

# Cardiopulmonary Exercise Testing:

## Predicting Risk in Mothers with Congenital Heart Disease

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# Background

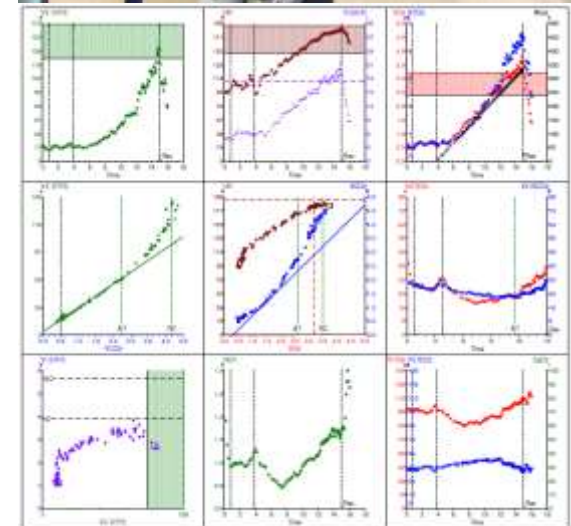
- More than 90% of patients with CHD survive to adulthood in developed countries.<sup>1-3</sup>
- ACHD generally associated with poorer outcomes in pregnancy.<sup>4,5</sup>
- WHO and CARPREG scoring systems have been used to predict risk in this population.<sup>6,7</sup>
  - Based on lesion, or clinical history and echocardiography.
  - Probably overestimate risk.<sup>8</sup>

# Cardiopulmonary exercise testing (CPET)

## Exercise tolerance test

- Cycle ergometer – ramp protocol
  - 3 minutes unloaded exercise, followed by 15 watt min<sup>-1</sup> ramp.
- Respiratory volumes and gases measured breath-by-breath.
- 12 lead ECG
- Blood pressure before and after exercise

1. % predicted peak VO<sub>2</sub><sup>9</sup>
2. VE/VCO<sub>2</sub>
3. VO<sub>2</sub> at AT
4. Peak VO<sub>2</sub>

