Pregnant Women's Health Consequences Following Exposure to PBDEs

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GW | Public Health

BACKGROUND

PBDEs (Polybrominated diphenyl ethers) are chemicals introduced by industry in the 1970s to serve as flame-retardants on common consumer products like electronics, plastics, and foam in furniture. They are also suspected to disrupt thyroid activity during a woman's pregnancy, which is a time of increased demand on the thyroid gland. Maternal thyroid fluctuations and disease as a result of exposure to PBDEs are therefore a concern. This systematic review aimed to capture all of the relevant literature that studied the association between PBDEs and maternal thyroid activity.

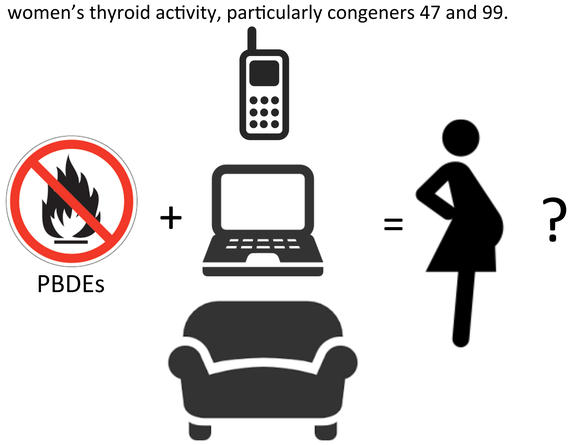
ABSTRACT

Objectives: I conducted a systematic review of literature that provided epidemiological evidence on the association between PBDE exposure during pregnancy and maternal thyroid function.

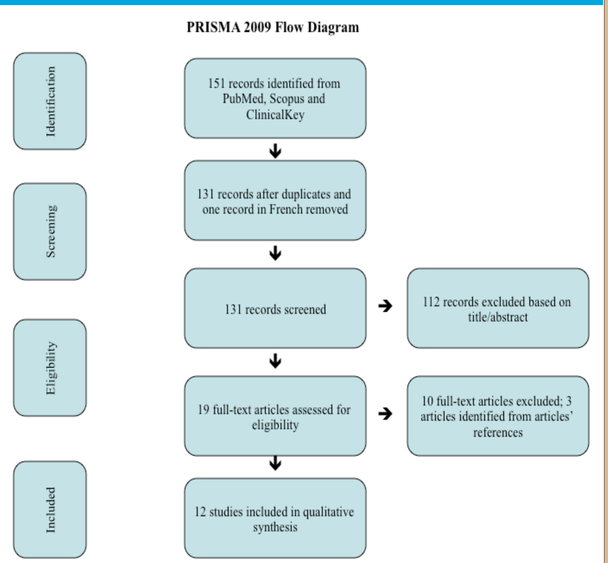
Methods: I searched electronic literature databases (October 9, 2015) for studies that assessed the association between PBDE exposure (measured via house dust, maternal blood serum, cord blood, breast milk, or house dust,) and thyroid hormone function during pregnancy (measured via maternal or cord blood). I assessed each study for bias and confounding.

Results: Of the twelve studies I found, nine of them reported significant associations between PBDEs and thyroid hormones. The nine studies differed in which congeners showed significant associations and whether those associations were positive or negative. Cross sectional studies likely suffered some bias from confounding factors and a few of the prospective cohorts had small sample sizes and power. Also, many did not or were unable to include confounders like iodine, which is known to affect the thyroid gland. Lastly, studies assessed PBDE exposure and thyroid activity at one or different times over the course of a pregnancy, which makes results difficult to compare.

Conclusions: Nine of the twelve studies report significant associations between PBDE exposure during pregnancy and thyroid hormone levels; although the direction of the association varies. While many of the studies results' disagree over which PBDE congeners have negative or positive associations with thyroid activity, it is still of important note that the studies have shown PBDEs to have a statistically significant association with pregnant women's thyroid activity, particularly congeners 47 and 99.



