

# Uteroplacental Doppler flow and adverse neonatal outcomes in maternal heart disease

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## Introduction

- Pregnancy requires significant physiological adaptations of the maternal cardiovascular system, increasing cardiac output by 50%, which is important to support fetal growth.<sup>1,2</sup>
- 1-4% of pregnancies are complicated by maternal heart disease and these women are at high risk of neonatal complications.<sup>3,4,5</sup>
- We hypothesised that poor maternal cardiovascular adaptation to pregnancy leads to insufficient uteroplacental circulation, which results in fetal growth restriction.

## Objectives

- We aimed to evaluate the relationship between maternal left ventricular systolic function, uteroplacental Doppler flow, and fetal growth in women with heart disease.

## Methods

- A retrospective cohort of **119 women** that attended the maternal cardiology service at a single tertiary UK obstetrics centre (2019-2021) were identified.
- Women were classified according to their cardiac condition (aortopathy, arrhythmia, cardiomyopathy, congenital heart disease, valvular heart disease, other).
- Data on neonatal outcomes (delivery details, birth-weight, sex and gestational age) were collected from the electronic medical record.
- Adverse neonatal outcomes were pre-defined as:
  - Low birth weight (<2500g)
  - Small for gestational age (SGA; <10<sup>th</sup> birth-weight centile)
  - Pre-term delivery (<37 weeks' gestation)
  - Fetal demise (>20 weeks' gestation)
- Ejection fraction, global longitudinal strain and cardiac output were retrospectively calculated from echocardiograms performed during pregnancy.
- Umbilical artery pulsatility index (PI) was recorded from the last growth scan prior to delivery.

## Hospital admission

- 24 women required hospital admission during pregnancy due to their cardiac condition (20%); 16 (66%) of these women had an adverse neonatal outcome.

## Adverse neonatal outcomes

- Adverse neonatal outcomes occurred in **28 neonates** (24%); low birth weight (16%), SGA (8%), pre-term delivery (16%) and fetal demise (1%).
- SGA neonates** were significantly more common in women with **cardiomyopathy** than other cardiac conditions (56% vs 44%, p=0.016).

## Maternal left ventricular systolic function & adverse neonatal outcomes

- Ejection fraction** and **global longitudinal strain** were not significantly different between women with cardiac disease who had adverse neonatal outcomes and those who had healthy neonates.
- Cardiac output** in late pregnancy was significantly lower in women with adverse neonatal outcomes than those with healthy neonates ( $5.11 \pm 1.02$  L/min vs  $5.77 \pm 0.94$  L/min, p=0.008; Figure 1).