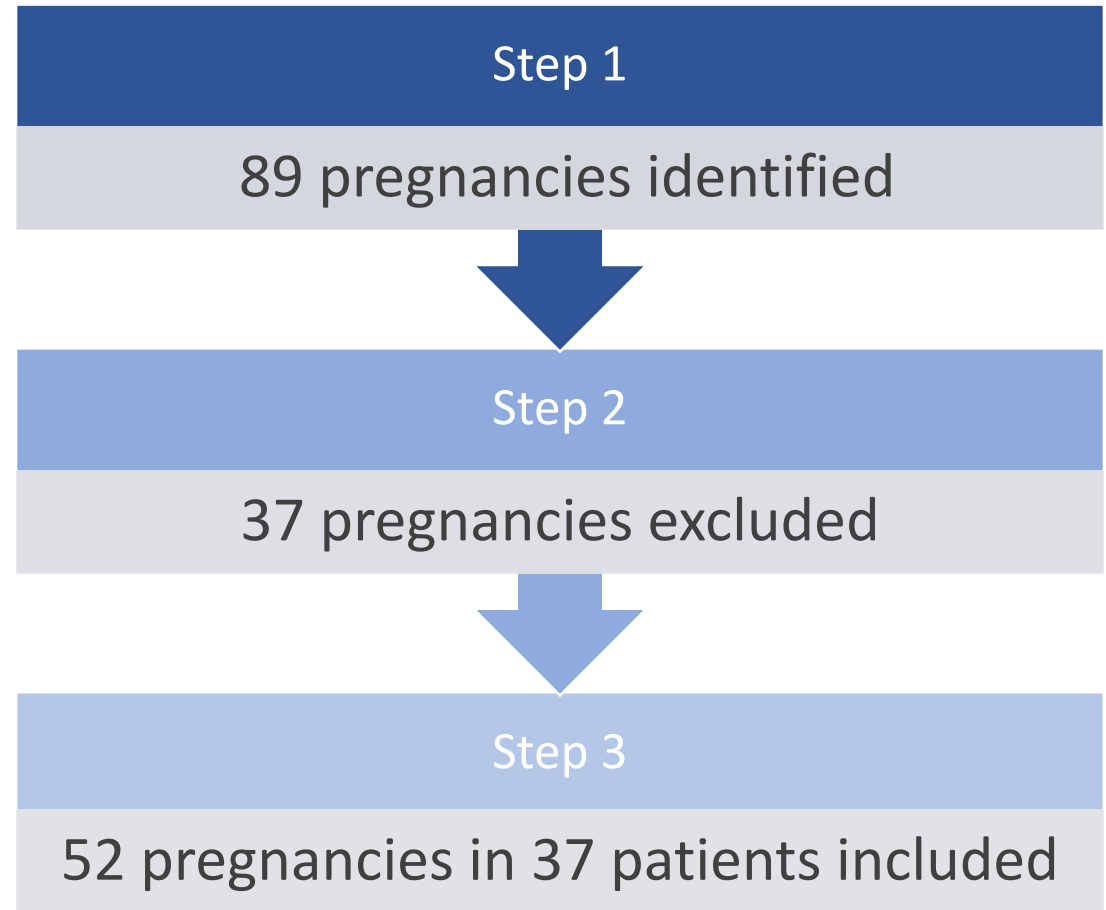


# Aims

1. Are CPET variables associated with risk of neonatal, obstetric, or maternal cardiac complications in WCHD?
2. Do CPET variables predict risk better than other risk scores?

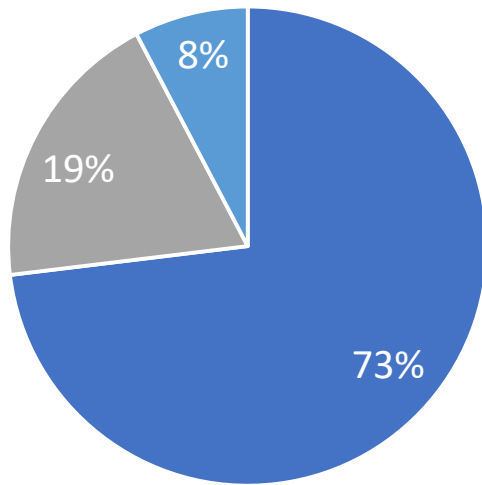
# Methods

- Compared CPET and maternity databases
- Exclusions: CPET after pregnancy, no ACHD, 6 year cutoff.
- Manual search of notes
  - Complications – neonatal, obstetric, cardiac
  - Gestation at delivery
  - Birth weight
- Looked for associations between outcomes and CPET, WHO, and CARPREG



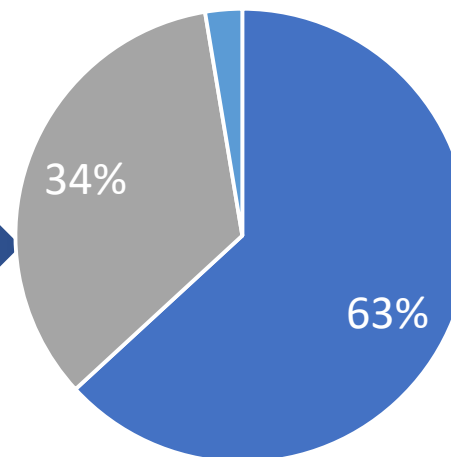
# Outcomes

Pregnancy Outcomes  
(n=52)



