# Are all ultra-processed foods bad for health? – Author's reply

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Monteiro and Rezende raise several points regarding our investigation into food processing and incident type 2 diabetes mellitus (T2DM).[1]

Evidence grows regarding ultra-processed food (UPF) and associations with poor health outcomes.[2] However, as the authors highlight is important,[3] few studies have examined UPF sub-groups, and any potential heterogeneity in their association with health outcomes. We therefore aimed to address this important question.[1]

Our paper did not directly compare the associations between the same food across processing groups (i.e., non-UPF vs. UPF fruit), instead assessing whether any sub-groups were inversely associated with incident T2DM. Indeed, we found that consuming more of some UPF (e.g., breads, biscuits, breakfast cereals, and plant-based alternatives) in place of non-UPF was associated with lower incident T2DM. If several UPF can be consumed instead of non-UPF with beneficial outcomes associated, then the most pragmatic public health implication is that efforts should focus foremost on UPF sub-groups positively associated with incident T2DM. Importantly, our implication does not argue against the value of an overall UPF metric for other health outcomes, nor promote consumption of UPF.

Issues of multicollinearity, false-positives and residual confounding apply across nutritional epidemiology. For example, overall UPF was implausibly positively associated with accidental death in a negative control analysis.[4] We already acknowledged the potential for confounding and measurement error, and false positives regarding sweets and desserts.[1] Even so, studies from other countries also report that artificially-sweetened and sugar-sweetened beverages (ASB/SSB), animal-based products and ready meals are positively associated, yet breads and breakfast cereals are inversely associated, with T2DM.[5] The same goes for wider cardiometabolic diseases,[6] suggesting consistent findings.

When presented by weight, energy dense foods such as UPF tend to contribute a smaller proportion to total intake, with larger contributions from beverages. With the large sample size of over 300,000 participants and relative sub-group intakes varying by 50–100% across quartiles of UPF (except savoury snacks), there are significant and relatively narrow confidence intervals for most sub-groups.[1] Similar magnitudes were reported for animal-based product intake,[1] with positive associations consistent with other studies.[5]

We feel the authors have misrepresented the implication, which is specific to T2DM. We made no implications beyond T2DM, given the range of poor health outcomes associated with UPF reported in an umbrella review,[2] as acknowledged in our paper.[1] Despite this, for reducing T2DM, it is reasonable at the very least to question an overall UPF metric as the most helpful public health strategy, and to focus on reducing specific UPF, for several reasons. First, our findings show significant heterogeneity across UPF sub-groups with T2DM, not just neutral associations, but several UPF with beneficial outcomes when consumed in place of non-UPF. This is not the first study to report this for T2DM, as outlined in our paper.[1] Second, with an overall UPF metric, it is important to consider that if several UPF sub-groups have large positive associations with poor health outcomes, combining these sub-groups with UPF sub-groups with inverse associations into a single overall UPF metric would plausibly result in an overall UPF metric with positive associations. For example, in the United States, SSBs and processed meats largely explain the overall UPF association with cardiovascular disease outcomes, and for stroke, when SSBs and processed meats are excluded, overall UPF even becomes inversely associated.[6] This is plausibly the case in our study as well.[1] As the umbrella review did not conduct sub-group analyses,[2] it is unclear if these associations are also just simply driven by specific UPF sub-groups. However, it is plausible that all UPF sub-groups may have positive associations with different health outcomes, but this is largely unknown.

Researchers investigating UPF all aim to improve public health, by reducing morbidity and premature mortality. Our pragmatic interpretation of the results aligns existing dietary guidance with growing evidence on UPF, without unnecessarily implementing guidance before sufficient evidence warrants it.

**References**

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