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# A Cross-sectional Analysis of Prenatal Bisphenol an Exposure and Pregnancy Characteristics in Northeastern Yunnan, China

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**Abstract:** *Objective*: To assess prenatal Bisphenol A (BPA) exposure levels and explore their preliminary associations with maternal and fetal characteristics in a population from Northeastern Yunnan. *Methods*: A cross-sectional analysis was performed using data and urine samples from 70 pregnant women in their third trimester recruited at Qujing Central Hospital. Urinary BPA was measured by HPLC-MS/MS. Participants were stratified into high and low BPA exposure groups based on the median concentration. *Results:* BPA was detected in all samples (100%) with a median concentration of 2.41 μg/L (IQR: 0.68–4.96). The high BPA exposure group (≥ 2.41 μg/L) had a significantly higher proportion of gestational diabetes mellitus (GDM) (42.9% vs. 17.1%, $p = 0.021$) and a lower median fetal birth weight (3250 g vs. 3450 g, $p = 0.048$) compared to the low exposure group. *Conclusion:* This pilot study reveals ubiquitous BPA exposure in pregnant women from Northeastern Yunnan. The observed preliminary associations with GDM and reduced fetal birth weight warrant further investigation in larger, longitudinal studies.

**Keywords:** Bisphenol A; Pregnancy; Exposure assessment; Cross-sectional study; China

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## 1. Introduction

Bisphenol A (BPA) is a widespread endocrine-disrupting chemical, and pregnant women and fetuses are vulnerable to its effects [1]. Studies have linked prenatal BPA exposure to adverse pregnancy outcomes (APOs) like gestational diabetes mellitus (GDM) and fetal growth restriction [2–5]. However, data on exposure levels and their potential health implications in specific Chinese industrializing regions like Northeastern Yunnan are scarce. Therefore, this study aimed to conduct a preliminary assessment of urinary BPA concentrations in late pregnancy and explore their associations with key maternal and fetal characteristics in this understudied population.

## 2. Materials and methods

### 2.1. Study population and design

A cross-sectional analysis was conducted using data from the first 70 pregnant women who completed urine sample collection and BPA measurement in an ongoing prospective cohort at Qujing Central Hospital in Northeastern Yunnan (Data collected between Jan 2022 and Dec 2023). Spot urine samples were collected during the third-trimester prenatal visit. This study represents the initial laboratory analysis from the parent cohort.

### 2.2. Measurement of BPA exposure

Urinary BPA concentrations were analyzed using HPLC-MS/MS (Agilent 1290/6470), a highly sensitive and specific method recommended for human biomonitoring [3]. The limit of detection (LOD) was 0.1 ng/mL. Values below the LOD were replaced by LOD/√2. For this initial analysis, raw urinary concentrations (μg/L) are reported to present the direct measurement results.

### 2.3. Statistical analysis

Participants were divided into two groups based on the median urinary BPA concentration (High Exposure ≥ median; Low Exposure < median). Descriptive statistics were presented as median (interquartile range, IQR) for continuous variables and number (percentage) for categorical variables. Differences between groups were tested using the Mann-Whitney U test for continuous variables and the Chi-square or Fisher's exact test for categorical variables. All analyses were performed using SPSS (Version 26.0), and a two-tailed $p$-value < 0.05 was considered statistically significant.

## 3. Results

BPA was detected in all 70 urine samples (100%). The median urinary BPA concentration was 2.41 μg/L (IQR: 0.68–4.96; range: 0.06–54.54). As shown in Table 1, women in the high BPA exposure group had a significantly higher prevalence of GDM (42.9% vs. 17.1%, $p$ = 0.021) and gave birth to infants with a lower median birth weight (3250 g vs. 3450 g, $p$ = 0.048) compared to those in the low exposure group. No significant differences were observed in maternal age, gestational age at sampling, weight gain, delivery mode, or low Apgar score proportion.

**Table 1.** Characteristics of the study population stratified by median BPA exposure level

| Characteristic | Total (n = 70) | Low BPA exposure (< 2.41 μg/L) (n = 35) | High BPA exposure (≥ 2.41μg/L) (n = 35) | *p*-value |
|---|---|---|---|---|
| Maternal Age (years), median (IQR) | 30 (27–34) | 31 (28–35) | 29 (26–32) | 0.104 |
| Gestational Age at Sampling (weeks), median (IQR) | 38 (37–39) | 38 (37–39) | 38 (37–39) | 0.789 |
| Gestational Weight Gain (kg), median (IQR) | 14 (12–16) | 114 (11-6) | 14 (12–15) | 0.665 |
| Delivery Mode (Cesarean), n (%) | 49 (70.0%) | 23 (65.7%) | 26 (74.3%) | 0.438 |
| Gestational Diabetes Mellitus (GDM), n (%) | 21 (30.0%) | 6 (17.1%) | 5 (42.9%) | 0.021 |
| Fetal Birth Weight (g), median (IQR) | 3300(2930–3600) | 3450(3210–3700) | 3250(2750–3540) | 0.048 |
| Apgar Score at 1 min < 8, n (%) | 8 (11.4%) | 3 (8.6%) | 5 (14.3%) | 0.456 |
| Urinary BPA (μg/L), median (IQR) | 2.41 (0.68–4.96) | 0.86 (0.32–1.51) | 4.49 (3.25–7.66) | < 0.001 |

## 4. Discussion

In this pilot cross-sectional analysis of 70 pregnant women from Northeastern Yunnan, we found universal detection of BPA in urine during the third trimester [1]. The median concentration observed here provides the first preliminary exposure data for this region. Notably, higher BPA exposure was preliminarily associated with an increased likelihood of GDM and lower fetal birth weight [2,4–6]. These findings are consistent with the known endocrine-disrupting properties of BPA, which may interfere with glucose metabolism and fetal growth pathways [1,2].

The primary strength of this study is the presentation of first-hand, objectively measured exposure data from an understudied population. However, several important limitations must be emphasized. First, the cross-sectional design and small sample size preclude causal inference and limit statistical power. Second, the use of a single spot urine sample and reporting of uncorrected concentrations may introduce exposure misclassification bias, although it provides a direct snapshot of exposure. Third, despite observing some significant associations, residual confounding by unmeasured factors (e.g., detailed diet, socioeconomic status) cannot be ruled out [6]. Therefore, these results should be interpreted as preliminary and hypothesis-generating.

## 5. Conclusion

This initial analysis confirms widespread prenatal BPA exposure in Northeastern Yunnan and suggests potential associations with maternal GDM and fetal growth that merit further scrutiny. The findings underscore the need for larger, longitudinal studies in this region employing repeated exposure assessments and creatinine-adjusted concentrations to accurately characterize the health risks of BPA exposure during pregnancy.

## Disclosure statement

The authors declare no conflict of interest.

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