 6 toxaphenes (Parlar-26, Parlar-41, Parlar-40, Parlar-44,
494 495	182	Parlar-50, and Parlar-62). Details of the measurement methods have been described
496 497	183	previously (Kanazawa et al. 2012).
498 499	184	
500 501 502	185	2.3 Measurement of steroids and reproductive hormones
502 503 504	186	The methods used to measure steroids and reproductive hormones were described
505 506	187	previously (Araki et al. 2017; Araki et al. 2014; Goudarzi et al. 2016). Briefly, the
507 508	188	concentrations of 7 steroid hormones including progesterone, estradiol, testosterone,
509 510	189	DHEA, androstenedione, cortisol, and cortisone in cord blood were measured using
511 512	190	liquid chromatography-tandem mass spectrometry (LC-MSMS) (Yamashita et al.
513 514 515	191	2007a; Yamashita et al. 2007b). An immunoradiometric assay (IRMA) was used to
516 517	192	measure the concentrations of LH, FSH, and prolactin (Spac-S LH Kit, Spac-S FSH Kit,
518 519	193	and Spac-Prolactin Kit, respectively, TFB, Inc., Tokyo Japan). SHBG was also
520 521	194	measured using IRMA-Count SHBG (Siemens, Berlin, Germany). Concentrations of
522 523	195	inhibin B were measured by using an enzyme-linked immunosorbent assay (ELISA)
524 525	196	(Inhibin B Gen ELISA, Beckman Coulter, Inc., CA, USA), while INSL3 was measured
526 527 528 529	197	by using an enzyme immunoassay (EIA) (INSL3/RLF [human] EIA kit, Phoenix
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537	198	Pharmaceutical., Inc., CA, USA). All hormone measurements were conducted at Aska
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539	199	Pharma Medical Co., Ltd (Kanagawa, Japan).
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541	200	
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543	201	2.4 <i>Questionnaires and medical records</i>
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545	202	The participants completed a self-administered questionnaire that extracted information
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547	203	on maternal age education level household income maternal smoking and alcohol
548	205	on material age, education level, nousehold meome, material smoking and alcohol
549	204	consumption during the first trimester and medical history. Information at the time of
550	204	consumption during the first trimester, and medical instory. Information at the time of
551	205	
552	205	delivery, including pre-pregnancy body mass index, pregnancy complications,
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554	206	gestational age, infant sex, parity, congenital anomalies such as hypospadias and
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556	207	cryptorchidism, and infant size was obtained from medical records (Kishi et al. 2013;
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558	208	Kishi et al. 2011).
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562	210	2.5 Statistical analyses
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564	211	Of the 514 participants, 10 were excluded from the study owing to miscarriage,
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566	212	stillbirth, relocation, or voluntary withdrawal prior to delivery. Among 426 maternal
567		
568	213	blood samples. 379 were of sufficient quantity for OCP analysis, while hormone
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570	214	measurements were obtained from 295 infant cord blood samples. Ultimately, 232
571	211	incustrements were obtained from 295 infant cord blood sumples. Ortificatory, 252
572	215	matched maternal serum and cord blood samples (for OCP and hormone levels
573	215	matched matching serum and core blood samples (for over and normone revers
574	216	maguramenta respectively) were included in the statistical analysis
575	210	measurements, respectively) were included in the statistical analysis.
576	017	
5//	217	Associations between maternal OCP concentrations and infant steroid normone
578	<b>a</b> 10	
579	218	levels were examined for each OCP separately via linear regression analysis. In each
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581	219	model, the OCP was the independent variable while the hormone was the dependent
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583	220	variable. Initially, linear regression models for both sexes combined were constructed
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586	221	with the interaction terms of sex $\times$ OCP levels added in each model; this revealed
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significant differences between the sexes. Next, the models were applied following stratification by sex. OCP levels and the concentrations of steroid hormones were converted to a log<sub>10</sub> scale because they were not normally distributed. Two-sided P-values <0.05 were considered statistically significant. Selected OCPs with *P*-values <0.1 in linear regression models were then categorized into concentration quartiles to examine dose-response relationships. The interquartile range for each OCP concentration and the least squares means (LSM) of log-transformed hormone levels were calculated and back-transformed. To calculate a P-value for the trend, linear contrast coefficients of -3, -1, +1, and +3 were assigned to the first, second, third, and fourth quartiles, respectively (Goudarzi et al., 2016; Itoh et al., 2016). P-values for trend <0.05 were considered statistically significant. The OCP levels in the first quartile were also compared to those in the second, third, and fourth quartiles using the Dunnett-Hsu method; *P*-values were adjusted using Bonferroni's correction (P < 0.0167). When below their detection limits, the half values of these detection limits were used for both OCPs and hormones. In addition to single hormone levels, we also examined the product-to-substrate ratios of hormones that are adjacent in the metabolic pathway to determine their enzyme activity indices (Hicks et al. 2014). For example, the estradiol-testosterone ratio represents the index of the cytochrome P450 family 19 subfamily A member 1 (CYP19A1), better known as aromatase. The androstenedione-DHEA ratio represents the hydroxy-delta-5-steroid dehydrogenase, 3 beta- and steroid delta-isomerase 1 (HSD3B1) index; the testosterone-androstenedione ratio represents the hydroxysteroid 17-beta dehydrogenase 1 (HSD17B1) index; and the cortisone-cortisol ratio represents the HSD3B1 index. Increasing and decreasing ratios suggest the up- and 

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654	246	downregulation of enzyme activity respectively. Additionally the adrenal androgen
655	210	downegalation of enzyme activity, respectively. Additionally, the adjenal and ogen
656	247	(the sum of DHEA and androstenedione)-glucocorticoid (sum of cortisol and cortisone)
659	217	(the sum of DTELT and analostenedione) gradeeorateora (sum of cortisor and cortisone)
000 650	248	ratio was examined to determine the balance shift of adrenal androgen (C19-steroids)
660	210	
661	249	and glucocorticoid (C21-steroids) (Goudarzi et al. 2016) Similarly testosterone-LH
662	,	
663	250	and FSH-inhibin B ratios were examined as indices of gonadal function. The inclusion
664		
665	251	of covariates was examined based on biological considerations, and included maternal
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667	252	age (continuous), parity (primipara or multipara), and gestational age (continuous). All
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669	253	statistical analyses were performed using the Japanese version of IBM SPSS Statistics
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672	254	19 (IBM Analytics, NC, USA) and the Japanese version of JMP Pro 12 (SAS Institute
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674	255	Inc., NC, USA).
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676	256	
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678	257	2.6 Ethical approval
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680	258	This study was approved by the Institutional Ethical Board for Epidemiological Studies
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683	259	at Hokkaido University Graduate School of Medicine and Hokkaido University Center
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685	260	for Environmental and Health Sciences, in accordance with the principles of the
686	261	Declaration of Halpinki. All nontininents may ided witten informed concent
687	201	Declaration of Heisinki. All participants provided written informed consent.
688	262	
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690	263	3 Dosults
691	205	5. Results
692	264	Table 1 shows the characteristics of the participants included in this study as well as
693	204	Table 1 shows the characteristics of the participants included in this study as well as
695	265	those of the original cohort. Compared to the original cohort, the mean birth weight and
696	200	those of the original conort. Compared to the original conort, the mean of the weight and
697	266	gestational age were slightly larger among the participants; the vaginal delivery rate
698		
699	267	among participants was 99.1%. One infant with cryptorchidism was included in the
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701	268	study.
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714	269	The concentrations of OCP in maternal blood samples are shown in Table 2.
715 716 717	270	There were 15 OCPs (3 chlordanes [cis-nonachlor, trans-nonachlor, and oxychlordane],
717 718 719	271	5 DDTs [ <i>o</i> , <i>p</i> '-DDT, <i>p</i> , <i>p</i> '-DDT, <i>o</i> , <i>p</i> '- DDE, <i>p</i> , <i>p</i> '-DDE, p,p'-DDD], dieldrin, <i>cis</i> -HCE,
713 720 721	272	HCB, $\beta$ -HCH, Mirex, and 2 toxaphenes [Parlar-26 and Parlar-50]) that were above 80%
722 723	273	of their detection limits; these OCPs were subjected to further analysis. The median
724 725	274	concentration of $p,p'$ -DDE was the highest at 619.26 pg/g-wet, followed by $\beta$ -HCH at
726 727	275	154.31 pg/g-wet, and HCH at 103.99 pg/g-wet. The distributions of OCPs in the
728 729	276	original cohort are shown in Supplemental Table S1; trans-chlordane, cis-nonachlor,
730 731	277	and trans-nonachlor levels of participants in this study were slightly higher compared
732 733	278	with the levels in those who were excluded (Mann-Whitney U test, P=0.06, 0.039, and
734 735 726	279	0.040, respectively; data not shown). Associations between OCP levels and maternal
730 737 738	280	and child characteristics are shown in Supplemental Table S1. The levels of most OCPs
739 740	281	increased with the ages of the mothers. OCP concentrations were not significantly
741 742	282	associated with infant characteristics such as sex, birth weight, or gestational age.
743 744	283	The steroid and reproductive hormone levels in infants are shown in Table 3.
745 746	284	Testosterone and DHEA levels were significantly higher and lower in boys than in girls,
747 748	285	respectively. The detection rate of LH, FSH, and inhibin B was below 30% in girls,
749 750 754	286	among whom only 16 samples were analyzed for INSL3. Therefore, no further tests of
751 752 753	287	LH, FSH, inhibin B, and INSL3 were conducted for girls. The distribution of all
753 754 755	288	measured hormone levels are shown in Supplemental Table S3; there were no
756 757	289	differences between subjects included and excluded from the study.
758 759	290	The associations between OCPs and steroid and reproductive hormone levels for
760 761	291	both sexes combined were examined (Supplemental Table S4). Sex-specific OCP
762 763 764	292	interactions ( $P < 0.05$ ) between one or more hormones and cis-nonachlor, trans-
765 766 767		13

nonachlor, *p,p* '-DDE, *o,p* '-DDT, dieldrin, and Mirex were observed, suggesting that the
effects of OCPs differ according to sex.

Adjusted regression coefficients ( $\beta$ ) and 95% confidence intervals (CIs) for the association between a 10-fold increase of OCP and log<sub>10</sub>-transformed hormone levels as determined by a linear regression model in boys and girls are shown in Tables 4 and 5, respectively. Among infant boys, Mirex was inversely associated with testosterone, and *p*,*p*'-DDE showed a positive association with the estradiol-testosterone ratio. Oxychlordane, cis-nonachlor, trans-nonachlor, dieldrin, cis-HCE, HCB, Mirex, Parlar-26, and Parlar-50 were positively associated with DHEA. Oxychlordane, trans-nonachlor, cis-HCE, and Mirex were inversely associated with the androstenedione-DHEA ratio. Oxychlordane, cis-nonachlor, trans-nonachlor, dieldrin, cis-HCE, HCB, Mirex, and Parlar-50 showed inverse associations with the testosterone-androstenedione ratio. Both trans-nonachlor and Mirex were inversely associated with cortisol and cortisone. Oxychlordane, cis-nonachlor, trans-nonachlor, cis-HCE, Mirex, and Parlar-50 were positively associated with the adrenal androgen-glucocorticoid ratio. β-HCH was inversely associated with SHBG, and  $\beta$ -HCH, Mirex, Parlar-26, and Parlar-50 were positively associated with FSH. *o*,*p*'-DDE, *p*,*p*'-DDE, *o*,*p*'-DDT, *p*,*p*'-DDT, dieldrin, β-HCH, Mirex, and Parlar-50 were all inversely associated with prolactin. Finally, cis-nonachlor, p,p'-DDE, p,p'-DDT, cis-HCE, HCB, β-HCH, Mirex, Parlar-26, and Parlar-50 were inversely associated with the FSH-inhibin B ratio. There was no statistically significant association between OCPs and progesterone, estradiol, androstenedione, FSH, inhibin B, or INSL3. Among girls, p,p'-DDD was inversely associated with DHEA and the adrenal androgen-glucocorticoid ratio, and was positively associated 

with cortisone. There was no association between OCPs and progesterone, estradiol, testosterone, androstenedione, cortisol, SHBG, or prolactin among girls. Figure 1 shows the relationships between hormones and OCPs in quartile models for boys (only in cases where P < 0.05 was observed). Testosterone showed a decreasing trend in relation to quartiles of Mirex, while LSM analysis of the estradiol-testosterone ratio showed an increasing trend of p,p'-DDE in relation to quartiles. DHEA showed increasing trends in relation to the quartiles of *cis*-Nonachlor, Dieldrin, Parlar-26, and Parlar-50. Moreover, the LSM method showed that the 4th quartile of *cis*-nonachlor was significantly increased compared to the 1st quartile *cis*-nonachlor. LSM analysis of the testosterone-androstenedione ratio showed decreasing trends in relation to cis-nonachlor, trans-nonachlor, Dieldrin, Mirex, and Parlar-50. Moreover, LSM analysis of the adrenal androgen-corticoid ratio showed an increasing trend of *cis*-nonachlor, Parlar-26, and Parlar-50, while SHBG showed a decreasing trend of  $\beta$ -HCH. Prolactin showed decreased trends of p,p'-DDE and o,p'-DDT. Statistically significant relationships between hormones and OCPs in the quartile models were not found among girls. 4. Discussion In linear models, we found that relatively low levels of OCPs were inversely associated with testosterone, cortisol, cortisone, SHBG, and prolactin, but positively associated with DHEA in newborn boys after stratification by sex. Positive associations between OCPs and each of estradiol-testosterone and adrenal androgen-glucocorticoid, as well as an inverse association between OCPs and each of androstenedione-DHEA, testosterone-androstenedione, corticoid-cortisone, and the FSH-inhibin B ratio, were also observed 

among boys. In quartile models, testosterone was inversely associated with OCPs, whereas DHEA was positively associated with them. The estradiol-testosterone and adrenal androgen-glucocorticoid ratios tended to increase when OCP concentrations were the higher quartile, while the testosterone-androstenedione ratio tended to decrease. SHBG and prolactin showed inverse associations with OCPs. Among girls, *p*,*p*'-DDD was inversely associated with DHEA levels and positively associated with levels of cortisol; it was also inversely associated with the glucocorticoid-adrenal androgen ratio. However, these associations were not observed in the quartile models, which would have provided more credence to the findings of the linear models. Overall, our data suggested that the natures of the associations between OCP and hormones differ according to sex, and that clear associations were observed only among infant boys. The levels of OCPs in maternal blood have been measured in several studies performed in various countries. In this study, the median  $p_{p}$ -DDE value in maternal whole blood was 619.26 pg/g-wet. In a study in Chiapas, Mexico, the median values of DDT and DDE in maternal serum collected in 2002–2003 were 1.9 and 19.5 µg/L, respectively (Longnecker et al. 2007). A study of Mexican-Americans in the US state of California found that the maternal geometric mean values of p,p'-DDT, o,p'-DDT, and p,p'-DDE were 22.0, 1.8, and 1436.9 ng/g-lipid, respectively (Eskenazi et al. 2006). A study in China showed geometric means of p,p'-DDE, HCB, and  $\beta$ -HCH in maternal serum, at 203.54 ng/g, 70.62 ng/g, and 67.67 ng/g, respectively (Guo et al. 2014). In another recent study in South Africa, the median maternal  $p_{,p}$ '-DDE level was 241.3 ng/g lipids (Bornman et al. 2016). A meta-analysis of 12 European cohorts found that the median cord serum p,p'-DDE concentration was 527.9 ng/L (ranging from 49.8 

ng/L to 1208 ng/L in various studies) (Govarts et al. 2012). By using Govarts et al.'s conversion factor to calculate cord serum levels from maternal whole blood levels in our study (cord serum level =  $0.36 \times$  maternal whole blood level), the estimated median level of p,p'-DDE in the cord serum of our study was 229.1 ng/L, which is approximately half the median value of European cohorts. Taken together, the OCP exposure levels in our cohort were relatively low in comparison. 

