Bisphenol A (BPA) in Human Serum and Urine: Exposure via Dermal Absorption from Thermal Paper Receipts and Oral Ingestion after Transfer from Hand to Food

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Abstract

Bisphenol A (BPA) exposure is thought to be mainly due to absorption from the gut by oral ingestion. Thermal receipt paper represents another potential source of BPA exposure via direct absorption through the skin or indirectly via transfer of the chemical to food. Examination of BPA in thermal receipt from local businesses were used to determine whether handling thermal receipt paper prior to eating food effects serum and urine BPA concentrations. Measurements of BPA in 51 receipts were taken to assess the amount of the BPA on receipts. Blood and serum measurements from human participants were taken: Controls (n=10) with no manipulation, participants exposed to BPA in thermal paper either dermally (n=24) or dermally and orally (n=10) after a two-day period of avoiding exposure to BPA. BPA was present in 46% of the receipts measured (mean $\pm$ SEM: 19.7 $\pm$ 1.0). The amount of BPA transferred to hands was about 100-fold higher when wet with hand sanitizer than dry. BPA transferred to wet hands and then consequently to French fries that were eaten. This resulted in significant elevation of unconjugated serum BPA from a baseline of 0.28.5 $\pm$ 1.2 to a maximum of 5.9 $\pm$ 2.6 ng/ml after 60 min. With total urine BPA (μ g/g creatinine) 0.5 $\pm$ 0.2 at baseline and 23.4 $\pm$ 7.4 at 90 minutes after being exposed from a receipt that contained 27.2 mg BPA/g receipt paper. Serum concentrations were suggestive of both oral and dermal BPA transmission. In conclusion, thermal paper is a significant source of BPA exposure that regulatory agencies have not included in exposure estimates.