METHODS



Eligibility Criteria: I sought published studies in English that were conducted in any period of time with pregnant women. I accepted both national and international studies, suspecting that most studies might be based in the United States. To measure PBDE exposure, I knew that studies could use samples from blood, house dust, serum, and breast milk. Rarely are there subjects who are truly unexposed to PBDEs, so I anticipated finding studies that analyzed health outcomes after high exposure to PBDE versus low exposure. But, I did not want to exclude case-control studies if I was to find any. Additionally, I searched for cross-sectional and longitudinal studies. For health outcomes, I limited my search to any kind of thyroid disease, including fluctuations in hormone levels in either pregnant women or cord blood at delivery. I included studies that do not necessarily examine PBDEs as the primary or only exposure. For example, there are studies done on exposure to multiple persistent organic pollutants, including dioxins and polychlorinated biphenyls, and the subsequent health outcomes. In those studies, PBDEs were identified as just one of the environmental exposures. It could be valuable to observe the impact of PBDE in pregnant women when alongside similar agents or other potentially harmful agents. Lastly, I included studies that analyzed additional health outcomes besides thyroid and hormone health in pregnant women, such as those that also analyzed health outcomes in the offspring.

Study exclusion: There are a number of studies done on pregnant animals and PBDE exposure; I excluded such studies. I also excluded studies that only analyzed health outcomes in the children borne from women who experienced PBDE exposure. In terms of exposure, I did not include studies that excluded PBDEs in favor of similar chemicals, like polychlorinated biphenyls (PCBs) or organochlorines (OCs). Lastly, I excluded all studies done in vitro and favored ones done in vivo.

RESULTS

Directions (+/-) of significant associations between PBDE congeners and hormones*

	PBDEs	TSH	Total/Free T3	Total/Free T4
Abdelouahab et al. 2013	PBDE-47, PBDE-99, PBDE-100, PBDE-153, ΣPBDE	TSH (NS)	**<20 weeks gestation:** Free T3: (+) for BDEs 99, ΣPBDE Total T3: (-) for BDEs 47, 99, ΣPBDE **At Delivery:** Free T3: (-) for BDEs 47, ΣPBDE Total T3: (-) for BDEs 47, ΣPBDE **Cord blood:** (NS)	**<20 weeks gestation:** Free T4: (+) for BDEs 47, 99, ΣPBDE Total T4: (-) for BDEs 47, 99, ΣPBDE **At Delivery:** Free T4: (-) for BDE 99 Total T4: (-) for BDE 99 **Cord blood:** Free T4: (-) for BDEs 47, 99, ΣPBDE Total T4: (-) for BDEs 47, 99, ΣPBDE
Chevrier et al. 2010	BDEs 17, 28, 47, 66, 85, 99, 100, 153, 154, 183, ΣPBDE	TSH: (-) for BDEs 28, 47, 99, 100, 153, ΣPBDE	*ND*	Free T4 (NS) Total T4 (NS)
Herbstman 2008	BDEs 47, 100, 153	TSH (NS)	*ND*	Free T4: (-) for BDEs 153 Total T4: (-) for BDE 100, 153
Kim et al. 2009	BDEs 28, 47, 99, 100, 153, 154, 183, ΣPBDE	TSH (NS)	*ND*	Free T4 (NS)
Kim et al. 2013	BDEs 17, 28, 47, 49, 66, 71, 77, 85, 99, 100, 119, 126, 138, 153, 154, 156, 183, 184, 191	TSH (NS)	Free T3: (-) for ΣPBDE Total T3: (-) for BDE 47, ΣPBDE	Free T4: (+) for ΣPBDE Total T4 (NS)
Lin 2011	BDEs 15, 28, 47, 99, 100, 153, 154, and 183	TSH (NS)	Free T3: (-) for BDEs 99, 154, 183, ΣPBDE Total T3:(-) for BDE 99, 154, 183	Free T4: (-) for BDE 183 Total T4
Mazdai 2003	BDEs 47, 99, 100, 153, 154, 183, ΣPBDE	*ND*	Free T3 (NS) Total T3 (NS)	Free T4 (NS) Total T4 (NS)
Shy et al. 2012	BDEs 28, 47, 49, 85, 99, 100, 153, 154, 183, 196, 197, 206, 207, 209	TSH (NS)	Free T3: *ND* Total T3: (+) for BDEs 47, 85, 99, 100 (-) for BDEs 183, 197, 207	Free T4: (-) for BDEs 47, 49, 85, 99, 100, 197, 207 Total T4: (+) for BDE 153
Stapleton et all. 2011	BDEs 28, 47, 66, 99, 100, 85, 155, 153, 154, ΣPBDE	TSH (NS)	Free T3 (NS) Total T3 (NS)	Free T4: (+) for BDEs 47, 99, ΣBDE Total T4: (+) for BDEs 47, 99, 100 ΣBDE
Vuong et al. 2015	BDEs 17, 28, 47, 66, 85, 99, 100, 153, 154, 183, ΣPBDE	TSH (NS)	Free T3: (+) for BDEs 28, 47 Total T3: : (+) for BDE 47	Free T4: (+) for BDEs 28, 47 Total T4: (+) for BDEs 28, 47
Zhang et al. 2010	BDEs 28, 47, 99, 100, 153, 154, ΣPBDE	TSH (NS)	Total T3 (NS)	Total T4 (NS)
Zota et al. 2011	BDEs 28, 47, 66, 85, 99, 100, 153, 183, 196, 197, 201, 203, 206, 207, 208, 209, ΣPBDE	TSH: (+) for BDE 85 (-) for BDE 207	*ND*	NS

