The impact of multivariate measurement error in epidemiologic studies
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Objectives: The impact of measurement error on observed exposure-disease associations remains an active area of both controversy and continued research. Epidemiologic studies usually assume within-person random error only, therefore ignoring the possibility for systematic, true exposure-related bias. This is problematic especially in nutritional epidemiology where reported dietary exposures display more complex error structure. Moreover, multiple exposures measured with error are often mutually adjusted in disease models. Extending previous work to multiple error-prone variables with realistic measurement error structures, we aimed at identifying when true associations can be masked or made spurious.

Methods: We used numerical calculations to cover multiple scenarios of measurement error and true multivariate associations between exposure, confounders and disease. We evaluated the sensitivity of observed exposure-disease associations to those parameters and identified situations in which true risks were attenuated, inflated, or altered in direction. As an illustration, we considered measurement error parameters estimated from the Observing Protein and Energy Nutrition study that used both biomarkers and questionnaires.

Results: We found attenuated risk in most, but not all, scenarios. Plausible measurement error structure and exposure-confounder-disease associations could indeed yield inflated or reversed risks. Moreover, in a large proportion of the scenarios where attenuation was found, the observed risk was rather suggestive of a null association.

Conclusion: This work provides useful—if sobering—insight into the extent to which investigators may be misled by distorted exposure-disease associations resulting from the effect of multivariate measurement error.