

Exploring the exposure to multiple toxic metals and endometriosis risk using Bayesian Kernel Machine Regression: evidence from peritoneal fluid

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INTRODUCTION

Endometriosis (**Fig. 1**) is a chronic gynaecological disorder affecting approximately 7–10% of menstruating individuals worldwide. Its etiopathogenesis remains largely unclear. Emerging evidence suggests that environmental contaminants such as cadmium (Cd), nickel (Ni), and lead (Pb) may contribute to its development.

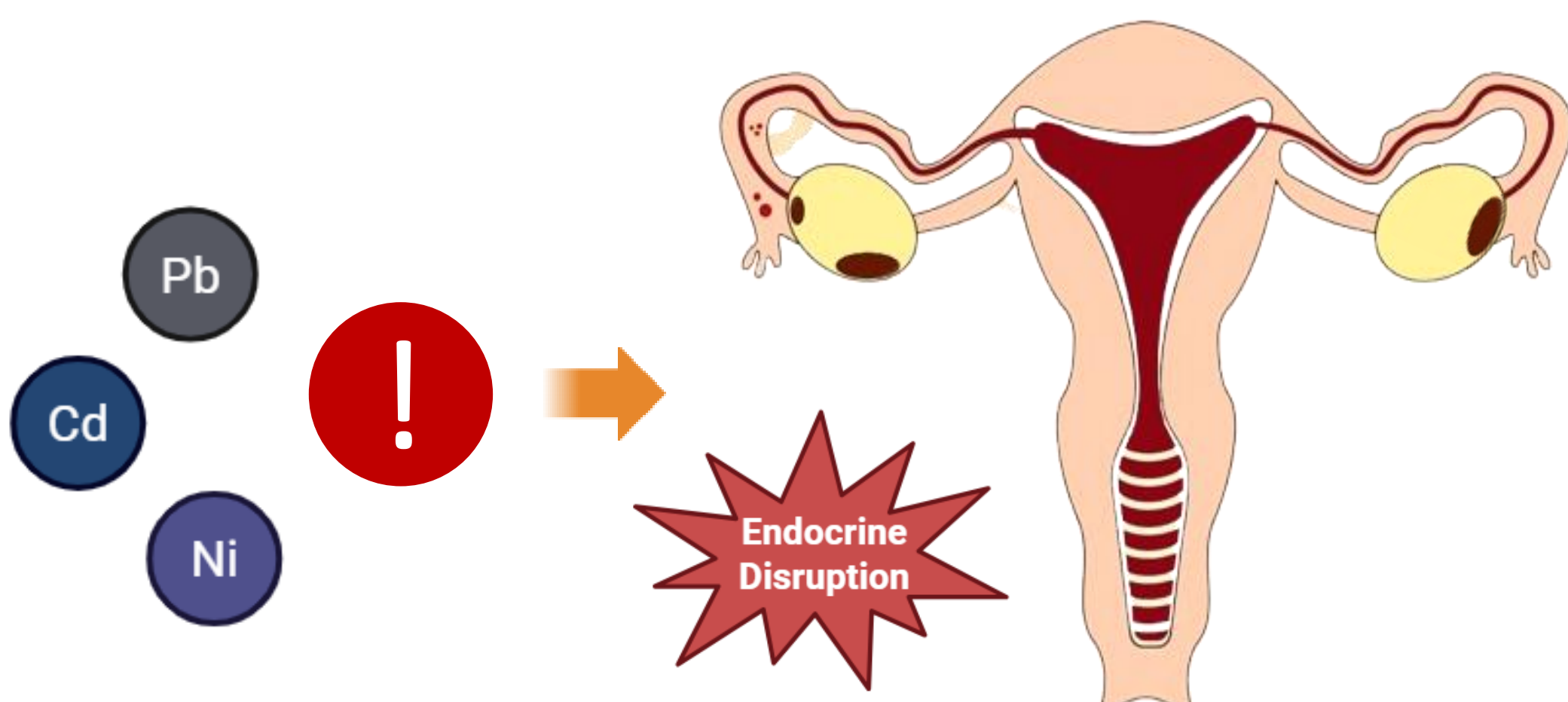


Figure 1. Drawing exhibiting endometriosis.

