

The role of Parabens in Diabetes

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Abstract

Parabens are esters of p-hydroxybenzoic acid and have been used as preservatives for personal care products, pharmaceuticals, cosmetics, and foods attributable to their anti-microbial and anti-fungal properties. Diabetes mellitus is a metabolic disease characterized by an increase in the concentration of sugar in the blood [hyperglycemia] and a disturbance of glucose metabolism, either as a result of decreased insulin secretion or due to a decrease in the sensitivity of the body's cells to insulin. It has been found association between urinary paraben levels in early pregnancy and Gestational diabetes. The purpose of the review is the association between parabens and diabetes. While previous studies have assessed the association between endocrine disruptors and conditions that are often comorbid with or predispose to diabetes, the literature lacks large population studies examining the association with diabetes. However, studies showed that butylparaben concentrations were positively associated with glucose levels, propylparaben concentrations negatively associated with glucose levels in pregnant women.

INTRODUCTION

A. PARABENS

Parabens are esters of p-hydroxybenzoic acid [PHBA] [Fig.1] and have been used as preservatives for personal care products, pharmaceuticals, cosmetics, and foods attributable to their anti-microbial and anti-fungal properties.

For many years parabens were a revolution in the field of preservatives in cosmetology. The popular use of parabens in cosmetic products to date is related to a series of properties displayed by these molecules. These are:

- their broad spectrum of activity against a large number of microorganisms
- their global legislative acceptance

- their great biodegradability
- their low cost
- their excellent chemical stability in a wide range of pH values and the change in temperature. Also, combinations of two or more parabens with different solubility are often sought and found, so that ultimately the life of the product can be increased with a simultaneous spectacular reduction of microbial contamination.

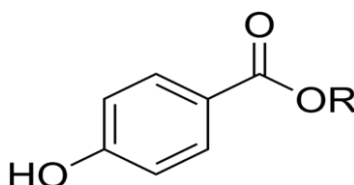


Figure 1. Chemical structure of parabens.

In cosmetics, it is allowed to preserve cosmetic products with Parabens at a maximum total concentration of the combination used up to 0.8% by weight. Products containing parabens can be used on different parts of the body and used both occasionally and on a daily basis. In the second case, the frequency and duration of the application [and consequently the exposure of the skin to these molecules] can be long and lasting. The ability of parabens to penetrate the stratum corneum of the skin increases with the increase in the lipophilic character of their molecule. However, even small rates of penetration of substances into the skin could cause a significant amount of such substances to penetrate the body at an overall level, considering that many cosmetic products are used on large areas of the skin. It is obvious that local exposure of people to parabens will largely depend on the way the product is manufactured, as already mentioned above.

Studies on the estrogenic nature of parabens have been increasing, with the aim of investigating whether and to what extent these substances affect the endocrinological and reproductive systems of living organisms. Estrogens are an important factor attributed to causing breast cancer cells to grow and increase in mass [2,4,7,8].

B. DIABETES MELLITUS

Diabetes mellitus DM is a metabolic disease characterized by an increase in the concentration of sugar in the blood [hyperglycemia] and a disturbance of glucose metabolism, either as a result of decreased insulin secretion or due to a decrease in the sensitivity of the body's cells to insulin. Type 1 diabetes is characterized by destruction of the β -cells of the pancreas, which are responsible for the production of insulin, resulting in a total lack or minimal secretion of insulin. Cell sensitivity to insulin is usually normal, especially in the early stages. This type is the main cause of diabetes in children, but it can also affect adults. The destruction of the β -cells of the pancreas is in the majority of cases of autoimmune etiology. In the majority of patients with type 1 diabetes, one or more types of autoantibodies are detected in the circulation, and these patients show an increased predisposition to other autoimmune diseases as well [1,3]. Type 2 diabetes is the most common cause of diabetes in adults. A major predisposing factor for the development of type 2 diabetes is obesity. Obesity predisposes to the development of insulin resistance probably due to the production of substances from the adipose tissue that reduce the sensitivity of cells to insulin. Other predisposing factors are age and family history [5,6]. The relationship between obesity and type 2

diabetes has been known for decades, and the recent significant increase in such diseases represents a major medical problem worldwide. The dominant factor in obesity is a permanent increase in plasma free fatty acids and inflammatory factors and a predominant use of lipids by muscle, causing a decrease in glucose uptake and, therefore, insulin resistance [9,10,11,12,13]. The increase in insulin secretion appears to be a compensatory mechanism in response to elevated circulating glucose levels. Gestational diabetes GDM is the appearance of diabetes mellitus for the first-time during pregnancy. This type is similar to type 2 diabetes in that it is characterized by both decreased insulin secretion and decreased sensitivity of cells to insulin. Obese women are more likely to develop gestational diabetes. This type of diabetes affects 3-5% of pregnancies.

PURPOSE

The purpose of the review is the association between parabens and diabetes.

RESULTS

A study among the 2005-2014 NHANES population (civilian population of all ages residing in all 50 states and Washington D.C, a representative sample of about 5,000 persons each year) suggested that increased urinary concentrations of triclosan, Benzophenone-3 (BP-3) and propyl, butyl, ethyl, and methyl parabens were associated with decreased diabetes odds [19]. The relationship for BP-3, triclosan, butyl paraben, ethyl paraben, and methyl paraben did appear to be stronger between individuals with Body Mass Index, BMI<30 vs. BMI≥30 kg/m² and for propyl paraben stronger among those with BMI≥30 kg/m².

Parabens can mimic the action of estrogen and bind to receptors on cells that normally bind to estrogen. When estrogen binds to these receptors, the cells multiply and this means an increased risk of cancer and in the case of women, breast cancer [20]. Bisphenol A also inhibited 17 beta-estradiol induced ERK1/2 activation in developing cerebellar neurons via activation of multiple transcription factors resulting in effector protein synthesis and causing changes in cell proliferation. Also, Reactive oxygen species, ROS, can induce oxidative damage of DNA, activate

DNA repair enzymes inducing ERK1/2 activation [21].

An epidemiologic study showed that first-trimester urinary butylparaben concentrations were positively associated with glucose levels and propylparaben concentrations were negatively associated with glucose levels in pregnant women [14,15]. At the same time, chemical risk factors for obesity and DM have been identified. Exposure to DEHP [Bis[2-ethylhexyl] phthalate] and BzBP [Monobenzyl phthalate] has been associated with obesity. In addition, higher concentrations of ethyl paraben and Bisphenol A in urine were found to be associated with obesity and DM [18]. Phthalates can prescribe adipocyte differentiation by inducing Peroxisome Proliferator Activated Receptor gamma [PPAR γ], also known as the glitazone reverse insulin resistance receptor. In a recent study of premenopausal Korean adult female population, urinary EtP concentrations were associated with increased serum adiponectin [16,17]. The potential involvement of EtP in the development of obesity and DM should be further evaluated in populations with high EtP exposure [18]. The continued presence of many phenols and parabens in commonly products, may permit for a more extensive comprehension of their association with diabetes in future studies.

CONCLUSION

The aim of this review is the association between parabens and diabetes. Parabens are esters of p-hydroxybenzoic acid [PHBA] and have been used as preservatives for personal care products, pharmaceuticals, cosmetics, and foods attributable to their anti-microbial and anti-fungal properties. The continued presence of many phenols and parabens in commonly products, may permit for a more extensive comprehension of their association with diabetes in future studies.

Conflicts of Interest: The author declares no conflicts of interest regarding the publication of this paper.

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