■ Successful pregnancy ■ Miscarriage  
■ Foetal death

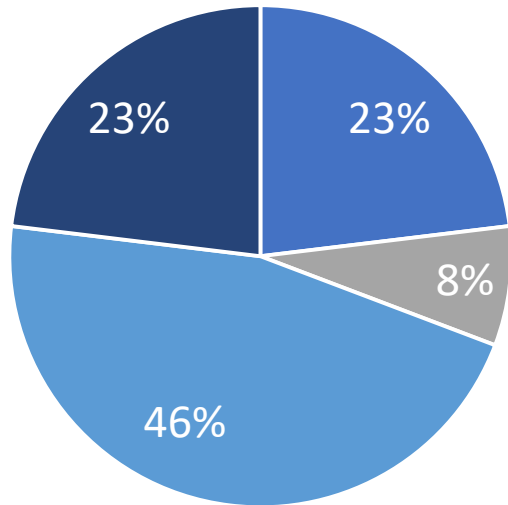
Preterm vs Term  
(n=38)



■ Term delivery ■ Preterm delivery ■ Unknown

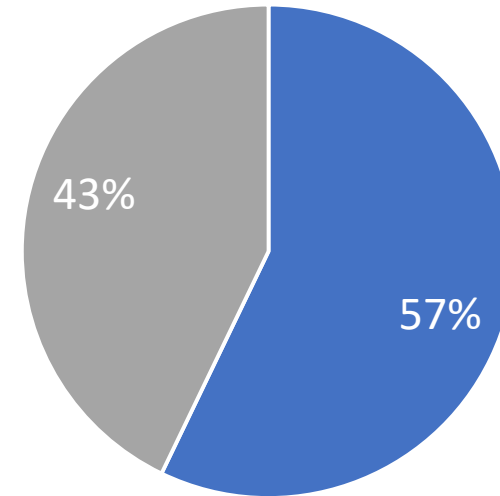
# Outcomes

Preterm: mode of delivery  
(n=13)



- Normal vaginal
- Assisted vaginal
- Elective C section
- Emergency C section

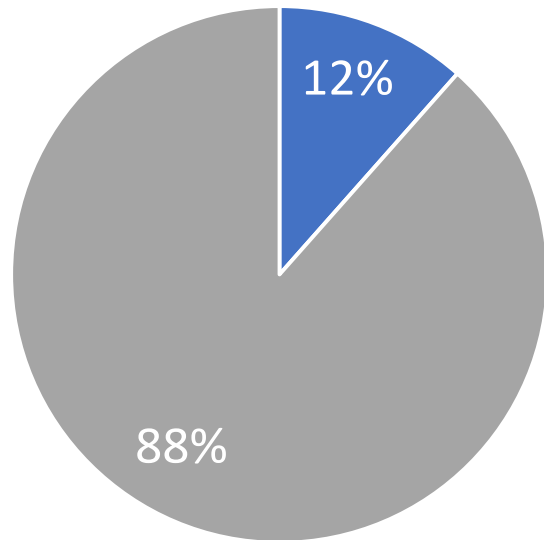
Preterm: planned vs. unplanned delivery  
(n=13)



- Planned
- Unplanned

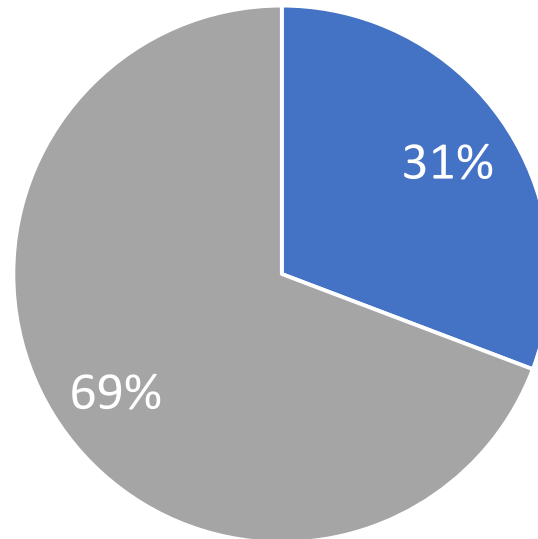
# Outcomes

Maternal Cardiac  
Outcomes  
(n=52)