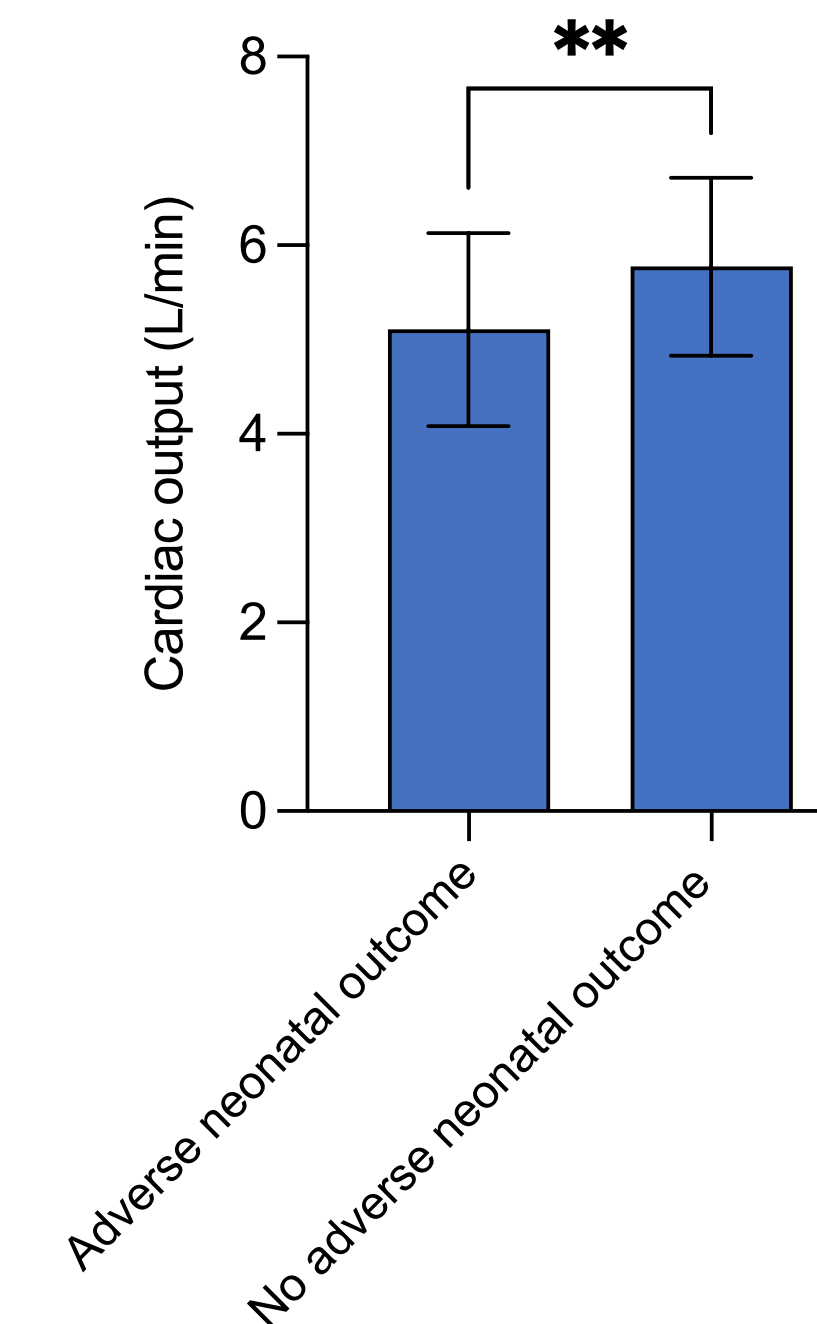


**Figure 1:** Cardiac output in women with adverse and no adverse neonatal outcomes. Data presented as mean±SD.

## Umbilical artery Doppler flow

- Umbilical artery pulsatility index was significantly higher in women with adverse neonatal outcomes ( $1.05 \pm 0.24$  vs.  $0.87 \pm 0.13$ , p<0.0001).
- Umbilical artery pulsatility index was significantly higher in women with **cardiomyopathy** than other forms of cardiac disease ( $1.00 \pm 0.23$  vs.  $0.88 \pm 0.16$ , p=0.007; Figure 2).

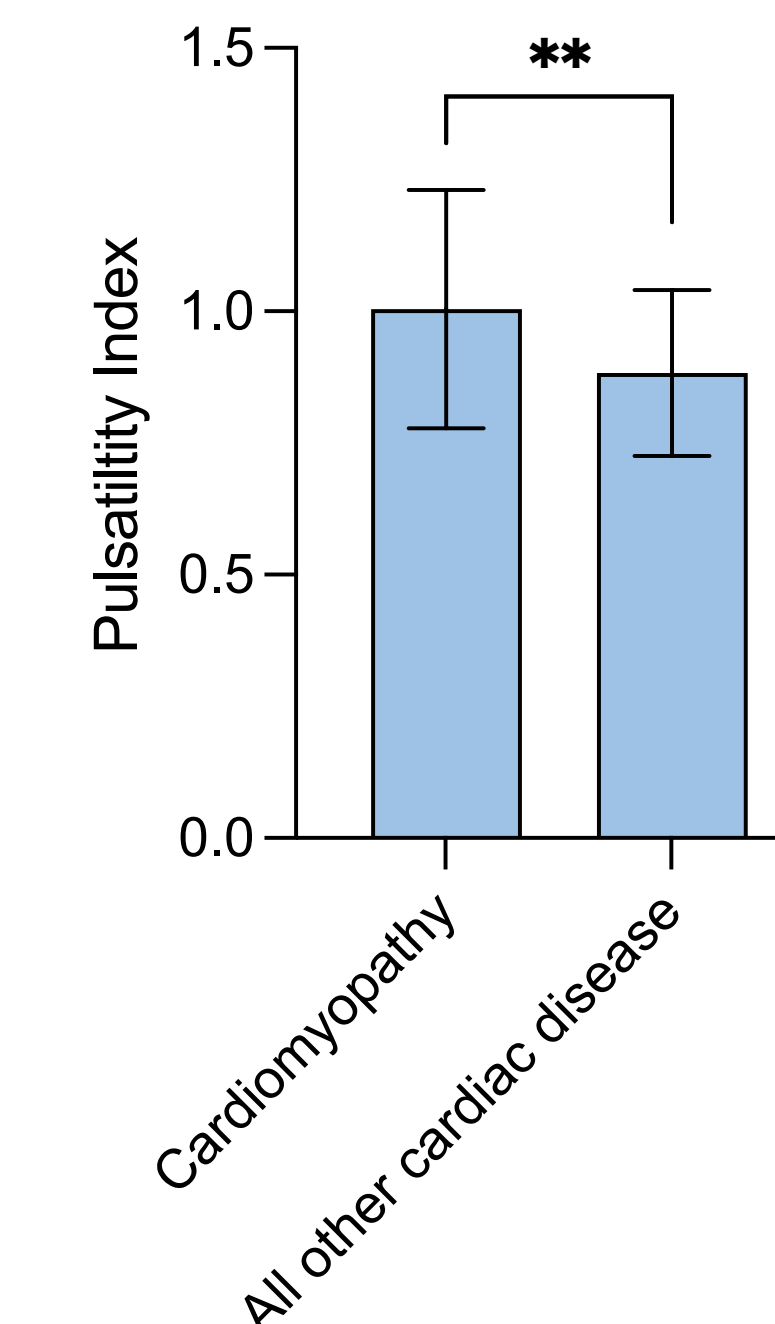


**Figure 2:** Umbilical artery pulsatility index in women with cardiomyopathy and other women with cardiac disease. Data presented as mean±SD.