Only 1 study, performed in France, examined prenatal OCP exposure and hormone levels at birth (Warembourg et al. 2016). The investigators found that higher levels of HCB and HCE were associated with reduced levels of testosterone and elevated levels of SHBG among boys. HCE was also associated with higher levels of estradiol and a lower testosterone-estradiol ratio among girls. There was no association between p,p'-DDE and any hormone levels. Their results were partly consistent with ours. In our study, OCPs including HCB and HCE showed inverse associations with testosterone; these were not significant except for Mirex among boys. Although we did not find any association between estradiol and OCPs, their levels tracked together in a manner also observed by Warembourg et al. (2016). Moreover, the positive association between the estradiol-testosterone ratio and OCPs, which was statistically significant for *p,p*'-DDE in this study, are consistent with the findings of Warembourg et al. (2016), as is the significant decrease in the aromatase index (testosterone/estradiol) with increasing HCE. On the other hand, SHBG had a significant inverse correlation with Mirex in our study; which was in direct contrast to Warembourg et al.'s findings; we are unable to explain this discrepancy, as the sampling period (2002–2006) and sample sizes (n=282 for their study and n=232 for ours) were comparable. Additionally, the exposure levels of DDE, HCE, and HCB in our study and in that of Warembourg et al. were 

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1009	388	comparable. However, the detection rates of HCB and HCE were higher in our study,
1010 1011	389	and Warembourg et al. did not measure chlordanes, Mirex, or toxaphenes. Because of
1012 1013	390	the low detection percentage, Warembourg et al. divided OCP levels into two or three
1014 1015	391	categories to examine the association of each with hormones; this could explain why
1016 1017	392	their results do not match ours more closely. We found no other studies that investigated
1018 1019 1020	393	associations between OCPs and DHEA, androstenedione, cortisol, or cortisone. More
1021 1022	394	studies are therefore warranted to ascertain the association between OCPs and
1023 1024	395	steroidogenesis at birth.
1025 1026	396	In this study, DDT, DDE, and DDD were not associated with steroid hormones
1027 1028	397	except for $p,p$ '-DDE, which showed a positive association with the estradiol-
1029 1030 1031	398	testosterone ratio in boys. The increased estradiol-testosterone ratio suggested increased
1032 1033	399	CYP19A1 enzyme activity. A previous animal study showed that $p,p$ '-DDE induces
1034 1035	400	CYP19A1 in hepatic microsomal samples of adult male rats (You et al. 2001), which is
1036 1037	401	consistent with our results. In girls, $p$ , $p$ '-DDD was inversely associated with DHEA and
1038 1039	402	the adrenal androgen-glucocorticoid ratio, but was positively associated with cortisone
1040 1041 1042	403	levels. However, these associations were not observed in the quartile models; therefore,
1042 1043 1044	404	false positive associations are likely. Longnecker et al. (2007) conducted a study in
1045 1046	405	Mexico where maternal DDT levels are relatively high, and found no evidence that in
1047 1048	406	utero exposure to DDE was related to anogenital distance or penile dimensions at birth
1049 1050	407	among male infants. Additionally, Bornman et al. (2016) conducted a similar study in
1051 1052	408	South Africa and reported no associations between $p,p'$ -DDT/-DDE or $o,p'$ -DDT and
1053 1054	409	anogenital distance measurements at birth in either boys or girls. Yet another study in
1055 1056 1057	410	Denmark found no association between prenatal <i>p</i> , <i>p</i> -DDE levels and reproductive
1057 1058 1059	411	hormones at approximately 20 years of age (Vested et al. 2014). Taken together, these
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412 data indicate that DDTs may not alter infant steroid hormones at the levels detected in413 these studies.

Among boys, p,p'-DDE and o,p'-DDT were inversely associated with prolactin in quartile models. Although there have been no specific studies of the mechanisms of OCP influence on prolactin, other investigations suggest that newborns with lower levels of prolactin in their cord blood are more likely to have an increased risk of respiratory distress syndrome than those with higher levels of prolactin (Parker et al. 1989; Padvi et al. 2017). Combined with data from the Canadian Health Measures Survey that DDT exposure is inversely associated with lung function parameters in adults (Ye et al. 2015), long term follow-up of children who were exposed to these chemicals is needed to clarify the health-related consequences of such exposure. Studies of OCPs other than DDTs are scarce. We found that cis/trans-nonachlor, Dieldrin, Mirex, and toxaphenes (Parlar-26 and 50) were positively associated with DHEA as well as with the adrenal androgen-glucocorticoid ratio, but were inversely associated with testosterone, the testosterone-androstenedione ratio, and prolactin in boys. Decreasing testosterone-androstenedione ratio trends suggests the downregulation of HSB17B1; previous animal studies have shown that aldrin inhibits HSB17B1 (Chatterjee et al. 1988), which is consistent with our findings. DHEA is the main precursor of sex hormones and cortisol antagonists (Mastorakos and Ilias 2003). The increasing adrenal androgen-glucocorticoid ratio suggests that chlordanes, Dieldrin, Mirex, and toxaphenes may shift steroidogenesis towards and rogenic hormones (C19-steroids), although we observed no evidence of this. However, circulating hormones are regulated by several cascade reactions. Translocation of cholesterol from the outer mitochondrial membrane to the inner membranes is a critical step in steroidogenesis; 

this process is enhanced by steroidogenic acute regulatory protein (StAR), which is encoded by STARD1. Other key human steroidogenic genes are CYP11A1, CYP17A1, CYP11B1/CYP11B2, CYP21A2, SRD5A1, and SRD5A2. Moreover, SULT2A1 and SULT2B1 encode enzymes that convert DHEA to DHEA-sulfate and vice versa. Although we have not measured methoxychlor, another synthetic organochlorine insecticide and a derivative of DDT showed decreased expression of CYP19A1, HSD17B1, CYP17A1-encoded cytochrome P450 family 17 subfamily A member 1, HSD3B1, CYP11A1-encoded cytochrome P450 family 11 subfamily A member 1, and StAR, but increased expression of CYP1B1-encoded cytochrome P450 family 1 subfamily B member 1 enzyme levels, in vitro (Basavarajappa et al. 2011; Vaithinathan et al. 2008). Therefore, our overall findings do not rule out that many of the OCPs measured in this study may alter steroid hormones by inhibiting such steroidogenesis enzymes. Moreover, a previous study notably examined 15 organochlorines (OCs) mixture similar to those found in the bladders of Arctic ringed seals. Exposing male rats in utero to this OC mixture caused disruptions in the development of androgen-dependent organs such as the testis, epididymis, seminal vesicle, and prostate (Anas et al. 2005). They also investigated that OC mixture's direct inhibition of Leydig cell steroidogenesis by disrupting cholesterol transport into the mitochondria via decreasing StAR protein levels, and by converting cholesterol into pregnenolone by modulating adrenodoxin reductase and CYP11A1 proteins (Enangue Niembele et al. 2014). We speculate that different OCPs influence steroidogenesis similarly. Additional studies on altered steroidogenic and metabolic enzymes with different OCPs are required to test these hypotheses. 

In our linear regression model, HCH, Mirex, and toxaphenes were positively associated with FSH, as was the FSH-inhibin B ratio. Sertoli cells secrete inhibin B, which was first identified by its ability to negatively regulate FSH (Carlson et al. 2009). Increasing levels of FSH together with the FSH-inhibin B ratio point to a negative feedback mechanism as well as the influence of OCPs on Sertoli cells. However, these associations were not statistically significant in our quartile model; hence, the effects of OCPs on Sertoli cells remain unclear. 

Our study found a significant association between OCPs and hormones only among boys. Although the reason for this remains unclear, one possible explanation for this sex preference is that most OCPs have an affinity for hormone receptors including androgen receptor, estrogen receptor, and/or aryl hydrocarbon receptor (Mnif et al. 2011; Kojima et al., 2004). Thus, OCPs may mimic or block the natural hormone's action (as an agonist or antagonist, respectively), and can interfere with the synthesis, transport, metabolism, and elimination of hormones (Mnif et al. 2011). Estrogen and androgen receptors are primarily involved in sexual differentiation and reproduction (Busillo et al. 2009). While estrogens and progestins are essential for normal female development, androgens are involved in various aspects of male reproductive physiology. One animal study showed that p,p'-DDE inhibits and rogen binding to the AR, and rogen-induced transcriptional activity, and and rogen action in developing (Kelce W.R., et al., 1995). Androgen receptors are expressed in variety of tissues, but their levels differed in human fetal tissues (Wilson and McPhaul, 1996). During fetal genital development, the female phenotype is considered to be the baseline (or default) condition, and the development of maleness requires additional secretions produced by the testis (Carlson 2009). Thus, we speculate that the effect of anti-androgenic activities 

of OCPs on males is more severe than the effect of their estrogenic activities on females. The physiological differences in the roles of these hormones may explain the observation of sex differences in OCP-hormone associations. One epidemiological study in Mexico found that higher exposure to *p*,*p*'-DDE *in utero* shortened the anal position index among boys but not among girls (Torres-Sanchez et al., 2008). The authors explained that this was due to the putative androgen deficiency occurring due to the reduction of transcriptional activity that occurs when AR is blocked by p'p-DDE in utero. Although the exposure levels in Torres-Sanchez et al.'s study were 10 times higher than that in ours, our results were in line with those of their study. In vitro reporter gene assays showed that not only p,p'-DDE, but also other DDTs, dieldrin, and heptachlors showed AR antagonist effects (Kojima et al., 2004). Hence, we assume that those OCPs studied herein with AR antagonist properties share similar modes of action in terms of male-specific responses. The strength of this study is that we examined a wide range of OCPs. Investigating seven steroids enabled us to construct a clearer picture of the association between steroidogenesis and OCPs levels. Measuring steroid hormones by LC-MSMS is considered more accurate than other methods such as radioimmunoassays, which is another strength of this study. However, there are several limitations as well. First, the 15 OCPs are moderately-to-highly correlated with each other (Spearman's rho: 0.230– 0.918, *P*<0.001). Thus, we were unable to clarify the effect of individual OCPs on hormones. Moreover, there may be other residual confounding factors. Previous studies suggested that reproductive hormones in cord blood may be affected by factors such as diurnal variation, duration of labor, placental weight, and the presence of pre-eclampsia (Hollier et al. 2014; Keelan et al. 2012). A recent cross-sectional study among adults 

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1304	507	suggested an association between OCP concentrations and total cholesterol levels
1305 1306	508	(Arrebola et al. 2014), which may also modify steroid hormones levels. Second,
1307 1308	509	multiple tests of 15 OCPs and 13 hormones may have found statistically significant
1309 1310 1311	510	associations by chance. However, the associations between OCPs and hormones
1312 1313	511	exhibited consistent trends, which suggest that the results are robust and that OCP
1314 1315	512	exposure is likely to alter infants' hormones in utero. Finally, there is a possibility of
1316 1317	513	selection bias in this study, as only participants with available cord blood samples were
1318 1319	514	included in the analysis. Because the life and the safety of the mother and child were of
1320 1321	515	utmost priority, cord blood samples were seldom acquired during Caesarian sections.
1322 1323 1324	516	Thus, two infants were delivered Caesarian sections and others included in this study
1325 1326	517	were delivered vaginally; they had longer gestational ages and heavier birth weights
1327 1328	518	than the infants who were excluded, which indicated that the analysis was biased
1329 1330	519	towards healthier infants. Therefore, the effects of OCPs may have been underestimated
1331 1332	520	in this study.
1333 1334	521	
1335 1336 1337	522	5. Conclusion
1338 1339	523	We found that exposure to relatively low levels of OCPs such as <i>cis/trans</i> -nonachlor,
1340 1341	524	<i>p</i> , <i>p</i> '-DDE, <i>o</i> , <i>p</i> '-DDT, Dieldrin, $\beta$ -HCH, Mirex, and toxaphenes <i>in utero</i> was
1342 1343	525	significantly associated with levels of hormones and their ratios in male fetuses. These
1344 1345	526	results suggest that OCPs that include but are not limited to DDTs ought to be
1346 1347	527	examined, as the existing data are limited. Disrupting the balance of steroid hormones
1348 1349	528	may cause adverse effects on reproductive growth, development, and other health
1350 1351 1352	529	outcomes in later life. The clinical significance of these findings is unclear at present, as
1353 1354	530	it remains unknown whether these small hormonal alterations are of any future health
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1302	531	consequences in these individuals. Therefore, further studies investigating the long-term
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1365	532	effects of OCP exposure are required.
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1371	535	We would like to thank the mothers and children who participated in the study, as well
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Figure legends