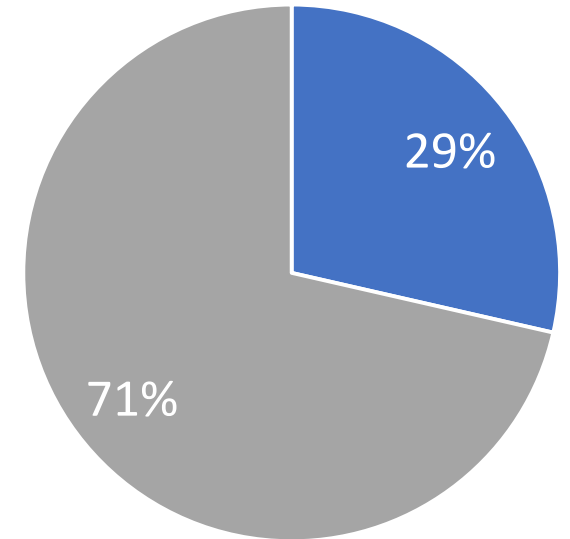
■ Complications ■ No complications

Obstetric outcomes  
(n=38)



■ Complications ■ No complications

Weight for gestational age  
(n=38)



■ Small for gestational age  
■ Normal or large for gestational age



# Results - WHO, CARPREG, and complications

## CARPREG score

- Did not associate with any outcomes, but...
- All patients in our cohort scored 0 or 1 on CARPREG.

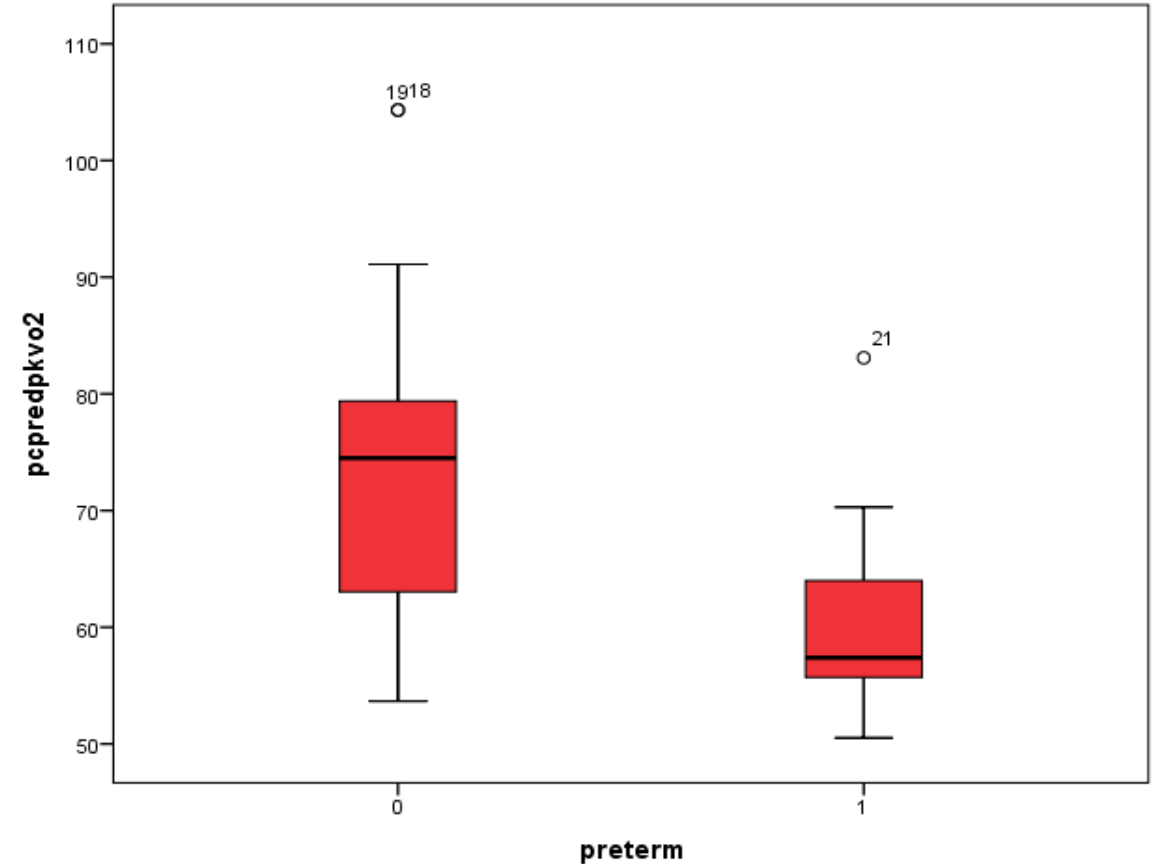
## WHO classification (I-II vs. III-IV)

