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Research Article

Understanding the Link between Endocrine Disrupting Chemicals and Diabetes Risk

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ABSTRACT

Introduction: An exogenous substance or chemical combination that interferes with any component of hormone action is referred to as an EDC by the Endocrine Society. EDCs can obstruct the activity and secretion of insulin as well as other pathways that control glucose homeostasis. The well-known plastic hardener bisphenol A (BPA) has a very short half-life (hours) in humans, but due to exposure on a more-or-less daily basis, detectable quantities are still detected in the majority of people in industrialized countries. T1DM development has been linked to exposure to several EDCs.

Results: A meta-analysis of cross-sectional and prospective research, published in 2016, revealed that levels of dioxins, PCBs, organochloride insecticides, and BPA were significantly correlated with the prevalence of diabetes in the cross-sectional setting. To find out whether foetal and prenatal exposure to EDCs causes obesity and later type 2 diabetes, big prospective studies are required.

Conclusion: Several epidemiological studies have suggested an association between EDC and diabetes. Higher exposure to diabetogenic contaminants is an important factor. Further work is needed to validate the association between EDC and diabetes and to more accurately quantify differences in exposure.

Keywords: T1DM, Type 2 diabetes, EDCs, BPA, phthalates.

INTRODUCTION

"An exogenous chemical that interferes with the synthesis, secretion, transport, metabolism, binding action, or removal of natural blood-borne hormones that are present in the body and are responsible for homeostasis, reproduction, and developmental process" is how the US EPA defines an EDC [1].People can be exposed to EDCs through agrochemicals, food, pharmaceutical medications, personal care goods, medical equipment, and even children's toys. EDCs, or environmental discharge contaminants, are now pervasive. Daily-use objects like bottles, food packaging, eyeglasses, pipelines, and other industrial products all include EDCs as an essential component [2]. Diabetes mellitus, obesity, PCOS, infertility, and other endocrinopathies, among others, may develop as a result of interactions with EDCs[3]. EDC has the ability to impair hormone action at every point, from production to receptor activity. People are regularly exposed to EDCs through ingestion, inhalation, or direct skin contact because they are found in many widely used goods [4] .

Epidemiological studies have demonstrated associations between endocrine system dysfunction brought on by exposure to EDCs and neurological, metabolic, and reproductive problems. EDCs can affect physiology by using a wide range of hormonal signaling systems. It has been demonstrated in numerous studies that exposure to EDCs influences the development of obesity in model organisms, either directly or by increasing sensitivity to additional variables such as a high-fat diet [5].Several EDCs that are known to have an obesogenic impact in animals are also connected to a higher prevalence of obesity in people, according to evidence from observational studies [6].Numerous cross-sectional, meta-analytic, and prospective studies have found strong correlations between levels of dioxins, PCBs, organochloride insecticides, and BPA with the prevalence of diabetes; however, the link with phthalates was only weakly significant. Additionally, EDCs interact with adipose tissue receptors, causing differentiation, lipid buildup, and adiponectin inhibition[7].

MATERIALS & METHOD

Finding all studies that looked at links between EDC exposure and the risk of diabetes mellitus was the goal of the literature search.

Web of Knowledge, Google Scholar, and PubMed was used in a thorough search. A search in

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PubMed for "(EDC) AND (Diabetes mellitus) AND ((Human) OR (Animal))" produced 192 articles.

RESULT

In laboratory research, it has been demonstrated that phthalates and the powerful dioxin TCDD affect insulin secretion in isolated rat pancreatic cells and a rat insulin-secreting beta cell line. In the beta cell line INS-1E, TCDD has also been shown to promote pancreatic cell death by autophagy. TCDD enhanced insulin resistance in insulin-sensitive organs such as the liver, skeletal muscle, and adipose tissue of the guinea pig, possibly through down regulating glucose transporters. It has been noted that the insecticides malathion and diazinon have an impact on beta cells that secrete insulin, in part through down regulating muscarinic receptors. Di(2-Ethylhexyl) phthalate (DEHP) has been demonstrated to cause hyperglycemia, hyperinsulinemia, and a decreased beta cell mass in rats when exposed to it during pregnancy. Organochloride insecticides inhibited pancreatic INS-1E beta cells ability to secrete insulin in vitro. According to rodent research, exposure to BPA, insecticides, nonylphenol, and PFOA during pregnancy or the first few months after birth increases weight growth in adults in a dose- and gender-dependent way.

Human research has also discovered a connection between prenatal EDC exposure and an increased risk of obesity in adulthood. BPA stimulates the conversion of 3T3-L1 preadipocytes into adipocytes, promotes the inheritance of fat across generations, and raises obesity in vivo. Animals exposed to the food ingredient carboxymethylcellulose develop adipogenesis in vitro and become obese.

Table 1:

Author	Study design/sample size	Result
Lang et al	Cross-sectional, n=1455	Increased type-2 diabetes diagnosis was substantially correlated with higher urine BPA levels[8].
Shankar et al	Cross-sectional, n=3967	Increased type-2 diabetes was substantially linked to higher urine BPA levels.
Ning et al	Cross-sectional, n=3423	As evaluated by blood glucose, higher urine BPA had a moderately positive correlation (trend) with increasing diabetes.
Melzer et a	Cross-sectional, n=2948	Type-2 diabetes, cardiovascular disease, and liver enzymes were all substantially correlated with higher urine BPA levels.
Silver et al	Cross-sectional, n=4389	A substantial positive relationship between type-2 diabetes incidence and higher urine BPA levels and haemoglobin A1c was found[9].
Wolff et al	Cross-sectional, n=90	Girls with a BMI in the 85th percentile or higher had considerably lower urine BPA levels[10].
Wang et al	Cross-sectional, n=3390	Greater BPA levels in the urine were found to significantly correlate with higher BMI, abdominal obesity, and insulin resistance.
Wei j et al	Wistar rat	Effects of BPA exposure on body weight, lipid homeostasis, glucose tolerance, insulin resistance, plasma insulin, and cell mass
Alonso et al	Mice	Measurements of cell mass and proliferation in response to BPA exposure include changes in body weight, glucose tolerance, insulin sensitivity, insulin, leptin, triglycerides, and glycerol plasma levels[11].
Kim and Park	Cross-sectional, n=1210	A higher diagnosis of diabetes was sporadically correlated with higher urine BPA levels. There were substantial relationships between BPA and type-2 diabetes, and other demographic characteristics were significant confounders[12].
Carwile and Michels et al	Cross-sectional, n=2747	Higher BMI and waist circumference were substantially correlated with higher urinary BPA[13].

CONCLUSION

Human and animal studies show a positive correlation between exposure to EDCs and the risk of Diabetes. Studies on other EDCs are scarce and were mainly focused on Bisphenol-A. The paucity of animals and *in Vitro,* studies are also seen. EDC like BPA, TCDD, and phthalate exposure may increase the risk of diabetes on exposure. Further studies are needed to validate the relationship. Fewer studies were done on the Asian population. Most of the studies are cross-sectional, therefore, another study design is further needed.

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