56		
57 58	737	Fig. 1. Least square means (LSMs) of hormone levels according to maternal
59 60	738	organochlorine pesticide (OCP) concentration quartiles in boys. The X-axes show the
61 62	739	OCP quartiles, while the Y-axes show each hormone level calculated using the LSM in
63 64	740	the boxes; the error bars are the 95% confidence intervals. The four OCP categories
65 66	741	were, <i>cis</i> -nonachlor: Quartile 1 (Q1) (≤7.07 pg/g-wet), Q2 (7.08–10.37 pg/g-wet), Q3
67 68	742	(10.38–15.06 pg/g-wet), and Q4 (≥15.07 pg/g-wet); <i>trans</i> -nonachlor: Q1 (≤52.25 pg/g-
69 70	743	wet), Q2 (52.26–75.60 pg/g-wet), Q3 (52.26–75.60 pg/g-wet), and Q4 (≥110.29 pg/g-
71 72	744	wet); <i>p,p</i> '-DDE: Q1 (≤0.99 pg/g-wet), Q2 (1.00–1.65 pg/g-wet), Q3 (1.66–2.54 pg/g-
73 74 75	745	wet), and Q4 (≥2.55 pg/g-wet); <i>o,p</i> '-DDT: Q1 (≤2.28 pg/g-wet), Q2 (2.29–3.36 pg/g-
75 76 77	746	wet), Q3 (3.37–4.66 pg/g-wet), and Q4 (≥4.67 pg/g-wet); Dieldrin: Q1 (≤12.17 pg/g-
78 79	747	wet), Q2 (12.17–16.68 pg/g-wet), Q3 (16.69–22.05 pg/g-wet), and Q4 (≥22.06 pg/g-
80 81	748	wet); β-hexachlorocyclohexane (β-HCH): Q1 (≤104.33 pg/g-wet), Q2 (104.34–154.31
82 83	749	pg/g-wet), Q3 (154.32–238.06 pg/g-wet), and Q4 (≥238.07 pg/g-wet); Mirex: Q1 (≤4.12
84 85	750	pg/g-wet), Q2 (4.13–6.04 pg/g-wet), Q3 (6.05–8.52 pg/g-wet), and Q4 (≥8.53 pg/g-
86 87	751	wet); Parlar-26: Q1 (≤2.84 pg/g-wet), Q2 (2.85–4.46 pg/g-wet), Q3 (4.47–7.11 pg/g-
88 89	752	wet), and Q4 (≥7.12 pg/g-wet); and Parlar-50: Q1 (≤4.31 pg/g-wet), Q2 (4.31–6.56
90 91 92	753	pg/g-wet), Q3 (6.56–9.83 pg/g-wet), and Q4 (≥9.83 pg/g-wet). (A) Testosterone
92 93 94	754	according to Mirex, (B) Estradiol-testosterone ratio (E2/T) according to $p,p'$ -
95 96	755	dichlorodiphenyldichloroethylene (DDE), (C) dehydroepiandrosterone (DHEA)
97 98	756	according to cis-nonachlor, (D) DHEA according to Dieldrin, (E) DHEA according to
99 00	757	Parlar-26, (F) DHEA according to Parlar-50, (G) Testosterone-androstenedione ratio
01 02	758	(T/Adione) according to <i>cis</i> -Nonachlor, (H) T/Adione according to <i>trans</i> -Nonachlor, (I)
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2012	759	T/Adione according to Dieldrin, (J) T/Adione according to Mirex, (K) T/Adione
2013	-	
2014	/60	according to Parlar-50, (L) Adrenal androgen-glucocorticoid ratio according to cis-
2015	761	Nonachlar (M) Adrenal andregen glucocarticaid ratio according to Darlar 26 (N)
2016	/01	Nonaction, (M) Adrenar androgen-glucocorticold ratio according to Farlar-20, (N)
2017	762	Adrenal androgen-glucocorticoid-ratio according to Parlar-50 (O) sex hormone-binding
2019	102	Automation and the second function and according to Farmar 50, (0) sex normonic officing
2020	763	globulin (SHBG) according to $\beta$ -HCH, (P) Prolactin according to $p,p$ '-DDE, (Q)
2021		
2022	764	Prolactin according to <i>o</i> , <i>p</i> '-DDT. The first quartile is compared to the second, third, and
2023		
2024	765	fourth quartile OCPs as calculated using the Dunnett-Hsu method; the statistical
2026	7((	
2027	/66	significance of the <i>P</i> value was $P < 0.01$ / based on Bonferroni's correction. LSMs were
2028	767	adjusted for maternal age parity and destational age
2029	/0/	adjusted for maternal age, parity, and gestational age.
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2051		
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2062		
2063		
2064		25
2065		







Fig. 1.

			This study (n=232)			Or	riginal co	ohort (n=514)
			No.	%	Mean ± SD	No.	%	Mean ± SD
Moth	er							
	Age at delivery (years)		232		$30.45 \pm 4.81$	510		30.4 ± 4.9
	Pre-pregnancy BMI (kg/m²)		232		21.03 ± 2.92	506		21.2 ± 3.2
	Educational level (years)	≤12	100	43.1		225	44.3	
		>12	132	56.9		283	55.7	
	Annual Household income	<5	166	71.6		345	68.3	
	(million yen per year)	≥5	66	28.4		160	31.7	
	Smoking during pregnancy	No	190	81.9		404	79.7	
		Yes	42	18.1		103	20.3	
	Alcohol consumption during pregnancy	No	154	66.4		351	69.1	
		Yes	78	33.6		157	30.9	
	Parity	Primiparous	120	51.7		240	47.7	
		Multiparous	112	48.3		263	52.2	
	Type of delivery	Vaginal	230	99.1		397	78.8	
		Caesarian section	2	0.9		107	21.2	
	Blood sampling timing	During pregnancy	159	68.5		296	69.5	
		After delivery	73	31.5		130	30.5	
Infant								
	Sex	Boys	106	45.7		246	48.1	
		Girls	126	54.3		265	51.9	
	Birth weight (grams)		232		3130.5 ± 332.5	511		3025.6 ± 420.7
	Gestational Age (weeks)		232		39.3 ± 1.1	511		38.9 ± 1.5
	cryptorchidism		1	0.9		1	0.4	
	hypospadias		0	0.0		0	0.0	

Table 1 Maternal and infant characteristics

Persistent	Detection		_	I	Percentile		
organochlorine	limit	>DL (%)	Minimum	25th	50th	75th	Maximum
pesticides	(pg/g-wet)		Minimum	ZJII	JUII	7501	Maximum
Aldrin	1.00	0.4				<dl< td=""><td>12.83</td></dl<>	12.83
Chlordanes							
oxychlordane	0.90	100.0	7.93	28.87	40.04	57.32	250.94
cis-Chlordane	0.70	62.1		<dl< td=""><td>1.15</td><td>2.29</td><td>17.53</td></dl<>	1.15	2.29	17.53
trans-Chlordane	0.50	49.6			<dl< td=""><td>0.84</td><td>3.79</td></dl<>	0.84	3.79
cis-Nonachlor	0.40	100.0	1.63	7.07	10.37	15.07	37.58
trans-Nonachlor	0.50	100.0	13.45	52.09	75.60	110.54	513.52
DDTs							
o,p'-DDD	0.50	14.2				<dl< td=""><td>1.16</td></dl<>	1.16
p,p'-DDD	0.40	88.8	<dl< td=""><td>0.98</td><td>1.65</td><td>2.54</td><td>9.04</td></dl<>	0.98	1.65	2.54	9.04
o,p'-DDE	0.40	86.6	<dl< td=""><td>0.72</td><td>1.25</td><td>1.78</td><td>4.60</td></dl<>	0.72	1.25	1.78	4.60
p,p'-DDE	0.60	100.0	99.52	409.79	619.26	968.05	2686.23
o,p'-DDT	0.60	96.6	<dl< td=""><td>2.28</td><td>3.36</td><td>4.67</td><td>17.15</td></dl<>	2.28	3.36	4.67	17.15
p,p'-DDT	0.40	100.0	2.38	16.22	23.17	33.94	104.76
Dieldrin	0.80	100.0	4.11	12.16	16.68	22.21	71.52
Endrin	1.00	0.0					<dl< td=""></dl<>
Heptachlors							
Heptachlor	0.80	0.9				<dl< td=""><td>1.14</td></dl<>	1.14
trans-HCE	1.00	0.0					<dl< td=""></dl<>
cis-HCE	0.40	100.0	6.17	18.81	26.25	37.45	200.53
HCB	0.90	100.0	34.94	83.04	103.99	131.61	245.48
HCHs							
α-HCH	0.70	68.5		<dl< td=""><td>0.91</td><td>1.31</td><td>3.10</td></dl<>	0.91	1.31	3.10
β-НСН	0.60	100.0	19.95	104.25	154.31	238.45	717.67
γ-HCH	0.90	57.3		<dl< td=""><td>1.09</td><td>1.73</td><td>100.92</td></dl<>	1.09	1.73	100.92
δ-HCH	0.70	1.3				<dl< td=""><td>1.11</td></dl<>	1.11
Mirex	0.50	100.0	0.88	4.11	6.04	8.53	30.11
Toxaphenes							
Parlar-26	1.00	97.0	<dl< td=""><td>2.84</td><td>4.46</td><td>7.13</td><td>20.82</td></dl<>	2.84	4.46	7.13	20.82
Parlar-41	0.70	28.4			<dl< td=""><td>0.73</td><td>1.96</td></dl<>	0.73	1.96
Parlar-40	2.00	0.9				<dl< td=""><td>2.43</td></dl<>	2.43
Parlar-44	2.00	2.2				<dl< td=""><td>2.77</td></dl<>	2.77
Parlar-50	2.00	96.1	<dl< td=""><td>4.30</td><td>6.56</td><td>9.86</td><td>29.29</td></dl<>	4.30	6.56	9.86	29.29
Parlar-62	6.00	0.0					<dl< td=""></dl<>

## Table 2 Concentrations of organochlorine pesticides in maternal blood

DL, detection limit; DDD, dichlorodiphenyldichloroethane; DDE, dichlorodiphenyldichloroethylene; DDT, dichlorodiphenyltrichloroethane; HCB, hexachlorobenzene; HCE, heptachlor epoxide; HCH, hexachlorocyclohexane.

## Table 3 Distribution of steroids and reproductive hormones

			>DI -	Т	otal (n=232	)		Boys (n=106)						Girls (n=126)				
	DL	n	(%)	25%	Med	75%	n	>DL (%)	25%	Med	75%	n	>DL (%)	25%	Med	75%	P-value	
Steroid hormones																		
Progesterone (ng/mL)	0.01	232	100.0	177.381	219.036	278.019	106	100.0	184.087	224.121	280.633	126	100.0	169.619	216.065	276.129	0.460	
Testosterone (pg/mL)	0.01	232	100.0	59.750	82.050	114.025	106	100.0	76.788	101.875	132.050	126	100.0	50.975	68.675	92.400	<0.001	
Estradiol (ng/mL)	0.01	232	99.6	3.220	4.546	7.053	106	99.1	3.248	4.458	7.311	126	100.0	3.140	4.645	6.672	0.393	
DHEA (ng/mL)	0.01	232	100.0	1.763	2.160	2.970	106	100.0	1.590	2.090	2.830	126	100.0	1.898	2.270	3.140	0.040	
Androstenedione (ng/mL)	0.01	232	99.6	0.360	0.460	0.588	106	99.1	0.380	0.470	0.613	126	100.0	0.350	0.450	0.580	0.414	
Cortisol (ng/mL)	0.25	232	98.7	22.808	41.485	65.258	106	99.6	22.415	41.065	66.213	126	98.4	24.725	42.455	63.953	0.773	
Cortisone (ng/mL) Steroid Hormone Binding	0.10	232	96.1	76.393	95.145	124.655	106	98.1	72.825	94.175	122.963	126	94.4	77.150	95.650	125.123	0.807	
Globulin (nmol/L)	1.10	232	99.6	13.500	15.700	18.875	106	100.0	13.575	16.200	19.300	126	99.2	13.300	15.450	18.425	0.239	
Lutheling Hormone (mIU/mL) Follicle Stimulating	0.50	226	17.3			<dl< td=""><td>103</td><td>36.9</td><td></td><td><dl< td=""><td>0.870</td><td>123</td><td>0.8</td><td></td><td></td><td><dl< td=""><td>&lt;0.001</td></dl<></td></dl<></td></dl<>	103	36.9		<dl< td=""><td>0.870</td><td>123</td><td>0.8</td><td></td><td></td><td><dl< td=""><td>&lt;0.001</td></dl<></td></dl<>	0.870	123	0.8			<dl< td=""><td>&lt;0.001</td></dl<>	<0.001	
Hormone (mIU/mL)	0.50	225	22.2			<dl< td=""><td>103</td><td>48.5</td><td></td><td><dl< td=""><td>0.660</td><td>122</td><td>0.0</td><td></td><td></td><td><dl< td=""><td>&lt;0.001</td></dl<></td></dl<></td></dl<>	103	48.5		<dl< td=""><td>0.660</td><td>122</td><td>0.0</td><td></td><td></td><td><dl< td=""><td>&lt;0.001</td></dl<></td></dl<>	0.660	122	0.0			<dl< td=""><td>&lt;0.001</td></dl<>	<0.001	
Inhibin B (pg/mL)	11	232	61.6	<dl< td=""><td>23.500</td><td>45.325</td><td>106</td><td>98.1</td><td>34.200</td><td>44.350</td><td>61.300</td><td>126</td><td>31.0</td><td></td><td><dl< td=""><td>13.900</td><td>&lt;0.001</td></dl<></td></dl<>	23.500	45.325	106	98.1	34.200	44.350	61.300	126	31.0		<dl< td=""><td>13.900</td><td>&lt;0.001</td></dl<>	13.900	<0.001	
Insulin-like factor 3 (ng/mL)	0.01	119	100.0	0.230	0.280	0.330	103	100.0	0.250	0.290	0.340	16	100.0	0.180	0.185	0.235	<0.001	
Prolactin (ng/mL)	1.0	226	99.6	64.600	87.600	118.250	103	100.0	63.400	87.200	119.000	123	99.2	64.600	87.800	116.000	0.921	

P values were calculated by Mann-Whitney U test;