- **Associated with preterm delivery**
  - (p=0.012, OR (95%CI) = 9.17 (1.64 - 51.1))
- Not associated with failed pregnancies
- Not associated with small for gestational age neonate
- Not associated with maternal cardiac events

# Results - does CPET predict outcomes?

## % predicted peak $\text{VO}_2$ was associated with preterm delivery

- (p=0.008, OR (95%CI) = 0.89 (0.82-0.97))
- Median % predicted peak  $\text{VO}_2$ :
  - 57.4% in preterm group, 74.5% in term group (p=0.001)



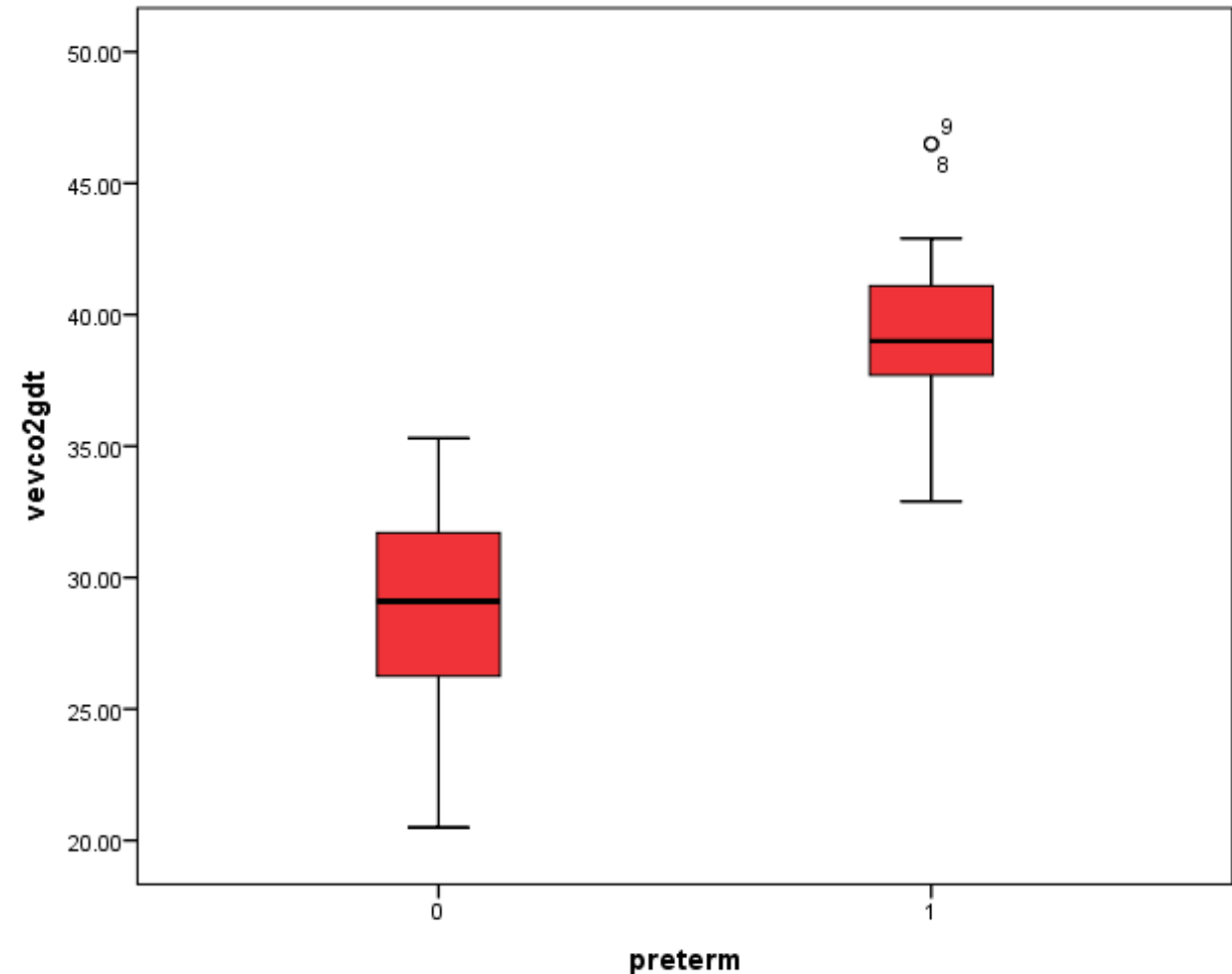
# Results - does CPET predict outcomes?

