Possible effect of triclosan exposure on the gut microbiome and on obesity traits in humans

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Microbiology Degree, 2019/2020

1. INTRODUCTION

Triclosan is an ubiquitous chemical with activity against bacteria and fungi commonly found in products used on a daily basis, ranging from household disinfectants to toothpastes or even textiles[1]. Although this chemical has been widely incorporated into consumer products, factors such as the extent to which its exposure perturbs microbial communities in humans and if these perturbations are associated with any chronic condition, such as obesity, are still under study[2,3]. These uncertainties make the constant exposure to triclosan become a topic of concern.

OBJECTIVE: The aim of this review is to examine previous studies existing assessing the possible effect of triclosan over the human microbiome and over obesity.

2. EFFECT OF TRICLOSAN OVER HUMAN MICROBIOME

2.1. RESULTS

Subjects		Measures		Findings	
	Mothers [2]	Triclosan	**Urine**	↑ Triclosan*	↓ Triclosan*
		Microbiome	**Fecal**	↑ ***Proteobacteria***	–
	Infants (<1 y/o) [2]	Triclosan	**Urine**	↑ Triclosan*	↓ Triclosan*
		Microbiome	**Fecal**	–	↑ ***Bacteroidetes fragilis***
[Single spot]	Mothers [4]	Triclosan	**Breast milk**	↑ Triclosan*	↓ Triclosan*
[Single spot]	Infants (<1 y/o) [4]	Microbiome	**Fecal**	↑ ***Proteobacteria*** ↑ *Actinobacteria*	↑ *Firmicutes*
[Single spot]	Adults (≥20 y/o) [5]	Triclosan	**Urine**	No association	
		Microbiome	**Enterolactone**		

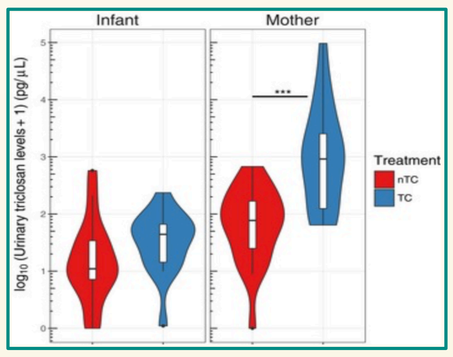

Figure 1. Urinary triclosan measures for 38 mothers (17 using triclosan products (TC) and 21 using triclosan-free products (nTC)) and for 22 infants (15 TC and 18 nTC). The black line represents the median value and the box plot the interquartile range. The violin plot represents the full range of values, where width of the colored region represents the probability density of sample values at that level. The P-value is P=5.66e-5 (Mann- Whitney U-test) represented by ***. Ribado *et al*., 2017.

The strong emergence of *Proteobacteria* was observed after patients started using triclosan-containing **toothpaste,** which could explain the higher difference on triclosan levels observed in mothers and not in infants (Fig.1). [2]

2.2. DISCUSSION

Infants from the group with lower triclosan levels* presented a higher relative abundance of ***B. Fragillis***, a promoter of the maturation of the immune system and a protector from inflammatory diseases[6], while mothers and infants from the group with higher triclosan levels* showed a strong enrichment of ***Proteobacteria***, which has been proposed as a potential diagnostic criterion for disease[7]. These differential abundances could result in potential **health implications**. A speculative explanation to the no association found when analysing the microbiome through bacterial **enterolactone** could be the resistance of the bacterial species involved in enterolactone production to low-dose triclosan concentrations.

3. EFFECT OF TRICLOSAN OVER OBESITY TRAITS

3.1. RESULTS

Subjects		Measures		Findings	
[Single spot]	Adults (20-85 y/o) [3]	Triclosan	**Urine**	High triclosan levels**	Medium & low levels**
		Obesity	**BMI**	–	Increase of 1.29 BMI (kg/m^2)
[Single spot]	Adults (≥20 y/o) & Kids (6-19 y/o) [8]	Triclosan	**Urine**	↑ Triclosan*	↓ Triclosan*
		Obesity	**BMI & waist circumference**	↓ BMI & waist circum. Higher impact on female	–
	Mothers & infants (until age of 8) [9]	Triclosan	**Urine**	No association	
		Obesity	**BMI & waist circumference**		

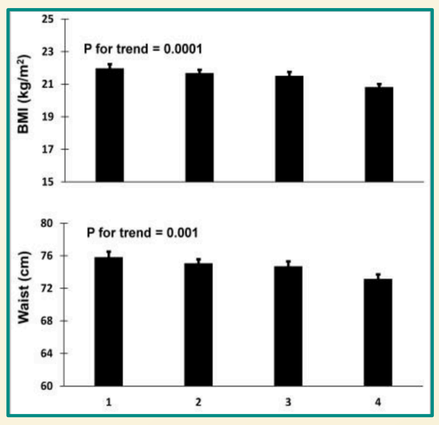

Figure 2. BMI (Body Mass Index) and waist circumference according to the urinary triclosan concentrations in 2.898 US children (6-19 years old) from samples obtained in 2003-2010. P values are adjusted for possible confounders. 1. Low urinary triclosan concentration. 2. Middle-low urinary triclosan concentration. 3. Middle-high urinary triclosan concentration. 4. High urinary triclosan concentration. Li *et al*., 2015.

3.2. DISCUSSION

Studies on the association between urinary triclosan and obesity traits showed associations to be either **positive**[3], **negative**[8] or even **absent**[9]. Considering that urinary triclosan levels depend more on **recent rather than sustained exposure**[10] and that most studies are based on **single-spot** urine samples, a potential for exposure misclassification could explain the variety of results presented. However, while others using multiple measures might seem more reliable, **confounders** not taken into consideration might also strongly influence their result. Additionally, lower triclosan concentrations having in some cases a greater impact than higher ones could be explained due to the possibility of triclosan affecting some microbial colonizers at **lower doses** than others[3].

4. CONCLUSION

Human triclosan exposure has been associated with differentially abundant species in the human microbiome. The important role of the gut microbiome on infant's health later in life highlights the need for increased consumer safety testing of everyday use products containing triclosan.

Being still incomplete, the association between triclosan exposure and obesity awaits further investigation.

* ↑ Triclosan refers to the subjects of study provided with triclosan-containing products, the ones whose surveys indicated use of triclosan or the ones with high levels of triclosan detected. ↓ Triclosan refers to the subjects of study not provided with triclosan-containing products, the ones whose surveys indicated no use of triclosan or the ones with low/non-detectable levels of triclosan. ** Differences observed when compared to the group of subjects showing non-detectable triclosan concentrations.

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