DHEA, dehidroepiandrostenedione; DL, detection limit

Table 4	Associations between OCPs exposure and steroid and reproductive hormone levels among boys	
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β         9%         9%         β         9%         β         9%         β         9%        9%        9% <th< th=""><th></th><th colspan="2">Progesterone Estradiol Testosterone</th><th></th><th colspan="5">Estradiol/Testosterone DEHA</th><th></th><th colspan="3">Androstenedione</th><th colspan="4">Androstenedione/DHEA</th></th<>		Progesterone Estradiol Testosterone			Estradiol/Testosterone DEHA						Androstenedione			Androstenedione/DHEA											
Orientering         0.099         0.416         0.329         0.379         0.372         0.176         0.421         0.426         0.226         0.479         0.000         0.214         0.226         0.176         0.021         0.116         0.256         0.176         0.021         0.000         0.116         0.256         0.077         0.027         0.021         0.000         0.011         0.026         0.021         0.021         0.021         0.011         0.026         0.021	-	β	95%	CI	β	95%	CI	β	95%	CI		β	95%	CI		β	95%	CI	β	95%	CI	β	95	%CI	
cirkhamedir         0.149         0.429         0.129         0.029         0.144         0.231         0.139         0.039         0.144         0.247         0.050         0.147         0.237         0.021         *         0.070         0.015         0.015         0.027         0.015         0.013         0.021         *         0.015         0.016         0.015         0.015         0.015         0.015         0.015         0.015         0.015         0.015         0.015         0.015         0.015         0.015         0.015         0.015         0	Oxychlordane	-0.090	-0.416	0.236	0.007	-0.359	0.372	-0.176	-0.421	0.068		0.183	-0.140	0.505		0.243	0.028	0.459 *	0.006	-0.214	0.226	-0.238	-0.470	-0.005	*
trans-word         0.162         0.438         0.112         0.021         0.033         0.128         0.070         0.275         0.038         0.147         0.244         0.127         0.141         0.021           opi-000         0.070         0.279         0.085         0.018         0.025         0.076         0.035         0.114         0.106         0.027         0.026         0.017         0.018         0.018         0.016         0.016         0.016         0.018         0.016	cis-Nonachlor	-0.149	-0.424	0.125	-0.005	-0.314	0.304	-0.095	-0.303	0.113		0.090	-0.184	0.363		0.247	0.066	0.427 **	0.070	-0.116	0.255	-0.177	-0.375	0.021	Ť
pc/b00       -0.077       -0.027       0.085       -0.151       -0.354       0.051       -0.023       0.027       0.085       -0.024       0.016       0.147       0.101       -0.101       -0.101       0.101       0.107       0.108       0.007       0.228       0.021       0.111       0.016       0.127       0.016       0.131       0.001       0.111       0.016       0.237       0.024       0.011       0.101       0.111       0.010       0.111       0.010       0.111       0.010       0.111       0.010       0.111       0.010       0.111       0.010       0.111       0.010       0.111       0.010       0.111       0.010       0.111       0.010       0.111       0.010       0.111       0.010       0.111       0.010       0.011       0.010       0.011       0.010       0.011       0.010       0.011       0.010       0.011       0.010       0.011       0.010       0.011       0.010       0.011       0.010       0.011       0.011       0.010       0.011       0.010       0.011       0.010       0.011       0.011       0.010       0.011       0.010       0.011       0.010       0.011       0.010       0.011       0.010       0.011       0.011	trans-Nonachlor	-0.162	-0.436	0.112	-0.027	-0.335	0.282	-0.161	-0.367	0.045		0.134	-0.138	0.407		0.255	0.076	0.435 **	0.038	-0.147	0.224	-0.217	-0.413	-0.021	*
op-OpE         Oud4         OL34         OL36         OL37         OL36         OL36         OL37         OL36         OL36         OL37         OL37         OL36         OL36         OL36         OL37         OL36         OL36         OL37         OL37         OL36         OL36         OL37         OL37         OL36         OL37	p,p'-DDD	-0.097	-0.279	0.085	-0.151	-0.354	0.051	-0.065	-0.203	0.073		-0.086	-0.267	0.095		-0.023	-0.147	0.101	-0.016	-0.139	0.108	0.007	-0.126	0.141	
μµ-µ Qu         0.048         0.471         0.048         0.471         0.048         0.471         0.048         0.471         0.048         0.471         0.048         0.471         0.048         0.471         0.048         0.471         0.048         0.471         0.048         0.471         0.048         0.471         0.048         0.471         0.048         0.471         0.048         0.471         0.048         0.471         0.048         0.471         0.048         0.474         0.041         0.011         0.033         0.007         0.013         0.011         0.033         0.011         0.033         0.011         0.033         0.011         0.033         0.011         0.033         0.011         0.033         0.012         0.033         0.013         0.014         0.014         0.013         0.014         0.024        <	o,p'-DDE	-0.046	-0.234	0.143	0.050	-0.161	0.260	-0.029	-0.171	0.114		0.078	-0.108	0.265		0.080	-0.046	0.207	0.013	-0.114	0.140	-0.067	-0.204	0.069	
op-bort         0.05         0.246         0.138         0.010         0.246         1         0.010         0.014         0.149         0.408         0.021           op-bort         0.077         0.390         0.184         0.018         0.246         1         0.010         0.014         0.190         0.014         0.190         0.014         0.190         0.014         0.190         0.014         0.190         0.014         0.190         0.014         0.012         0.013         0.024         0.024         0.026         0.016         0.026         0.026         0.026         0.016         0.026         0.016         0.026         0.016         0.026         0.016         0.026         0.016         0.026         0.026         0.026         0.026         0.026         0.026         0.026         0.026 </td <td>p,p'-DDE</td> <td>0.034</td> <td>-0.218</td> <td>0.286</td> <td>0.192</td> <td>-0.088</td> <td>0.472</td> <td>-0.105</td> <td>-0.295</td> <td>0.084</td> <td></td> <td>0.297</td> <td>0.054</td> <td>0.541</td> <td>*</td> <td>0.108</td> <td>-0.061</td> <td>0.278</td> <td>-0.041</td> <td>-0.211</td> <td>0.128</td> <td>-0.150</td> <td>-0.331</td> <td>0.032</td> <td></td>	p,p'-DDE	0.034	-0.218	0.286	0.192	-0.088	0.472	-0.105	-0.295	0.084		0.297	0.054	0.541	*	0.108	-0.061	0.278	-0.041	-0.211	0.128	-0.150	-0.331	0.032	
pch-017       -0.07       -0.33       0.144       0.041       -0.22       0.23       -0.03       0.141       0.042       0.034       0.035       0.036       0.035       0.036       0.035       0.036       <	o,p'-DDT	-0.056	-0.248	0.136	0.048	-0.167	0.263	-0.035	-0.180	0.110		0.083	-0.107	0.273		0.118	-0.010	0.246 †	0.010	-0.119	0.140	-0.108	-0.246	0.031	
Deleting         -0.17         0.442         0.125         0.089         0.27         0.047         0.47         0.475         0.048         0.395         0.112         0.033         0.109           HCB         0.007         0.438         0.449         0.038         0.449         0.055         0.025         0.031         0.040         0.057         0.025         0.026         0.025         0.025         0.026         0.025         0.025         0.026         0.025         0.025         0.026         0.025         0.025         0.026         0.027         0.027         0.024         0.024         0.024         0.025         0.026         0.027         0.027         0.027         0.026         0.027         0.026         0.027         0.026         0.027         0.026         0.027         0.026         0.027         0.	p,p'-DDT	-0.077	-0.339	0.184	0.031	-0.262	0.324	-0.065	-0.263	0.132		0.096	-0.163	0.356		0.151	-0.024	0.325 †	0.016	-0.161	0.192	-0.135	-0.324	0.054	
cir.+HCS       0.007       0.416       0.237       0.017       0.421       0.428       0.408       0.429       0.28       0.408       0.429       0.243       0.028       0.438       0.439       0.016       0.018       0.244       0.038       0.249       0.038       0.249       0.038       0.243       0.038       0.243       0.038       0.243       0.038       0.244       0.038       0.244       0.038       0.244       0.038       0.244       0.038       0.244       0.038       0.244       0.038       0.244       0.038       0.244       0.038       0.244       0.038       0.244       0.038       0.244       0.038       0.243       0.007       0.244       0.248       0.028       0.028       0.027       0.004       0.044       0.044       0.044       0.048       0.028      <	Dieldrin	-0.178	-0.482	0.125	0.069	-0.273	0.410	-0.023	-0.254	0.208		0.092	-0.211	0.394		0.267	0.067	0.467 **	0.155	-0.048	0.359	-0.112	-0.333	0.109	
HCB       0.025       0.438       0.449       0.433       0.449       0.259       0.100       0.111       0.014       0.015       0.024       0.024       0.0259       0.015       0.025       0.024       0.025       0.026       0.025 <th< td=""><td>cis-HCE</td><td>-0.090</td><td>-0.416</td><td>0.236</td><td>0.007</td><td>-0.359</td><td>0.372</td><td>-0.176</td><td>-0.421</td><td>0.068</td><td></td><td>0.183</td><td>-0.140</td><td>0.505</td><td></td><td>0.243</td><td>0.028</td><td>0.459 *</td><td>0.006</td><td>-0.214</td><td>0.226</td><td>-0.238</td><td>-0.470</td><td>-0.005</td><td>*</td></th<>	cis-HCE	-0.090	-0.416	0.236	0.007	-0.359	0.372	-0.176	-0.421	0.068		0.183	-0.140	0.505		0.243	0.028	0.459 *	0.006	-0.214	0.226	-0.238	-0.470	-0.005	*
$ \begin{array}{  c  c  c  c  c  c  c  c  c  c  c  c  c$	НСВ	0.025	-0.438	0.489	0.114	-0.404	0.633	-0.139	-0.489	0.210		0.254	-0.203	0.711		0.311	0.004	0.619 *	0.058	-0.254	0.370	-0.253	-0.586	0.081	
Mires       -0.08       -0.418       0.203       0.007       -0.355       0.424       -0.262       -0.024       0.021       0.021       0.021       0.021       0.021       0.024       0.014       0.024       0.014       0.024       0.014       0.024       0.014       0.024       0.013       0.021       0.024       0.013       0.024       0.013       0.024       0.013       0.024       0.013       0.024       0.014       0.016       0.016       0.027       0.022       0.023       0.016       0.027       0.023       0.016       0.017       0.024       0.011       0.007       0.023       0.010       0.017       0.012	β-НСН	0.118	-0.157	0.392	0.168	-0.139	0.474	-0.091	-0.299	0.117		0.259	-0.010	0.528	†	0.136	-0.049	0.320	-0.004	-0.190	0.181	-0.140	-0.339	0.059	
Partar-50       -0.124       -0.38       0.091       0.114       0.116       0.244       0.124       0.012       0.019       0.123       0.020       0.235       0.027       0.237       ***       0.100       0.044       0.248       0.238       0.020       ↑         Partar-50       0.099       0.315       0.116       0.017       0.107       0.113       0.020       0.118       0.019       0.123       0.026       0.027       0.236       0.097       0.374       **       0.100       0.044       0.248       0.132       0.028       ↑         B       95%       B       95%       B       95%       C       B       95%       B       95%       C       Cortisor       Cortisor <t< td=""><td>Mirex</td><td>-0.108</td><td>-0.418</td><td>0.203</td><td>-0.007</td><td>-0.355</td><td>0.342</td><td>-0.262</td><td>-0.492</td><td>-0.032 *</td><td>*</td><td>0.256</td><td>-0.050</td><td>0.561</td><td></td><td>0.213</td><td>0.007</td><td>0.420 *</td><td>-0.061</td><td>-0.270</td><td>0.149</td><td>-0.274</td><td>-0.494</td><td>-0.054</td><td>*</td></t<>	Mirex	-0.108	-0.418	0.203	-0.007	-0.355	0.342	-0.262	-0.492	-0.032 *	*	0.256	-0.050	0.561		0.213	0.007	0.420 *	-0.061	-0.270	0.149	-0.274	-0.494	-0.054	*
Partar-S0         -0.09         -0.315         0.116         0.070         0.313         0.020         0.138         0.021         0.123         0.305         0.305         0.037         0.374         **         0.103         0.021         0.028         0.023         *           Excision=/Currison=/Curri	Parlar-26	-0.124	-0.338	0.091	0.124	-0.116	0.364	0.002	-0.161	0.165		0.122	-0.090	0.335		0.235	0.097	0.373 **	0.100	-0.044	0.244	-0.135	-0.290	0.020	Ť
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Parlar-50	-0.099	-0.315	0.116	0.072	-0.170	0.313	-0.020	-0.183	0.144		0.091	-0.123	0.305		0.236	0.097	0.374 **	0.103	-0.041	0.248	-0.132	-0.288	0.023	Ť
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		Testoste	erone/And	rostenedione		Cortiso			Cortisone	5		Co	ortisone/Co	ortisol		Adrenal ar	ndrogen/C	Glucocorticoid		SHBG			Prolac	tin	
Oxychlordane       -0.182       -0.393       -0.024       *       -0.363       -0.763       0.038       -0.398	-	β	95%	CI	β	95%	CI	β	95%CI			β	95%CI			β	95%CI		β	95%CI		β	95	5%CI	
cis-Nonachlor       -0.165       -0.297       -0.032       *       -0.218       -0.259       0.124       -0.310       -0.700       -0.707       -0.027       -0.048       0.040       0.935       *       -0.040       -0.178       0.098       -0.150       -0.310       -0.036       *       -0.036       *       -0.036       *       -0.036       *       -0.036       *       -0.036       *       -0.036       *       -0.036       *       -0.036       0.032       0.036       *       -0.036       0.036	Oxychlordane	-0.182	-0.339	-0.024 *	-0.363	-0.763	0.038	-0.398	-0.858	0.062	†	-0.035	-0.316	0.246		0.571	0.042	1.100 *	-0.082	-0.245	0.081	-0.077	-0.261	0.107	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	cis-Nonachlor	-0.165	-0.297	-0.032 *	-0.218	-0.559	0.124	-0.310	-0.700	0.079		-0.092	-0.330	0.145		0.487	0.040	0.935 *	-0.040	-0.178	0.098	-0.150	-0.303	0.003	Ť
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	trans-Nonachlor	-0.199	-0.330	-0.069 **	-0.372	-0.708	-0.036 *	-0.426	-0.810	-0.041 *	*	-0.054	-0.291	0.184		0.609	0.168	1.050 **	-0.027	-0.165	0.111	-0.075	-0.230	0.080	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	p,p'-DDD	-0.049	-0.140	0.041	0.061	-0.166	0.289	0.014	-0.248	0.275		-0.048	-0.205	0.110		-0.049	-0.352	0.255	0.055	-0.036	0.146	0.021	-0.082	0.124	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	o,p'-DDE	-0.042	-0.134	0.051	-0.108	-0.342	0.126	-0.148	-0.415	0.119		-0.040	-0.202	0.122		0.200	-0.109	0.510	-0.030	-0.124	0.064	-0.120	-0.224	-0.015	*