*Basic format of table taken from Abdelouahab et al. 2013.

NS= not significant

ND= no data

Eight studies did not find statistically significant results for PBDEs and TSH association. Mazdai et al. 2003 did not measure TSH while studies Chevrier et al. 2010 and Zota et al. 2011 found different directions of associations between PBDEs and TSH. Of the studies that measured Free and Total T3, results varied, but there were more negative than positive associations between them and the PBDEs measured. Measuring Free and Total T4, studies were almost split on negative and positive associations. However, it is important to note that when looking across these studies, different congeners presented the statistically significant associations.

Although there is not a clear consensus on which congeners have either a positive or a negative association with thyroid function, these results are still relevant for healthcare providers, users and policy makers. Namely, a number of the congeners do present a statistically significant association with thyroid activity, particularly 47 and 99. Research has shown repeated associations especially with these two congeners and so caution is warranted.

DISCUSSION

There is not a clear consensus in the literature as to which PBDE congeners have a statistically significant association with pregnant women's' thyroid activity and whether that activity is definitively negative or positive. These results need to be replicated through further research before coming to final conclusions.

Studies varied in their methods of measuring PBDEs and hormones. Some methods were more robust than others, and funding or time restraints may have played a role here. Future studies should present their results in the context of their measurement methods. Additionally, as discussed earlier, studies varied in their choice of PBDE congeners and hormones to measure. Abdelouahab et al. 2013 chose to include thyroid peroxidase antibodies, for example, which are different indicators of thyroid function. Including more congeners and hormones can give a bigger picture and provide unexpected associations, but may make it more difficult to elucidate individual associations between particular congeners and hormones.

Chevrier, et al. 2010 took PBDE and thyroid measurements around the 27th week of gestation. According to Haddow et al., thyroid function could be of the most importance in the first trimester. In this assessment, studies have shown interesting and significant associations later in pregnancy and at birth. Observing changes in PBDE and thyroid hormone levels over the course of a pregnancy and across multiple studies would tell us more about PBDE and hormone interaction.

Many studies look at PBDEs alongside other chemicals, like PCBs or pesticides. It is possible that PBDEs interact with these factors or other elements like iodine, so it is important to control for these covariates. We need to differentiate and understand the effect of PBDEs alone, especially as industry may introduce new chemicals to the market that mimic or replace PBDEs.

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