## VE/VCO<sub>2</sub> gradient was associated with preterm delivery

- p=0.003, OR (95%CI) = 1.69 (1.20-2.39).
- Median VE/VCO<sub>2</sub> gradient:
  - 38.8 (28.6-46.5) in preterm group, 29.1 (20.5-35.3) in term group, p<0.005.

## VE/VCO<sub>2</sub> at AT was associated with preterm delivery

- (p=0.001, OR (95%CI) = 1.66 (1.21-2.27)
- Mean (stdev) VE/VCO<sub>2</sub>:
  - Term group 30.2 (3.0) and preterm group 37.7 (4.5), p<0.005.



# Discussion

- Strengths
  - First study to use a consistent bike protocol
  - Patients pushed to peak effort
    - Defined as peak HR > 80% predicted peak HR (220-age),
    - Or RER > 1.15
- Limitations
  - Small cohort
  - Highly heterogenous group
  - Difficult to obtain clear picture of maternal cardiac history, particularly assessing CARPREG retrospectively

# Conclusions

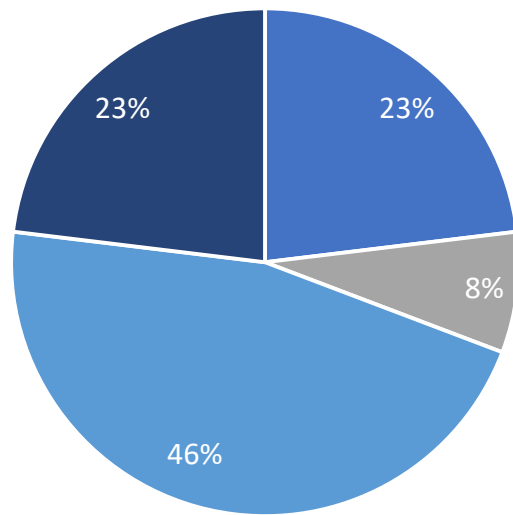
- Previous studies have suggested associations between CPET variables and neonatal and maternal cardiac outcomes.<sup>9,10</sup>
- Failed to reproduce associations found in previous studies, but novel association found.
- Inclusion of CPET in pre-pregnancy counselling may help inform obstetricians in assessing risk in WCHD.
- Large scale multi-centre studies needed to examine this relationship, and to compare CPET with existing risk scores.

# References

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Thank You

Preterm: mode of delivery  
(n=13)



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- Emergency C section