op op p-DDT       -0.45       -0.44       0.049       -0.172       -0.410       0.065       -0.153       -0.426       0.120       -0.146       0.185       0.260       -0.055       0.574       -0.017       -0.114       0.079       -0.172       -0.275       -0.069       **         p.p-DDT       -0.081       -0.210       0.048       -0.073       -0.000       0.253       -0.192       -0.565       0.180       -0.119       -0.344       0.015       0.267       -0.19       -0.170       -0.119       -0.112       -0.275       -0.029       -0.112       -0.155       -0.270       -0.119       -0.344       0.021       -0.155       0.707       -0.019       -0.110       -0.112       -0.155       -0.270       -0.017       -0.11       -0.112       -0.110       -0.112       -0.112       -0.117       -0.114       0.079       -0.120       -0.117       -0.114       0.079       -0.112       -0.117       -0.117       -0.117       -0.117       -0.017       -0.112       -0.017       -0.112       -0.017       -0.113       -0.020       -0.021       -0.021       -0.021       -0.021       -0.021       -0.021       -0.021       -0.021       -0.020       -0.021       -0.021       -0.	p,p'-DDE	-0.064	-0.188	0.060	-0.290	-0.600	0.019 †	-0.249	-0.606	0.108		0.041	-0.176	0.258		0.354	-0.059	0.766 †	-0.080	-0.206	0.045	-0.226	-0.361	-0.092	* *
p.p.'DDT       -0.081       -0.210       0.048       -0.073       0.400       0.253       -0.192       0.055       0.180       -0.119       0.344       0.105       0.276       0.155       0.77       -0.019       0.150       0.112       -0.155       0.209       -0.011       *         Dieldrin       -0.178       -0.322       -0.322       *       0.028       -0.352       0.028       *       0.028       -0.494       0.025       -0.494       0.029       -0.134       0.867       -0.049       -0.202       0.010       -0.209       -0.209       -0.201       *       -0.017       -0.209       -0.017       -0.209       -0.201       *       -0.017       -0.209       -0.017       -0.209       -0.017       -0.201       -0.017       -0.201       -0.017       -0.201       -0.017       -0.201       -0.017       -0.214       -0.017       -0.111       -0.012       -0.010       -0.022	o,p'-DDT	-0.045	-0.140	0.049	-0.172	-0.410	0.065	-0.153	-0.426	0.120		0.019	-0.146	0.185		0.260	-0.055	0.574	-0.017	-0.114	0.079	-0.172	-0.275	-0.069	* *
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	p,p'-DDT	-0.081	-0.210	0.048	-0.073	-0.400	0.253	-0.192	-0.565	0.180		-0.119	-0.344	0.105		0.276	-0.155	0.707	-0.019	-0.150	0.112	-0.155	-0.299	-0.011	*
cis-HCE       -0.182       -0.339       -0.024       *       -0.363       -0.763       0.038       †       -0.385       0.062       †       -0.035       -0.316       0.246       0.571       0.042       1.100       *       -0.082       -0.245       0.081       -0.077       -0.261       0.107         HCB       -0.198       -0.424       0.028       †       -0.353       -0.365       0.476       0.070       -0.329       0.469       0.474       -0.289       1.236       -0.167       -0.397       0.062       -0.239       -0.495       0.017       †         β-HCH       -0.087       -0.222       0.048       -0.153       -0.049       0.189       -0.076       -0.469       0.317       0.077       -0.160       0.314       0.221       -0.234       0.676       -0.147       -0.282       -0.012       *       -0.385       -0.076       -0.397       0.062       -0.147       -0.382       -0.012       *       -0.013       -0.017       -0.185       -0.018       -0.012       -0.017       -0.185       -0.018       -0.016       -0.212       0.216       -0.115       -0.015       -0.011       0.216       -0.115       -0.017       0.111       0.083       *	Dieldrin	-0.178	-0.325	-0.032 *	0.028	-0.352	0.409	-0.207	-0.641	0.227		-0.235	-0.494	0.023	†	0.367	-0.134	0.867	-0.049	-0.202	0.103	-0.209	-0.377	-0.040	*
HCB       -0.198       -0.424       0.028       †       -0.255       -0.830       0.321       -0.185       -0.476       0.070       -0.329       0.469       0.474       -0.289       1.236       -0.167       -0.397       0.062       -0.239       -0.495       0.017       †         β-HCH       -0.087       -0.222       0.048       -0.153       -0.495       0.189       -0.076       -0.499       0.317       0.077       -0.160       0.314       0.221       -0.234       0.676       -0.123       -0.012       *       -0.012       *       -0.012       *       -0.188       -0.959       ·0.218       **       -0.213       *       -0.017       -0.147       -0.239       -0.133       -0.017       -0.180       -0.329       -0.017       -0.147       -0.282       -0.012       *       -0.180       -0.329       -0.018       *       -0.018       -0.180       -0.180       -0.329       -0.017       -0.141       0.083       *       -0.017       -0.180       -0.017       -0.180       -0.107       -0.229       0.010       *         Parlar-26       -0.027       -0.019       *       -0.156       -0.240       0.111       0.418       0.069       0.767 <td>cis-HCE</td> <td>-0.182</td> <td>-0.339</td> <td>-0.024 *</td> <td>-0.363</td> <td>-0.763</td> <td>0.038 †</td> <td>-0.398</td> <td>-0.858</td> <td>0.062</td> <td>†</td> <td>-0.035</td> <td>-0.316</td> <td>0.246</td> <td></td> <td>0.571</td> <td>0.042</td> <td>1.100 *</td> <td>-0.082</td> <td>-0.245</td> <td>0.081</td> <td>-0.077</td> <td>-0.261</td> <td>0.107</td> <td></td>	cis-HCE	-0.182	-0.339	-0.024 *	-0.363	-0.763	0.038 †	-0.398	-0.858	0.062	†	-0.035	-0.316	0.246		0.571	0.042	1.100 *	-0.082	-0.245	0.081	-0.077	-0.261	0.107	
β-HCH       -0.087       -0.222       0.048       -0.153       -0.495       0.189       -0.076       -0.469       0.317       -0.160       0.314       0.221       -0.234       0.676       -0.147       -0.282       -0.012       *       -0.180       -0.332       -0.332       -0.332       -0.332       -0.332       -0.332       -0.332       -0.332       -0.332       -0.180       -0.332       -0.033       -0.180       -0.180       -0.332       -0.031       *       -0.083       -0.283       -0.017       -0.180       -0.332       -0.031       *       -0.083       -0.234       -0.017       -0.180       -0.332       -0.031       *       -0.018       -0.018       -0.018       -0.018       -0.018       -0.018       -0.018       -0.180       -0.018       -0.017       -0.180       -0.180       -0.018       -0.017       -0.125       -0.017       -0.125       -0.017       -0.125       -0.017       -0.125       -0.010       -0.123       -0.017       -0.123       -0.016       -0.015       -0.015       -0.015       -0.015       -0.015       -0.015       -0.015       -0.015       -0.015       -0.015       -0.015       -0.015       -0.015       -0.015       -0.015       -0.015	НСВ	-0.198	-0.424	0.028 †	-0.255	-0.830	0.321	-0.185	-0.845	0.476		0.070	-0.329	0.469		0.474	-0.289	1.236	-0.167	-0.397	0.062	-0.239	-0.495	0.017	Ť
Mirex       -0.202       -0.350       -0.053       **       -0.588       -0.959       -0.218       **       -0.572       -1.002       -0.142       *       0.016       -0.222       0.285       0.744       0.249       1.239       **       -0.083       -0.238       0.073       -0.180       -0.352       -0.008       **         Parlar-26       -0.098       -0.202       0.007       *       -0.174       -0.441       0.092       -0.231       -0.572       0.013       *       -0.299       0.069       0.457       0.111       0.803       *       -0.017       -0.125       0.091       -0.107       -0.229       0.015       *         Parlar-26       -0.012       -0.202       -0.019       *       -0.441       0.092       -0.231       -0.575       0.075       -0.260       0.111       0.418       0.069       0.767       *       -0.016       -0.107       -0.125       0.091       -0.131       -0.252       -0.010       *         Parlar-50       -1.11       -0.227       -0.019       -0.115       -0.115       -0.125       -0.016       -0.115       -0.016       -0.115       -0.125       -0.016       -0.115       -0.016       -0.115       -0.0	β-НСН	-0.087	-0.222	0.048	-0.153	-0.495	0.189	-0.076	-0.469	0.317		0.077	-0.160	0.314		0.221	-0.234	0.676	-0.147	-0.282	-0.012 *	-0.182	-0.332	-0.031	*
Parlar-26       -0.098       -0.203       0.007 $^{\dagger}$ -0.174       -0.441       0.092       -0.289       -0.592       0.013 $^{\dagger}$ -0.115       -0.299       0.069       0.457       0.111       0.803 $^{*}$ -0.017       -0.125       0.091       -0.107       -0.229       0.015 $^{\dagger}$ Parlar-26       -0.123       -0.019 $^{\bullet}$ -0.156       -0.424       0.111       -0.231       -0.537       0.075       -0.260       0.111       0.418       0.069       0.767 $^{\bullet}$ 0.048       -0.156       0.060       -0.131       -0.229       0.015 $^{\dagger}$ LH       FSH       Inhibin B       Inhibin B       INSL3       T/LH       FSH/InhibinB       I	Mirex	-0.202	-0.350	-0.053 **	-0.588	-0.959	-0.218 **	-0.572	-1.002	-0.142 *	*	0.016	-0.252	0.285		0.744	0.249	1.239 **	-0.083	-0.238	0.073	-0.180	-0.352	-0.008	*
Parlar-50       -0.123       -0.227       -0.019       *       -0.156       -0.424       0.111       -0.231       -0.537       0.075       -0.026       0.111       0.418       0.069       0.767       *       -0.048       -0.156       0.060       -0.131       -0.252       -0.010       *         LH       FSH       Inhibin B       INSL3       T/LH       FSH/InhibinB       FSH/InhibinB       -	Parlar-26	-0.098	-0.203	0.007 †	-0.174	-0.441	0.092	-0.289	-0.592	0.013	†	-0.115	-0.299	0.069		0.457	0.111	0.803 *	-0.017	-0.125	0.091	-0.107	-0.229	0.015	Ť
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Parlar-50	-0.123	-0.227	-0.019 *	-0.156	-0.424	0.111	-0.231	-0.537	0.075		-0.075	-0.260	0.111		0.418	0.069	0.767 *	-0.048	-0.156	0.060	-0.131	-0.252	-0.010	*
$\begin{array}{c c c c c c c c c c c c c c c c c c c $			IH			FSH			Inhibin B				INSI 3				Т/ІН			FSH/Inhib	inB				
Oxychlordane       0.037       -0.305       0.380       0.097       -0.143       0.337       -0.093       -0.301       0.115       -0.064       -0.190       0.063       -0.224       -0.684       0.236       0.190       -0.119       0.499         cis-Nonachlor       0.087       -0.202       0.376       0.189       -0.024       -0.015       -0.122       0.092       -0.185       -0.574       0.202       0.241       0.096       0.595       **	-	β	95%	CI	β	95%	CI	β	95%	CI		β	95%	CI		β	95%	CI	β	95%	CI				
	Oxychlordane	0.037	-0.305	0.380	0.097	-0.143	0.337	-0.093	-0.301	0.115		-0.064	-0.190	0.063		-0.224	-0.684	0.236	0.190	-0.119	0.499				
us-nonaunior v.vu/ -v.2U2 V.3/V V.177 V.VUV V.377 F -V.140 -V.313 V.V34 -V.U13 -V.123 V.V7Z -V.103 -V.3/4 V.2U3 V.341 V.V00 V.37J	cis-Nonachlor	0.087	-0.202	0.376	0.199	0.000	0.399 †	-0.140	-0.315	0.034		-0.015	-0.123	0.092		-0.185	-0.574	0.203	0.341	0.086	0.595 **				
trans-Nonachlor 0.077 -0.211 0.366 0.121 -0.080 0.323 -0.115 -0.290 0.060 -0.061 -0.167 0.045 -0.245 -0.632 0.141 0.236 -0.023 0.494 †	trans-Nonachlor	0.077	-0.211	0.366	0.121	-0.080	0.323	-0.115	-0.290	0.060		-0.061	-0.167	0.045		-0.245	-0.632	0.141	0.236	-0.023	0.494 †				
p,p'-DDD -0.045 -0.236 0.146 0.057 -0.077 0.191 -0.050 -0.167 0.067 -0.044 -0.114 0.027 -0.023 -0.281 0.235 0.105 -0.068 0.277	p,p'-DDD	-0.045	-0.236	0.146	0.057	-0.077	0.191	-0.050	-0.167	0.067		-0.044	-0.114	0.027		-0.023	-0.281	0.235	0.105	-0.068	0.277				
o,p'-DDE -0.042 -0.240 0.156 -0.012 -0.151 0.127 -0.090 -0.209 0.029 0.003 -0.070 0.077 0.019 -0.248 0.287 0.086 -0.093 0.265	o,p'-DDE	-0.042	-0.240	0.156	-0.012	-0.151	0.127	-0.090	-0.209	0.029		0.003	-0.070	0.077		0.019	-0.248	0.287	0.086	-0.093	0.265				
p,p'-DDE 0.084 -0.179 0.347 0.145 -0.038 0.328 -0.127 -0.286 0.033 -0.069 -0.165 0.028 -0.184 -0.538 0.169 0.284 0.052 0.517 *	p,p'-DDE	0.084	-0.179	0.347	0.145	-0.038	0.328	-0.127	-0.286	0.033		-0.069	-0.165	0.028		-0.184	-0.538	0.169	0.284	0.052	0.517 *				
o,p'-DDT 0.047 -0.154 0.248 -0.005 -0.146 0.137 -0.077 -0.199 0.045 -0.003 -0.078 0.071 -0.075 -0.346 0.196 0.080 -0.102 0.262	o,p'-DDT	0.047	-0.154	0.248	-0.005	-0.146	0.137	-0.077	-0.199	0.045		-0.003	-0.078	0.071		-0.075	-0.346	0.196	0.080	-0.102	0.262				
p,p'-DDT -0.014 -0.288 0.259 0.159 -0.031 0.349 -0.156 -0.320 0.009 <sup>†</sup> -0.014 -0.116 0.087 -0.061 -0.430 0.308 0.307 0.066 0.548 *	p,p'-DDT	-0.014	-0.288	0.259	0.159	-0.031	0.349	-0.156	-0.320	0.009	†	-0.014	-0.116	0.087		-0.061	-0.430	0.308	0.307	0.066	0.548 *				
Dieldrin -0.040 -0.362 0.282 0.071 -0.155 0.297 -0.183 -0.375 0.009 <sup>†</sup> -0.048 -0.167 0.071 0.011 -0.424 0.446 0.246 -0.043 0.535 <sup>†</sup>	Dieldrin	-0.040	-0.362	0.282	0.071	-0.155	0.297	-0.183	-0.375	0.009	t	-0.048	-0.167	0.071		0.011	-0.424	0.446	0.246	-0.043	0.535 †				
cis-HCE 0.037 -0.305 0.380 0.097 -0.143 0.337 -0.093 -0.301 0.115 -0.064 -0.190 0.063 -0.224 -0.684 0.236 0.190 -0.119 0.499	cis-HCE	0.037	-0.305	0.380	0.097	-0.143	0.337	-0.093	-0.301	0.115		-0.064	-0.190	0.063		-0.224	-0.684	0.236	0.190	-0.119	0.499				
HCB -0.116 -0.598 0.367 0.213 -0.124 0.549 -0.290 -0.581 0.000 <sup>†</sup> -0.041 -0.220 0.138 -0.032 -0.683 0.620 0.496 0.069 0.924 *	НСВ	-0.116	-0.598	0.367	0.213	-0.124	0.549	-0.290	-0.581	0.000	†	-0.041	-0.220	0.138		-0.032	-0.683	0.620	0.496	0.069	0.924 *				
β-HCH 0.030 -0.257 0.317 0.203 0.006 0.401 * -0.130 -0.304 0.045 -0.028 -0.134 0.078 -0.130 -0.516 0.256 0.324 0.072 0.577 *	β-НСН	0.030	-0.257	0.317	0.203	0.006	0.401 *	-0.130	-0.304	0.045		-0.028	-0.134	0.078		-0.130	-0.516	0.256	0.324	0.072	0.577 *				
Mirex 0.137 -0.188 0.461 0.229 0.004 0.453 * -0.069 -0.267 0.130 -0.061 -0.181 0.060 -0.401 -0.833 0.031 0.299 0.009 0.589 *	Mirex	0.137	-0.188	0.461	0.229	0.004	0.453 *	-0.069	-0.267	0.130		-0.061	-0.181	0.060		-0.401	-0.833	0.031	0.299	0.009	0.589 *				
Parlar-26 0.075 -0.154 0.304 0.164 0.006 0.323 * -0.099 -0.235 0.038 -0.058 -0.142 0.027 -0.073 -0.383 0.237 0.267 0.065 0.469 *	Parlar-26	0.075	-0.154	0.304	0.164	0.006	0.323 *	-0.099	-0.235	0.038		-0.058	-0.142	0.027		-0.073	-0.383	0.237	0.267	0.065	0.469 *				
Parlar-50 0.033 -0.197 0.262 0.173 0.015 0.331 * -0.124 -0.260 0.012 <sup>†</sup> -0.028 -0.113 0.057 -0.056 -0.365 0.254 0.297 0.097 0.497 **	Parlar-50	0.033	-0.197	0.262	0.173	0.015	0.331 *	-0.124	-0.260	0.012	†	-0.028	-0.113	0.057		-0.056	-0.365	0.254	0.297	0.097	0.497 **				

