

William Funk
104 Braswell Ct
Chapel Hill, NC 27516
USA
Email: wefunk@unc.edu

Exposure biomarkers in newborn dried blood spots

William E. Funk* Stephen M. Rappaport, Suramya Waidyanatha (University of North Carolina at Chapel Hill, School of Public Health, Department of Environmental Sciences & Engineering, Chapel Hill, NC, USA), Shu H. Chaing (North Carolina State Laboratory of Public Health, Raleigh, NC, USA)

Background: 1,4-Benzoquinone (1,4-BQ) is a putative leukaemogenic metabolite of benzene that modifies DNA and proteins. Because proteins are more abundant in blood than DNA and are not susceptible to repair processes, protein adducts offer advantages over DNA adducts as biomarkers of exposure to chemical electrophiles such as 1,4-BQ. In this study we use newborn dried blood spots (DBS) to measure 1,4-BQ adducts of haemoglobin (1,4-BQ-Hb) as biomarkers of prenatal exposure to 1,4-BQ.

Hypothesis: Measuring protein adducts in newborn DBS offers an opportunity to assess fetal exposures to toxic chemicals. Exposure to 1,4-BQ is of specific concern because 1,4-BQ has been linked to leukaemia in adult populations and because leukaemia is the most common form of childhood cancer.

Methodology: Globin was isolated in high purity from 20 newborn DBS and 20 DBS obtained from adult volunteers. 1,4-BQ adducts in the globin were derivatized to trifluorothioacetates and detected by gas chromatography-negative-ion-chemical-ionization mass spectrometry.

Results: In 20 newborn DBS the mean level of 1,4-BQ-Hb was 3.59 nmol/g globin (range: 1.25 – 6.82), compared to a mean level of 1.76 nmol/g globin (range: 1.02 – 2.69) in 20 adult DBS. The difference between these mean adduct levels was highly significant ($p < 0.0001$).

Implications: DBS offer a unique resource for measuring protein adducts as biomarkers of prenatal exposure to chemical toxicants. This is apparently the first report of measurements of protein adducts in DBS. We are currently considering possible reasons for the greatly increased levels of 1,4-BQ-Hb in newborn DBS compared to adult DBS.