MATERIALS AND METHOD

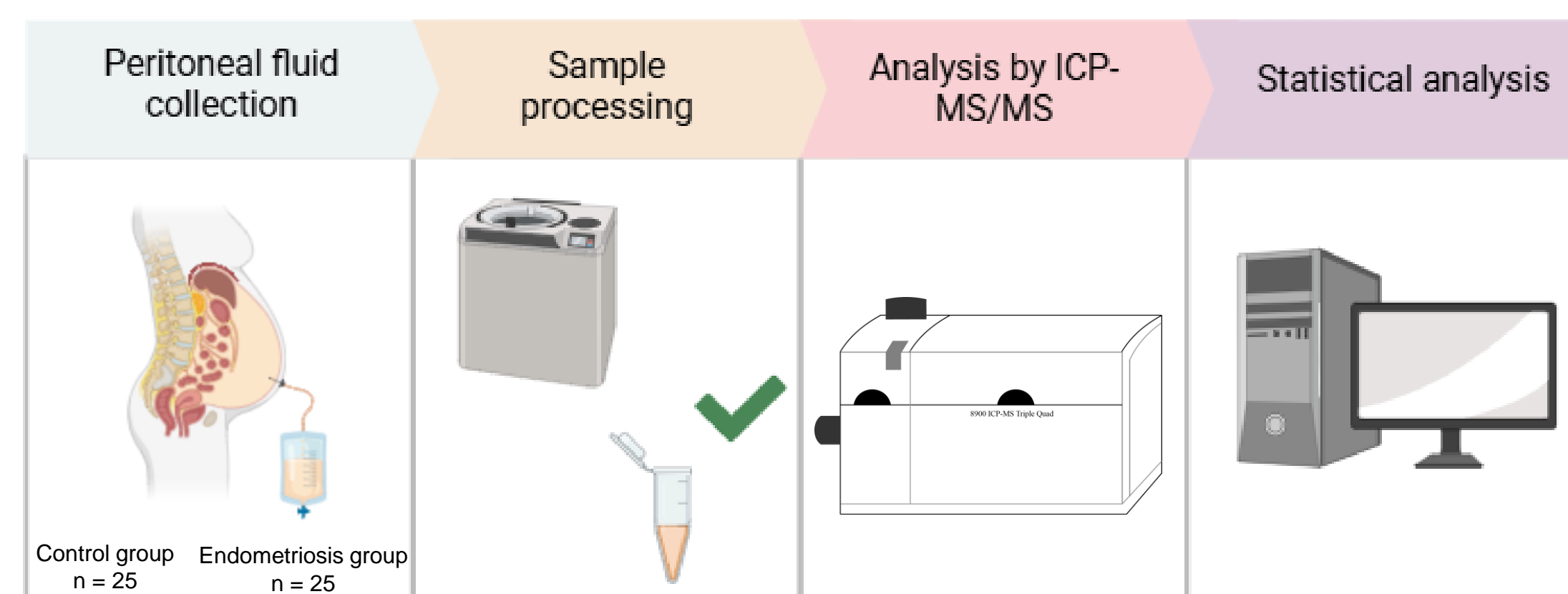


Figure 2. Flowchart illustrating the research process and methods.

CONCLUSION

These findings highlight the importance of considering environmental mixtures in research on reproductive health and gynecological diseases and emphasize the need for larger studies to better understand these associations..

RESULTS AND DISCUSSION

Cadmium levels were significantly higher in the endometriosis group compared to the control group (0.71 ± 0.94 vs. 0.25 ± 0.22 $\mu\text{g/L}$, $p=0.009$) as showed in **Fig. 3A**.

The BKMR model using PF concentrations of Cd, Ni, and Pb revealed a positive trend in endometriosis risk with increasing metal exposure (**Fig. 3B**). However, this combined effect was not statistically significant, and none of the metals showed an independent association with the disease (**Fig. 3C** and **Fig. 3D**).