Adjusted regression coefficients (β) and 95% confidence intervals (CIs) for the association between a 10-fold increase of OCP and log10-transformed hormone levels as determined by a linear regression model Each OCP was introduced into the model separately and adjusted for maternal age, parity, and gestational age.

\*P < 0.05, \*\*P < 0.01, †P <0.1

Table 5 Associations between OCPs exposure and steroid and reproductive hormone levels among girl
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	Progesterone			Estradiol			Testosterone		Estradiol/Testosterone			DEHA				Androstenedione							
_	β	95%	%CI	β	95%	6CI		β	95%	%CI		β	95%	6CI		β	95%	6CI		β	95%	6CI	
Oxychlordane	0.136	-0.149	0.420	0.047	-0.175	0.270		0.050	-0.219	0.320		-0.003	-0.222	0.216		-0.087	-0.377	0.203		0.032	-0.189	0.254	
, cis-Nonachlor	0.194	-0.069	0.456	0.019	-0.188	0.225		0.035	-0.215	0.284		-0.016	-0.220	0.187		-0.136	-0.404	0.132		0.006	-0.199	0.211	
trans-Nonachlor	0.192	-0.065	0.449	0.035	-0.167	0.237		0.065	-0.179	0.310		-0.030	-0.229	0.169		-0.163	-0.425	0.099		0.038	-0.163	0.239	
p.p'-DDD	0.099	-0.046	0.244	-0.059	-0.172	0.054		-0.041	-0.178	0.096		-0.018	-0.130	0.094		-0.160	-0.305	-0.014	*	-0.069	-0.181	0.043	
o.p'-DDF	-0.042	-0.212	0.127	-0.082	-0.214	0.049		-0.038	-0.198	0.122		-0.044	-0.174	0.086		0.000	-0.173	0.173		-0.066	-0.197	0.065	
n n'-DDF	0.018	-0 201	0.237	-0.116	-0.285	0.054		0.035	-0 172	0 241		-0.151	-0.317	0.015	†	-0 156	-0.377	0.065		-0.077	-0 246	0.092	
o n'-DDT	-0.071	-0.282	0.140	-0 109	-0 272	0.055		-0.024	-0 222	0.175		-0.085	-0 246	0.076	·	0.130	-0 202	0.227		-0.072	-0.235	0.091	
o,p DDT n n'-DDT	0.071	-0.202	0.289	-0.063	-0.256	0.000		0.024	-0 158	0.175		-0.138	-0 327	0.070		-0 102	-0.353	0.227		-0.0/2	-0.233	0.071	
p,p DD1 Dieldrin	-0.042	-0.205	0.287	-0.028	-0.250	0.127		-0.073	-0 373	0.000		0.100	-0 165	0.000		0.102	-0 235	0.177		-0.204	-0 /32	0.130	+
	0.012	-0 1/0	0.207	0.020	-0.175	0.204		0.072	-0.210	0.100		-0.007	-0.222	0.275		-0.087	-0.233	0.371		0.204	-0.190	0.024	1
	0.130	-0.147	0.420	-0.052	-0.175	0.270		0.000	-0.217	0.320		-0.003	-0.222	0.210		-0.007	-0.377	0.205		0.052	-0.107	0.254	
	0.210	0.174	0.000	-0.052	0.337	0.233		0.020	-0.344	0.375		-0.077	-0.370	0.223		-0.052	-0.430	0.340		0.001	0.232	0.334	
р-псп Мітох	-0.032	-0.200	0.222	-0.030	-0.240	0.147		0.037	-0.102	0.270		-0.107	-0.301	0.067		-0.010	-0.274	0.242		-0.000	-0.203	0.170	
Millex Dorlor 24	0.210	-0.000	0.503	0.043	-0.162	0.207		-0.030	-0.302	0.241		0.073	-0.140	0.294		-0.100	-0.457	0.120		0.025	-0.190	0.240	
Parlar 50	0.031	-0.107	0.229	-0.008	-0.100	0.149		-0.012	-0.170	0.175		0.000	-0.140	0.150		0.022	-0.100	0.223		-0.029	-0.102	0.124	
Parlar-50	0.046	-0.177	0.270	-0.012	-0.100	0.102		-0.002	-0.213	0.209		-0.010	-0.162	0.102		0.021	-0.207	0.240		-0.015	-0.109	0.150	
-	And	arostened	IONE/DHEA	lestost	erone/Ar	arosteneai	one	0	Cort			0	Cortis	one		0	Cortisone			Adrenal	androger	N/GIUCOCOTT	
	р 0.110	937		р 0.010	937			р 0.011	937			p	95%			p	937			р 0.0(1	937		
Oxychlordane	0.119	-0.217	0.455	0.018	-0.140	0.175		0.214	-0.265	0.692		0.374	-0.302	1.050		0.160	-0.145	0.465		-0.361	-1.139	0.416	
cis-Nonachlor	0.142	-0.169	0.453	0.029	-0.11/	0.175		0.229	-0.215	0.672		0.463	-0.161	1.08/	÷	0.234	-0.046	0.515	+	-0.463	-1.181	0.255	
trans-Nonachlor	0.201	-0.103	0.505	0.027	-0.116	0.1/0		0.276	-0.157	0.709	*	0.517	-0.092	1.126	T .	0.241	-0.033	0.516	1	-0.533	-1.234	0.168	
p,p'-DDD	0.091	-0.080	0.262	0.028	-0.052	0.108		0.208	-0.034	0.450	Ť	0.358	0.017	0.699	*	0.150	-0.004	0.304	Ť	-0.412	-0.803	-0.021 *	*
o,p'-DDE	-0.066	-0.266	0.134	0.027	-0.066	0.121		-0.176	-0.460	0.108		-0.030	-0.434	0.374		0.146	-0.034	0.327		0.088	-0.376	0.551	
p,p'-DDE	0.079	-0.179	0.337	0.112	-0.007	0.231 1	-	0.106	-0.261	0.474		0.285	-0.233	0.803		0.179	-0.054	0.411		-0.333	-0.928	0.261	
o,p'-DDT	-0.084	-0.333	0.164	0.048	-0.068	0.164		-0.269	-0.620	0.083		-0.058	-0.560	0.443		0.210	-0.013	0.433	Ť	0.143	-0.432	0.718	
p,p'-DDT	0.061	-0.231	0.353	0.116	-0.019	0.251 1	•	-0.045	-0.461	0.371		0.207	-0.380	0.795		0.253	-0.009	0.514	Ť	-0.167	-0.842	0.508	
Dieldrin	-0.272	-0.621	0.076	0.112	-0.051	0.275		-0.203	-0.704	0.297		-0.274	-0.982	0.434		-0.071	-0.391	0.249		0.256	-0.557	1.069	
cis-HCE	0.119	-0.217	0.455	0.018	-0.140	0.175		0.214	-0.265	0.692		0.374	-0.302	1.050		0.160	-0.145	0.465		-0.361	-1.139	0.416	
HCB	0.102	-0.359	0.564	-0.025	-0.241	0.191		0.317	-0.339	0.973		0.499	-0.428	1.425		0.182	-0.237	0.600		-0.420	-1.486	0.647	
β-НСН	0.010	-0.290	0.309	0.063	-0.077	0.202		0.004	-0.422	0.431		0.012	-0.592	0.615		0.007	-0.265	0.280		-0.014	-0.707	0.679	
Mirex	0.191	-0.148	0.529	-0.055	-0.214	0.103		0.229	-0.254	0.712		0.510	-0.170	1.189		0.280	-0.025	0.585	Ť	-0.525	-1.306	0.257	
Parlar-26	-0.051	-0.285	0.183	0.017	-0.092	0.127		0.044	-0.289	0.377		0.091	-0.380	0.562		0.047	-0.165	0.260		-0.040	-0.581	0.501	
Parlar-50	-0.036	-0.300	0.228	0.014	-0.110	0.137		0.028	-0.348	0.404		0.123	-0.408	0.655		0.095	-0.144	0.334		-0.050	-0.661	0.560	
		SHB	G		Prola	ctin																	
_	β	95%	%CI	β	95%	6CI																	
Oxychlordane	0.060	-0.118	0.238	0.092	-0.149	0.332																	
cis-Nonachlor	0.057	-0.108	0.221	0.076	-0.147	0.298																	
trans-Nonachlor	0.059	-0.102	0.220	0.085	-0.134	0.303																	
p,p'-DDD	0.064	-0.026	0.155	0.120	0.000	0.241 1	•																
o,p'-DDE	-0.004	-0.109	0.102	-0.048	-0.191	0.094																	
p,p'-DDE	0.074	-0.061	0.210	0.092	-0.091	0.275																	
o,p'-DDT	-0.002	-0.133	0.130	-0.009	-0.186	0.169																	
p,p'-DDT	0.034	-0.120	0.188	0.029	-0.178	0.237																	
Dieldrin	0.014	-0.172	0.200	-0.199	-0.453	0.055																	
cis-HCE	0.060	-0.118	0.238	0.092	-0.149	0.332																	
НСВ	0.116	-0.127	0.359	0.128	-0.202	0.458																	
в-нсн	0.125	-0.031	0.282	0.009	-0.207	0.225																	
Mirex	0.021	-0.159	0.200	0.120	-0.121	0.362																	
Parlar-26	0.037	-0.086	0.160	-0.022	-0.188	0.145																	
Parlar-50	0.030	-0.110	0.169	-0.002	-0.190	0.186																	

Adjusted regression coefficients (β) and 95% confidence intervals (CIs) for the association between a 10-fold increase of OCP and log10-transformed hormone levels as determined by a linear regression model Each OCP was introduced into the model separately and adjusted for maternal age, parity, and gestational age.

