The headline image of the University of Melbourne's Facebook link to its press release about r ecent research on Bisphenol A (BPA) is of a takeaway coffee cup. The kind that does not have any BPA in it at all [1]. The headline "Obesity Link to BPA" directly below the image of the cup is guaranteed to cause unwarranted consternation in consumers of our favourite takeaway beverage which I'm sure the researchers did not intend.

Bisphenol A (BPA) is one of the most recognizable chemicals to the general public. A component of some kinds of hard plastics, plastic liners for tins (but not paper cups) and certain kinds of thermal paper , it has generated quite a lot of concern as BPA is a mimic of the hormone estrogen.

However, it is a very weak mimic of estrogen (and some other hormones). BPA is typically 10,000 to 100,000 times weaker than estrogen (see for example here). BPA may also act through some other pathways, but again it is not very strong. Studies of our exposure to BPA have consistently shown that we have a safety margin of about 100-1000 fold between the threshold for BPA to produce biological effects and the levels in our bodies.

Still, we are not cavalier about BPA's presence in our environment and studies continuously reevaluate BPA's potential for harm, which is where this latest study from the University of Melbourne comes in.

So what did the researchers do?

They took cow embryos and placed them in tissue culture conditions . They then exposed them for four days to either BPA at 1 or 10 nanogram per millilitre of tissue culture solution (1ng/mL) or estrogen at 1 or 10 ng/mL [2]. To make sure that BPA was working through estrogen receptors they also exposed some of the embryos to a combination of BPA and a specific blocker of estrogen receptors.

What did they find?

Both 10 ng/mL BPA and estrogen reduced the number of 8 cell embryos that progressed to blastocysts by around 7% (1 ng/ml of BPA and estrogen had no significant effect). Roughly 10% fewer of the 10 ng/mL treated blastocysts were of implantation quality.

What about obesity where does that fit in?

In embryos treated 10 ng/mL of either BPA or estrogen, there was a roughly 50% increase in glucose uptake and lactate production. This increase was prevented by the selective estrogen receptor blocker (the 1 ng/mL concentration of BPA had no effect).

That's it?

While there is no direct evidence that increased glucose uptake and utilisation in the embryo will cause obesity later in life, it is at least plausible that this could somehow predispose organisms to obesity later in life.

So should we be worried?

Not really, as well as the link being weak, there are two key issues which means that the relevance to humans is limited.

One is that the concentrations used in the study are very unlikely to be achieved in the human body under normal conditions. 10 ng/mL is a really tiny quantity, and it is hard to visualise this [2], but the quantities in the human body are even smaller, on the order of picograms/mL (that is a thousand times less).

Measuring the levels of BPA in blood and biological fluid accurately is very difficult. BPA is very rapidly metabolised, most of BPA in the circulation is inactive metabolites. Not only do the low levels stretch the limits of our measuring devices, but BPA present in the plastics that are used to draw and store blood and other biological fluids can contaminate these fluids, giving spuriously high readings.

Very careful measurements and studies using BPA where the hydrogen atoms have been replaced with a heavier isotope of hydrogen (deuterium) have shown that levels of BPA in blood (and hence other body fluids) are well below the 1ng/mL concentration that had no effect in this study (see also here). This is backed up by back calculation from measurement of urinary excretion of BPA and its metabolites.

Another check is calculation of intake from foods and the environment. These show that intake of BPA is 100 to 1000 times less than the new, temporary European Food Safety tolerably daily intake of 4 micrograms per kilogram body weight (which is 1,000 times lower than the lowest levels that show no effect in animal studies).

Recent studies of food exposure from Australian foods showed very low intake levels (with the new limits, you only need to consume 10 cans of soup a day of the soups with the highest BPA content to reach the tolerably daily intake).

So, altogether the evidence is that human levels of BPA are well below the levels that produce these metabolic effects in these cow embryos.

Another issue is the response to BPA. Remember how I said that BPA is 10,000-100,000 times weaker than estrogen? This has been shown in numerous receptor and functional studies, including studies on human estrogen receptors. In the current cow embryo studies BPA and estrogen were approximately equally effective, and the blocker study confirmed that the effect of BPA was through the estrogen receptor, not some novel mechanism (as in this study).

This implies that cow embryo estrogen receptors are different to human receptors and that any extrapolation to humans must be made very carefully.

The take home message?

Don’t panic over BPA and obesity. You are very unlikely to reach the bodily levels of BPA that will cause disruption of glucose metabolism in early embryos. Of course, as I have said before, the best way to reduce BPA intake is to eat fresh, rather than pre-prepared foods, especially fresh fruit and vegetables as Australians in general do not eat enough fresh fruit an vegetables (and eat too many calories, and don’t exercise enough).

Another take home message is to make sure the containers you use to illustrate your press release actually do have BPA in them. You may be consuming too many calories from the milk and sugar in your takeaway coffee, but BPA? No.

[1] I can’t link directly to the Facebook advertisement. The main illustration on the University of Melbourne press release webpage is cans of soft drink, these do not measurably contribute to BPA intake . It also has the takeaway coffee cup, which is lined with polyethylene , not BPA containing plastic.

[2] A milligram will cover the head of a pin, a microgram would be a single speck on the head of a pin, you would need a microscope to see a nanogram. In contrast, a teaspoon full of sugar is around 4 grams, one teaspoon in a 250 mL coffee will result in 20 milligrams per millilitre (mg/mL) coffee. Now dilute that a million times and you will get 20 ng/mL.

Disclosure

Ian Musgrave receives funding from the National health and Medical Research Council to study contaminants in herbal medicines. He has recieved ARC funding for studying Alzheimer's disease in the recent past.He is a member of the Science Communicators South Australian Branch.

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