# [Determinants of Exercise Performance in Children and Adolescents with Repaired Tetralogy of Fallot Using Stress Echocardiography.](https://www.ncbi.nlm.nih.gov/pubmed/30121867)

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**Take Home Points:**

* **Among patients with repaired tetralogy of Fallot (rTOF), normal chronotropic response to exercise, defined as HR > 185 bpm, and those with greater HR reserve had better exercise performance and less pulmonary insufficiency at peak exercise.**
* **RV function at PI severity at rest were not associated with exercise performance.**
* **Further longitudinal studies using exercise testing should be done to determine if improved chronotropic response leads to less morbidity and mortality in this population.**



**Commentary from Dr. Jared Hershenson (Greater Washington DC), section editor of Pediatric Cardiology Journal Watch: Exercise performance in patients with rTOF is known to decline with age. Metabolic parameters from cardiopulmonary exercise testing (CPET) and diminished exercise capacity may predict morbidity and mortality in adults with rTOF. However, specific factors associated with this decline have not yet been elucidated, with many possibilities including pulmonary insufficiency (PI), ventricular dysfunction, chronotropic impairment, pulmonary artery stenosis/distortion, and abnormal lung function.**

**This was a small, but prospective, study that looked at CPET and stress echo findings in children/teenagers with rTOF. Those with pacemakers and on beta-blockers were excluded. 29 patients had CPET using a cycle ergometer or 1-min incremental treadmill protocol. Maximal exercise was achieved in all patients, based on an RER >1.10. Exercise factors such as VO2, O2 pulse, VE/VCO2 slope, peak heart rate (pHR) and heart rate reserve (HRR) were measured. Stress echo was performed immediately prior to exercise and at peak exercise, with peak RV global longitudinal strain (RV GLS), tricuspid inflow and myocardial velocity (TDI), and ratio of the diastolic to systolic time-velocity integral (DSTVI) for pulmonary insufficiency documented. 2 groups were compared and determined based on maximum VO2 (%mVO2), with VO2>80% predicted defined as high performers, and VO2<80% predicted as low performers.**

**The median %mVO2 in the high performers was 97.5%, with a max VO2 of 41.2 ml/kg/min, while the low performers had a median %mVO2 of 68% and a max VO2 of 30 ml/kg/min. The high performers were younger and had lower BSA. There was no difference based on genetic syndrome, type of TOF, type of repair, age at complete repair, or history of pulmonary valve replacement. See table 1. RVGLS was abnormal in both groups at baseline, and there was no difference in change or in the diastolic parameters from rest to peak exercise. There was a significant decrease in PI/DSTVI from rest to peak exercise in both groups, but the high performers had a greater reduction despite greater PI at rest. See figures 1 and 2. High performers had a greater peak HR and HRR (median 114) compared to the low performers (median 100). O2 pulse and VE/VCO2 were comparable.**

**As both groups had maximal effort and that O2 pulse (estimate of stroke volume) was equivalent, the authors noted that the ability to increase the HR may be a more significant contributor to augmentation of cardiac output and by extension, exercise performance. They also speculate that the decrease in PI may be due to a shorter diastolic time with increased heart rates, which is why baseline PI did not predict response. Additionally, the lack of change in strain suggests ventricular performance is not a factor in exercise performance. However, it is known that chronotropy is often a greater contributor to cardiac output in younger children than stroke volume, so it would important to know if this effect would continue with an older population.**

**Based on these observations, it is possible that exercise training/rehab may improve exercise capacity and potentially morbidity in this population by improving chronotropic response. As earlier studies have shown that the lowest VO2 (<15) and highest VE/VCO2 groups (>38) show a marked increase in mortality, early interventions may prevent these changes/declines. Limitations of this study included small numbers, low age and minimal residual pulmonary outflow abnormalities, so these findings may not be generalizable. Additionally, younger children are more likely to be active than older teens/young adults, and the authors did not attempt to qualitatively determine activity via parental reports or exercise logs. Further longitudinal studies should be done in this population, but it is refreshing to see good quality studies using a still somewhat underused testing modality, and one that may have more “real-world” applicability.**