\*P < 0.05, \*\*P < 0.01, †P <0.1

original cohort (n=379)							
Persistent	Detection		-		Percentile		
organochlorine	limit	>DL (%)	Minimum	25th	50th	75th	Maximum
pesticides	(pg/g-wet)		1•IIIIIIIIII	2511	5000	7500	Maximum
Aldrin	1.00	0.3				<dl< td=""><td>12.83</td></dl<>	12.83
Chlordanes							
oxychlordane	0.90	100.0	7.93	27.05	39.67	56.02	250.94
cis-Chlordane	0.70	58.8		<dl< td=""><td>1.15</td><td>2.29</td><td>17.53</td></dl<>	1.15	2.29	17.53
trans-Chlordane	0.50	45.4			<dl< td=""><td>0.71</td><td>3.79</td></dl<>	0.71	3.79
cis-Nonachlor	0.40	100.0	1.63	6.76	9.97	14.36	38.07
trans-Nonachlor	0.50	100.0	13.14	49.70	71.52	107.59	513.52
DDTs							
o,p'-DDD	0.50	12.4				<dl< td=""><td>1.16</td></dl<>	1.16
p,p'-DDD	0.40	89.7	<dl< td=""><td>0.94</td><td>1.48</td><td>2.29</td><td>9.04</td></dl<>	0.94	1.48	2.29	9.04
o,p'-DDE	0.40	85.0	<dl< td=""><td>0.75</td><td>1.27</td><td>1.82</td><td>6.20</td></dl<>	0.75	1.27	1.82	6.20
p,p'-DDE	0.60	100.0	99.52	401.53	650.99	1011.48	4575.67
o,p'-DDT	0.60	7.6	<dl< td=""><td>2.27</td><td>3.48</td><td>4.86</td><td>17.15</td></dl<>	2.27	3.48	4.86	17.15
p,p'-DDT	0.40	100.0	2.38	16.63	23.16	33.99	121.52
Dieldrin	0.80	100.0	4.11	12.08	16.42	22.62	71.52
Endrin	1.00	0.0					<dl< td=""></dl<>
Heptachlors							
Heptachlor	0.80	0.5				<dl< td=""><td>1.14</td></dl<>	1.14
trans-HCE	1.00	0.0					<dl< td=""></dl<>
cis-HCE	0.40	100.0	6.17	18.78	26.44	37.28	200.53
HCB	0.90	100.0	34.94	80.24	101.65	130.06	245.48
HCHs							
α-HCH	0.70	69.1		<dl< td=""><td>0.90</td><td>1.32</td><td>3.89</td></dl<>	0.90	1.32	3.89
β-НСН	0.60	100.0	19.95	105.05	154.45	244.76	1667.12
γ-HCH	0.90	59.1		<dl< td=""><td>1.05</td><td>1.63</td><td>100.92</td></dl<>	1.05	1.63	100.92
δ-ΗCΗ	0.70	0.8				<dl< td=""><td>1.11</td></dl<>	1.11
Mirex	0.50	100.0	0.88	4.07	5.95	8.26	34.97
Toxaphenes							
Parlar-26	1.00	97.1	<dl< td=""><td>2.87</td><td>4.39</td><td>6.65</td><td>20.82</td></dl<>	2.87	4.39	6.65	20.82
Parlar-41	0.70	26.9			<dl< td=""><td>0.72</td><td>1.96</td></dl<>	0.72	1.96
Parlar-40	2.00	0.5				<dl< td=""><td>2.43</td></dl<>	2.43
Parlar-44	2.00	1.6				<dl< td=""><td>2.84</td></dl<>	2.84
Parlar-50	2.00	96.0	<dl< td=""><td>4.36</td><td>6.52</td><td>9.68</td><td>29.29</td></dl<>	4.36	6.52	9.68	29.29
Parlar-62	6.00	0.0					<dl< td=""></dl<>

Supplemental Table S1 Concentrations of organochlorine pesticides in maternal blood all measured of original cohort (n=379)

DL, detection limit; DDD, dichlorodiphenyldichloroethane; DDE, dichlorodiphenyldichloroethylene; DDT, dichlorodiphenyltrichloroethane; HCB, hexachlorobenzene; HCE, heptachlor epoxide; HCH, hexachlorocyclohexane.

Supplemental table S2 Maternal and infant characteristics and concentrations of OCPs

characteristics		n	o,p'-DDT	p,p'-DDT	o,p'-DDE	p,p'-DDE	p,p'-DDD	cis-Nonachlor	trans-Nonachlor	oxychlordane
Mother			ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ
Age at delivery (years)			0.009	0.102	0.030	0.270**	0.137*	0.267**	0.311**	0.350**
Pre-pregnancy BMI (kg	/m2)		0.062	0.118	0.119	0.003	0.052	0.089	-0.011	-0.093
			Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)
Educational level	≤12 years	100	3.01 (2.09, 4.47)	21.59 (15.41, 32.84)	1.16 80.70, 1.71)	565.05 (376.81, 942.71)	1.62 (0.88, 2.44)	9.88 (7.22, 14.64)	72.73 (52.69, 108.21)	39.83 (27.1, 56.02)
	>12 years	132	3.54 (2.42, 4.99)	25.32 (16.37, 34.77)	1.33 (0.96, 1.86)	634.71 (422.04, 976.14)	1.69 (1.03, 2.58)	10.78 (6.85, 15.13)	78.85 (51.80, 118.08)	40.22 (28.87, 57.78)
Annual Household	<5 million yen per year	166	3.27 (2.22, 4.66)	22.35 (16.38, 33.65)	1.26 (0.71, 1.74)	619.26 (411.26, 942.60)	1.62 (0.99, .53)	9.93 (6.71, 14.35) *	70.06 (50.04, 111.09) *	39.07 (27.61, 56.02) *
income	≧5 million yen per year	66	3.64 (2.41, 5.06)	24.18 (15.54, 38.90)	1.23 (0.77, 2.05)	633.52 (392.24, 1302.85)	1.68 (0.98, 2.58)	11.91 (8.21, 15.98)	86.66 (62.34, 110.04)	45.83 (30.02, 66.07)
Smoking during pregnancy	No	190	3.46 (2.37, 4.66)	23.74 (16.38, 33.93)	1.26 (0.73, 1.77)	617.59 8409.71, 971.83)	1.61 (0.98, 2.57)	10.70 (7.17, 15.02)	76.63 (54.06, 112.12)	40.31 (29.25, 57.75)
	Yes	42	3.03 (1.79, 5.03)	21.09 (14.17, 34.22)	1.17 (0.70, 1.84)	625.95 (409.34, 944.10)	1.79 (1.07, 2.39)	8.94 (6.01, 15.10)	69.19 (48.19, 109.46)	38.64 (23.48, 51.97)
Alcohol consumption during pregnancy	No	154	3.10 (2.21, 4.67) *	22.62 (15.54, 33.44)	1.22 (0.69, 1.72)	60.5.48 (412.66, 971.83)	1.62 (0.99, 2.55)	10.14 (6.90, 14.76)	74.14 (51.75, 112.12)	40.13 (28.81, 58.13)
01 0 ,	Yes	78	3.86 (2.56, 4.98)	24.14 (17.27, 33.98)	1.27 (0.90, 1.87)	648.50 (406.30, 976.56)	1.67 (0.87, 2.41)	11.04 (7.29, 15.25)	78.85 (52.92, 108.95)	40.04 (28.87, 56.02)
Parity	0	120	3.39 (2.38, 4.67)	24.38 (17.17, 33.92)	1.35 (0.81, 1.83)	652.69 (453.78, 1002.45)	1.64 (1.00, 2.52)	11.52 (7.50, 15.13) *	87.74 (56.35, 117.19) *	42.99 (32.00, 60.65) **
	≥1	112	3.24 (2.22, 4.78)	21.98 (14.92, 34.69)	1.13 (0.69, 1.71)	564.40 (336.51, 938.47)	1.65 (0.91, 2.62)	9.5 (6.37, 14.06)	70.05 (45.60, 97.48)	38.97 (26.35, 54.44)
Blood sampling period	During pregnancy	159	3.42 (2.25, 4.72)	22.49 (15.57, 33.95)	1.22 (0.73, 1.83)	626.50 (412.96, 941.47)	1.51 (0.99, 2.28)	10.01 (7.06, 14.87)	70.38 (21.93, 105.61)	39.19 (27.65, 55.64)
	After delivery	73	3.36 (2.28, 4.48)	23.77 (19.33, 34.17)	1.35 (0.71, 1.73)	614.51 (339.28, 1008.37)	1.76 (0.87, 2.84)	11.15 (6.86, 16.79)	87.82 (51.95, 124.70)	44.66 (29.31, 60.98)
Type of delivery	Vaginal	230	3.36 (2.27, 4.68)	22.84 816.14, 33.93)	1.25 (0.72, 1.77)	619.26 8410.14, 964.80)	1.62 (0.98, 2.53)	10.33 (7.03, 15.04)	75.08 (51.89, 110.01)	39.87 (28.87, 57.31)
	Caesarian section	2	3.70 (3.03, 4.36)	36.58 (23.77, 49.38)	1.40 (0.91, 1.88)	688.72 (304.51, 1072.92)	2.87 (2.23, 3.5)	18.84 (12.12, 25.55)	119.01 (91.04, 146.97)	55.41 (40.2, 70.62)
Infant			ρ	ρ	ρ	ρ	ρ	ρ	ρ	ρ
Birth weight			0.022	-0.025	0.005	0.002	-0.087	-0.057	-0.057	-0.061
Gestational Age			0.066	0.037	0.039	0.117	-0.013	0.025	0.035	0.045
			Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)
Sex	Male	106	3.39 (2.42, 4.42)	23.90 (16.56, 33.88)	1.18 (0.72, 1.66)	641.93 (405.32, 934.78)	1.70 (1.04, 2.35)	10.29 (7.11, 15.11)	75.82 (53.44, 118.34)	40.22 (29.26, 57.54)
	Female	126	3.36 (2.20, 4.97)	21.96 (15.78, 34.45)	1.30 (0.72, 1.87)	611.15 (4101.00, 998.41)	1.60 (0.93, 2.66)	10.42 (6.80, 15.04)	74.66 851.75, 107.06)	39.87 (28.34, 57.15)

## Supplemental table S1 Maternal and infant characteristics and concentrations of OCPs (continued)

Characteristics		n	Dieldrin	cis-HCE	НСВ	β-НСН	Mirex	Parlar-26	Parlar-50
Mother			ρ	ρ	ρ	ρ	ρ	ρ	ρ
Age at delivery (years)			0.108	0.254**	0.119*	0.464**	0.513**	0.176**	0.181**
Pre-pregnancy BMI (kg/m2)			0.221**	0.177**	0.101	0.147*	-0.074	0.240**	0.240**
			Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)
Educational level	≤12 years	100	16.55 (12.52, 22.84)	26.07 (18.56, 40.28)	101.71 (80.26, 130.96)	154.79 (96.08, 262.30)	5.99 (4.08, 8.34)	4.85 (3.17, 7.55)	7.02 (4.61, 1028)
	>12 years	132	16.80 (12.11, 21.59)	26.91 (18.96, 37.13)	106.79 (85.26, 167.25)	154.31 (109.21, 220.69)	6.11 (4.31, 8.59)	4.05 (2.56, 6.68)	6.50 (3.88, 9.48)
Annual Household income	<5 million yen per year	166	15.93 (12.02, 20.99)	26.07 (18.44, 35.00)	102.17 (80.36, 129.52)	153.64 (100.87, 209.23)	5.76 (3.88, 7.79) *	* 4.32 (2.69, 6.82)	6.48 (4.25, 9.48)
	≧5 million yen per year	66	17.89 (12.60, 24.41)	26.55 (19.17, 43.07)	111.51 (85.53, 145.40)	165.66 (113.97, 279.53)	7.44 (4.82, 11.64)	5.22 (3.14, 7.61)	7.69 (4.33, 11.64)
Smoking during pregnancy	No	190	16.86 (12.35, 22.47)	26.79 (19.14, 37.90)	103.82 (83.69, 131.84)	158.46 (103.79, 241.30)	6.16 (4.51, 8.61)	4.50 (2.84, 6.60)	6.82 (4.32, 9.74)
0 01 0 ,	Yes	42	15.51 (11.41, 21.31)	24.39 (16.80, 35.42)	104.48 (74.82, 132.31)	150.87 (103.84, 184.91)	5.69 (3.73, 7.82)	4.23 (2.73, 8.24)	5.88 (3.75, 11.43)
Alcohol consumption during pregnancy	No	154	16.80 (12.14, 22.82)	27.18 (18.91, 39.08)	105.46 (81.20, 133.02)	162.80 (104.40, 244.79)	6.04 (4.11, 8.38)	4.19 (2.82, 6.82)	6.40 (4.28, 9.58)
01 0 /	Yes	78	16.35 (12.42, 21.66)	24.82 (18.42, 35.69)	99.34 (86.16, 130.72)	146.89 (102.56, 202.87)	6.09 (4.11, 8.61)	4.54 (2.91, 7.58)	7.32 (4.44, 10.56)
Parity	0	120	17.16 (12.52, 21.71)	26.79 (19.16, 36.85)	109.93 (91.03, 131.94) **	165.19 (114.52, 271.53)	5.98 (4.14, 8.81)	5.23 (2.96, 7.20)	7.54 (4.54, 9.99)
	≥1	112	16.35 (12.05, 22.66)	25.17 (18.19, 40.63)	95.36 (72.71, 129.15)	143.66 (90.00, 211.57)	6.19 (4.11, 8.47)	4.02 (2.72, 6.68)	5.94 (3.85, 9.66)
Blood sampling period	During pregnancy	159	17.59 (12.39, 22.87)	26.44 (18.91, 38.12)	104.06 (85.45, 130.56)	154.13 (108.08, 218.60)	5.88 (4.07, 7.86)	4.50 (2.93, 7.08)	7.16 (4.25, 9.72)
	After delivery	73	15.51 (12.06, 21.32)	25.10 (18.50, 36.78)	103.73 (75.77, 138.73)	158.62 (94.33, 254.44)	6.76 (4.54, 10.19)	4.33 (2.56, 7.49)	6.42 (4.45, 10.72)
Type of delivery	Vaginal	230	16.61 (12.16, 22.44)	26.15 (18.76, 37.42)	103.99 (82.85, 131.26)	154.31 (104.40, 237.67)	6.04 (4.11, 8.51)	4.41 (2.84, 7.09)	6.55 (4.28, 9.79)
	Caesarian section	2	18.66 (16.82, 20.50)	36.20 (28.26, 44.14)	134.17 (85.55, 182.79)	154.45 (68.50, 240.39)	13.99 (4.84, 23.14)	7.67 (5.34, 10.00)	10.15 (7.63, 12.67)
Infant			ρ	ρ	ρ	ρ	ρ	ρ	ρ
Birth weight			-0.049	-0.101	-0.066	-0.128	-0.030	-0.024	-0.022
Gestational Age			-0.035	-0.082	0.052	0.061	0.027	0.024	-0.018
			Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)	Med (min-max)
Sex	Male	106	15.92 (12.07, 22.55)	26.39 (19.22, 40.80)	101.76 (85.53, 130.85)	153.65 (107.63, 237.67)	6.04 (4.53, 8.94)	4.50 (2.91, 6.86)	6.64 (4.33, 10.27)
	Female	126	17.07 (12.51 21.96)	26,15 (18,49, 35,42)	104.60 (78.58 133.01)	155.04 (102.56, 240.78)	6.04 (4.03 8.41)	4.24 (2.73 7.36)	6.50 (4.25 9.74)