## Maternal left ventricular systolic function & birth-weight centile

- There was a **significant association** between birth-weight centile and both global longitudinal strain (p=0.04; Figure 3A) and cardiac output (p=0.0002; Figure 3B) in late pregnancy.

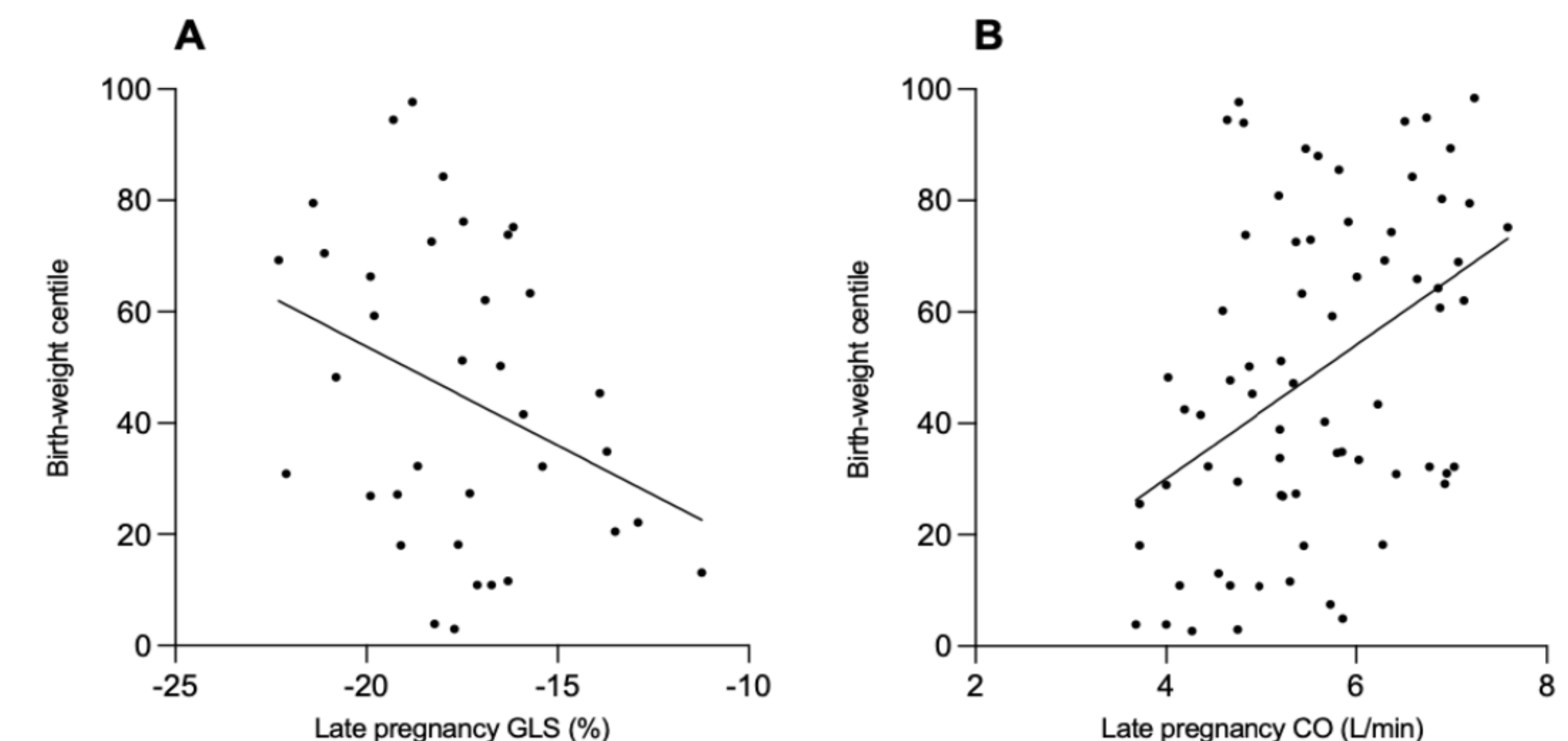


**Figure 3:** Correlation between birth-weight centile and maternal systolic function in late pregnancy. (A) Neonatal birth-weight centile and GLS. (B) Neonatal birth-weight centile and cardiac output. Abbreviations: CO: Cardiac output. GLS: Global Longitudinal Strain.

## Conclusion

- Our results support an association between impaired maternal cardiovascular adaptation to pregnancy and fetal growth restriction, which is likely due to insufficient placental circulation.
- There may be insufficient cardiac reserve in maternal cardiac disease to meet the increasing fetal demands.
- Cardiomyopathy limits the potential for increase in cardiac output, is associated with increased umbilical artery pulsatility index and is strongly associated with fetal growth restriction.
- Cardiomyopathy should be considered an independent risk factor for fetal growth restriction.

## References

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