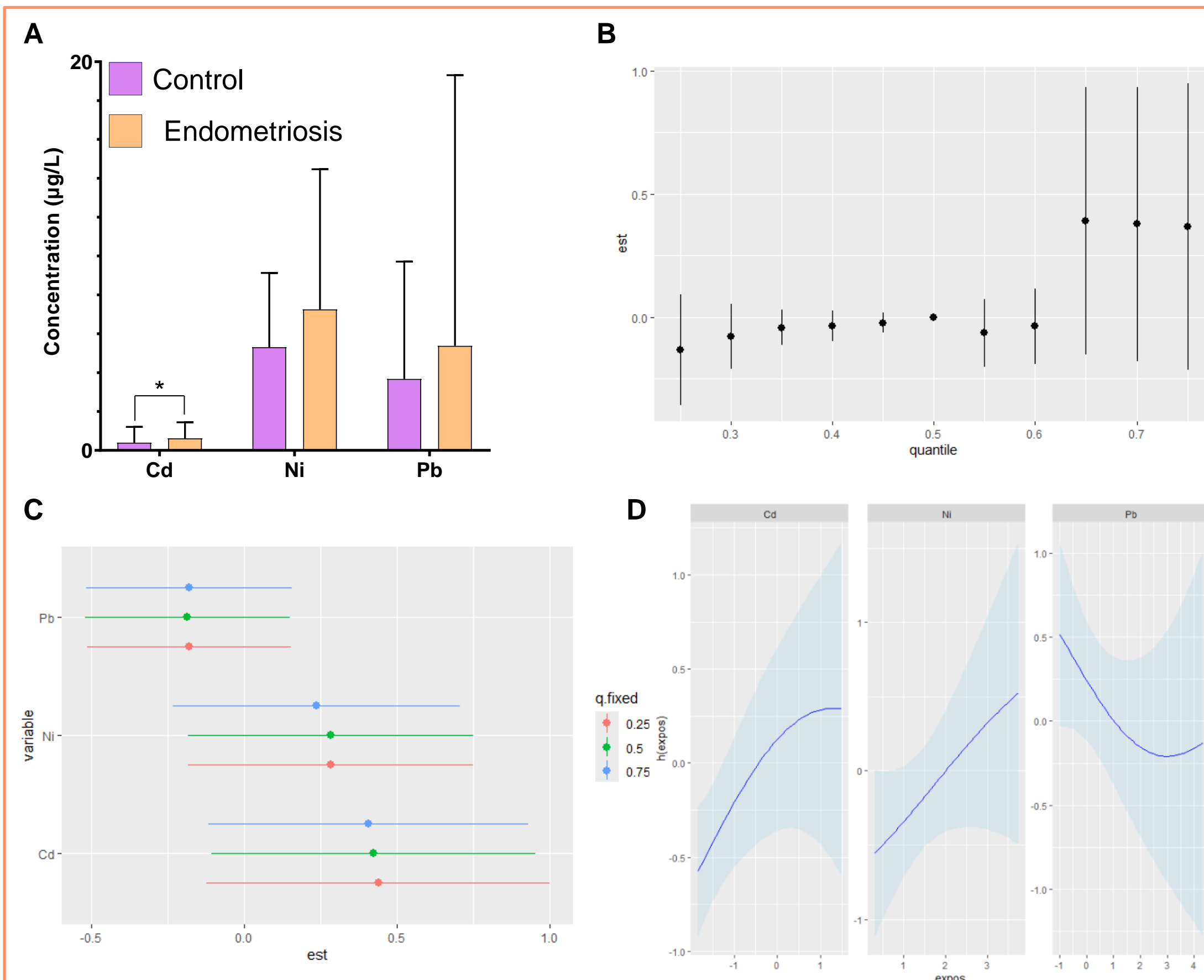


Figure 3. (A) Significant elevated concentrations of Cd found in the peritoneal fluid of endometriosis compared to control group. (B) Overall effect of the mixture (estimates and 95 % credible interval) on the risk of endometriosis. This plot showed the estimated change in the risk of endometriosis by comparing a particular percentile (ranging from the 25th percentile to 75th percentile) of all metal levels with the 50th percentile; (C) Individual variable contributions to the overall risk (estimate and 95 % credible intervals). This plot compared the endometriosis risk when Cd, Ni, and Pb were at the 75th vs. 25th percentile, when the other three metals were fixed at either the 25th, 50th or 75th percentile; (D) The trends of the exposure–response functions for Cd, Ni, and Pb with a 95 % confidence interval (in grey).

Although no statistically significant associations were observed, the positive trend in the combined effect of Cd, Ni, and Pb suggests a potential role of metal mixtures in endometriosis pathogenesis. This lack of statistical significance may be related to sample size limitations and inherent variability in peritoneal fluid composition. Nevertheless, the observed trend is consistent with previous literature on the endocrine-disrupting properties of these metals.