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Supplemental Table S3 Distribution of steroids and reproductive hormones among all measured of original cohort (n=295)

			>DI	Т	otal (n=29			Boys (n=1	LO6)			Girls (n=126)							
	DL	n	(%)	25%	Med	75%	n	>DL (%)	25%	Med	75%	n	>DL (%)	25%	Med	75%	value		
Steroid hormones																			
Progesterone (ng/mL)	0.01	295	100	175.5	218.8	278.8	135	100	183.8	225.9	285.6	160	100	167.6	209.0	275.6	0.184		
Testosterone (pg/mL)	0.01	295	100	59.8	83.9	114.1	135	100	76.5	98.9	126.3	160	100	52.1	70.1	96.8	<0.001		
Estradiol (ng/mL)	0.01	295	99.7	3.29	4.70	7.10	135	99.3	3.33	4.86	7.42	160	100	3.16	4.68	6.61	0.227		
DHEA (ng/mL)	0.01	295	100	1.77	2.19	2.99	135	100	1.59	2.08	2.76	160	100	1.91	2.34	3.22			
Androstenedione (ng/mL)	0.01	295	99.3	0.36	0.46	0.58	135	98.5	0.38	0.47	0.61	160	99.4	0.35	0.45	0.58			
Cortisol (ng/mL)	0.25	295	97.6	22.7	38.9	63.6	135	98.5	22.5	38.3	65.3	160	96.9	22.8	39.2	62.8			
Cortisone (ng/mL)	0.10	295	94.9	69.9	93.9	123.0	135	97.0	70.5	95.3	123.4	160	93.1	69.7	93.0	123.0			
Steroid Hormone Binding Globulin (nmol/L)	1.10	295	100	13.3	15.8	19.0	135	100	13.9	16.5	19.3	160	100	13.0	15.5	18.7	0.079		
Lutheling Hormone (mIU/mL)	0.50	288	16.3			<dl< td=""><td>132</td><td>34.8</td><td></td><td><dl< td=""><td>0.84</td><td>156</td><td>0.6</td><td></td><td></td><td><dl< td=""><td>&lt;0.001</td></dl<></td></dl<></td></dl<>	132	34.8		<dl< td=""><td>0.84</td><td>156</td><td>0.6</td><td></td><td></td><td><dl< td=""><td>&lt;0.001</td></dl<></td></dl<>	0.84	156	0.6			<dl< td=""><td>&lt;0.001</td></dl<>	<0.001		
Follicle Stimulating Hormone (mIU/mL)	0.50	287	20.9			<dl< td=""><td>132</td><td>45.5</td><td></td><td><dl< td=""><td>0.66</td><td>155</td><td>0</td><td></td><td></td><td><dl< td=""><td>&lt;0.001</td></dl<></td></dl<></td></dl<>	132	45.5		<dl< td=""><td>0.66</td><td>155</td><td>0</td><td></td><td></td><td><dl< td=""><td>&lt;0.001</td></dl<></td></dl<>	0.66	155	0			<dl< td=""><td>&lt;0.001</td></dl<>	<0.001		
Inhibin B (pg/mL)	11	295	59.7	5.5	23.2	44.6	135	98.5	33.9	44.0	58.3	160	26.9		<dl< td=""><td>12.4</td><td>&lt;0.001</td></dl<>	12.4	<0.001		
Insulin-like factor 3 (ng/mL)	0.01	157	100	0.23	0.27	0.32	132	100	0.25	0.29	0.34	25	100	0.17	0.18	0.23	<0.001		
Prolactin (ng/mL)	1.0	289	99.7	63.1	85.8	116.0	132	100	65.4	85.2	115.0	157	99.6	61.4	86.0	118.0	0.986		

P values were calculated by Mann-Whitney U test;

DHEA, dehidroepiandrostenedione; DL, detection limit

Supplemental Table S4	Associations between OCPs ex	posure and steroid and re	productive hormone lev	vels and sex interaction
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	Progesterone					Estradiol					Testosterone				Estradio			diol/Testosterone			DEHA				Androstenedione					
	β	959	%CI	р <sup>а)</sup>	<b>р</b> <sup>ь)</sup>	β	959	%CI	р <sup>а)</sup>	p <sup>b)</sup>	β	95%	6CI	<b>p</b> <sup>a)</sup>	$p^{b)}$	β	95%	6CI	р <sup>а)</sup>	<b>р</b> <sup>ь)</sup>	β	959	%CI	p <sup>a)</sup>	$p^{b)}$	β	95%	6CI	<b>p</b> <sup>a)</sup>	<i>p</i> <sup>b)</sup>
Oxychlordane	0.024	-0.189	0.238			0.025	-0.178	0.229			-0.065	-0.249	0.118			0.091	-0.099	0.281			0.067	-0.119	0.253			0.019	-0.137	0.175		
cis-Nonachlor	0.022	-0.166	0.210		*	0.010	-0.170	0.190			-0.030	-0.192	0.132			0.040	-0.128	0.208			0.055	-0.108	0.218		*	0.039	-0.098	0.176		
trans-Nonachlor	0.014	-0.172	0.200		*	0.005	-0.173	0.184			-0.049	-0.209	0.112			0.054	-0.112	0.221			0.046	-0.116	0.208		*	0.038	-0.098	0.175		
p,p'-DDD	0.004	-0.111	0.119		t	-0.102	-0.211	0.008	ť		-0.054	-0.153	0.045			-0.047	-0.150	0.055			-0.091	-0.191	0.009	Ť		-0.043	-0.126	0.041		
o,p'-DDE	-0.044	-0.169	0.082			-0.017	-0.136	0.102			-0.034	-0.142	0.074			0.017	-0.094	0.128			0.039	-0.070	0.149			-0.027	-0.118	0.064		
p,p'-DDE	0.017	-0.149	0.182			0.027	-0.130	0.183			-0.031	-0.172	0.110			0.058	-0.087	0.202		*	-0.029	-0.172	0.114			-0.060	-0.179	0.060		
o,p'-DDT	-0.069	-0.210	0.073			-0.035	-0.169	0.099			-0.024	-0.146	0.097			-0.011	-0.136	0.114			0.067	-0.056	0.190			-0.031	-0.134	0.071		
p,p'-DDT	-0.020	-0.198	0.158			-0.016	-0.186	0.154			0.007	-0.146	0.160			-0.023	-0.181	0.136			0.024	-0.130	0.179			-0.012	-0.141	0.118		
Dieldrin	-0.093	-0.304	0.118			0.022	-0.179	0.224			-0.059	-0.240	0.122			0.081	-0.106	0.269			0.164	-0.019	0.347	t		-0.022	-0.174	0.130		*
cis-HCE	-0.040	-0.238	0.158		t	-0.009	-0.198	0.181			-0.053	-0.224	0.118			0.044	-0.133	0.221			0.098	-0.074	0.271	I		-0.028	-0.173	0.117		
НСВ	0.122	-0.178	0.422		1	0.033	-0.253	0.319			-0.060	-0.317	0.198			0.093	-0.173	0.359			0.126	-0.135	0.387			0.053	-0.165	0.271		
в-нсн	0.035	-0.151	0.220			0.050	-0.126	0.227			-0.014	-0.173	0.145			0.065	-0.099	0.229			0.056	-0.106	0.217			-0.004	-0.139	0.130		
Mirex	0.061	-0.146	0.268		t	0.027	-0.171	0.226			-0.154	-0.332	0.024	†		0.182	-0.003	0.366	t		0.018	-0.163	0.200			-0.019	-0.171	0.133		
Parlar-26	-0.046	-0.190	0.099		I	0.061	-0.077	0.198			-0.004	-0.128	0.121	I		0.065	-0.064	0.193			0.127	0.003	0.252	*		0.036	-0.069	0.140		
Parlar-50	-0.027	-0.181	0.127			0.032	-0.114	0.179			-0.010	-0.142	0.123			0.042	-0.095	0.179			0.127	-0.006	0.260	†		0.044	-0.067	0.156		
	0.02)	01101	01127			0.002	01111	0.177			01010	01112	0.120			010 12	0.070	0.177			0112/	0.000	0.200				drenal an	drogen/		
	Andr	ostenedi	one/DHE	Ā		Testoste	erone/An	drostene	dione			Cortis	ol			Cortisone					C	ortisone/	Cortisol		Glucocorticoid					
Oxychlordane	-0.051	-0.263	0.161			-0.083	-0.195	0.029			-0.084	-0.402	0.234			-0.014	-0.436	0.408		ţ	0.071	-0.138	0.281			0.100	-0.386	0.585		†
cis-Nonachlor	-0.018	-0.205	0.168			-0.067	-0.166	0.032		Ť	-0.009	-0.290	0.272			0.066	-0.306	0.438		*	0.076	-0.108	0.260		Ť	0.022	-0.405	0.450		*
trans-Nonachlor	-0.009	-0.194	0.175		*	-0.086	-0.184	0.011	†	*	-0.057	-0.334	0.220		*	0.040	-0.328	0.407		*	0.097	-0.085	0.280		†	0.044	-0.378	0.466		*
p,p'-DDD	0.050	-0.065	0.164			-0.013	-0.074	0.048			0.133	-0.038	0.305			0.186	-0.040	0.413			0.053	-0.059	0.165		†	-0.230	-0.490	0.031	†	
o,p'-DDE	-0.066	-0.190	0.058			-0.008	-0.074	0.058			-0.139	-0.325	0.048			-0.088	-0.336	0.161			0.052	-0.071	0.174			0.142	-0.143	0.428		
p,p'-DDE	-0.032	-0.195	0.131			0.029	-0.057	0.115		†	-0.092	-0.337	0.153			0.017	-0.308	0.343			0.107	-0.054	0.269			0.006	-0.368	0.380		†
o,p'-DDT	-0.097	-0.237	0.042			0.006	-0.068	0.081			-0.215	-0.424	-0.006	*		-0.104	-0.384	0.176			0.110	-0.028	0.248			0.199	-0.123	0.520		I
p,p'-DDT	-0.037	-0.213	0.140			0.019	-0.075	0.112		*	-0.064	-0.331	0.202			0.003	-0.350	0.356			0.067	-0.106	0.240		*	0.058	-0.348	0.465		
Dieldrin	-0.189	-0.397	0.019	†		-0.035	-0.145	0.075		*	-0.094	-0.409	0.221			-0.243	-0.661	0.176			-0.149	-0.356	0.057			0.312	-0.168	0.793		
cis-HCE	-0.189	-0.326	0.068			-0.024	-0.127	0.080		*	0.001	-0.297	0.298			-0.092	-0.486	0.302			-0.094	-0.289	0.101			0.139	-0.314	0.592		
НСВ	-0.076	-0.373	0.221			-0.112	-0.269	0.046			0.014	-0.433	0.461			0.146	-0.448	0.740			0.132	-0.162	0.426			0.036	-0.647	0.719		
в-нсн	-0.063	-0.246	0.121			-0.009	-0.106	0.089			-0.070	-0.347	0.206			-0.035	-0.402	0.333			0.035	-0.147	0.217			0.101	-0.321	0.524		
Mirex	-0.037	-0.243	0.169			-0.134	-0.243	-0.026	*		-0.207	-0.515	0.100		*	-0.047	-0.456	0.362		*	0.161	-0.042	0.364			0.122	-0.349	0.593		*
Parlar-26	-0.092	-0.235	0.051			-0.039	-0.115	0.037			-0.070	-0.286	0.145			-0.100	-0.386	0.186			-0.031	-0.172	0.111			0.209	-0.119	0.536		
Parlar-50	-0.084	-0.237	0.068			-0.053	-0.134	0.028			-0.070	-0.300	0.159			-0.058	-0.362	0.247			0.012	-0.139	0.163			0.186	-0.163	0.536		
		SHBO	 G				Prolac	tin																						
Oxvchlordane	-0.014	-0.136	0.108			0.011	-0.144	0.167																						
, cis-Nonachlor	0.004	-0.104	0.112			-0.041	-0.177	0.096																						
trans-Nonachlor	0.012	-0.095	0.119			0.003	-0.133	0.139																						
p.p'-DDD	0.058	-0.008	0.123			0.070	-0.013	0.153	t																					
o.p'-DDF	-0.016	-0.087	0.056			-0.082	-0.172	0.009	+																					
p.p'-DDF	0.001	-0.092	0.095			-0.060	-0.178	0.058	I	*																				
o.p'-DDT	-0.006	-0.087	0.075			-0.090	-0.191	0.011	t																					
n n'-DDT	0.007	-0.095	0.079			-0.063	-0 191	0.065	1																					
Dieldrin	-0.020	-0 140	0 101			-0 201	-0.354	-0.048	*																					
cis-HCF	0.040	-0.074	0.153			-0.070	-0.215	0.075																						
HCB	-0.029	-0.200	0.141			-0.057	-0.273	0.159																						
β-НСН	-0.002	-0.107	0.103			-0.078	-0.212	0.056																						
Mirex	-0.041	-0.160	0.078			-0.029	-0.180	0.121																						
Parlar-26	0.008	-0.075	0.090			-0.066	-0.171	0.040																						
Parlar-50	-0.011	-0.099	0.077			-0.069	-0.181	0.043																						

βs were changes of hormone levels (log 10 transformed) of 10 fold increase of each OCP, calculated by linear regression model. <sup>a)</sup> P for OCP adjusted for Maternal age, Parity, Gestational age, and (sex) x (each OCP); <sup>b)</sup> P for interaction of sex and OCP. \*P < 0.05, \*\*P < 0.01, †P < 0.1