# [Reduced biventricular contractility during exercise in adults with small, unrepaired ventricular septal defects: an echocardiographic study.](https://www.ncbi.nlm.nih.gov/pubmed/31625565)

Maagaard M, Heiberg J, Redington AN, Hjortdal VE.

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**Take Home Points:**

* In young adults with small unrepaired ventricular septal defects (VSD), exercise capacity is diminished when compared with healthy controls, which can be explained by reduced biventricular contractility at rest and during exercise.
* Specifically, tissue Doppler parameters of left ventricle (LV) systolic function, including Isovolumetric acceleration (IVA), are diminished both at rest and during exercise in VSD patients when compared with healthy controls. Thus, LV contractile reserve is progressively decreased at higher workloads in VSD patient.
* Patients with small unrepaired VSD are at increased risk of long-term complications and should be followed in adult congenital heart centers.



***Commentary from Dr. Maan Jokhadar (Atlanta GA), section editor of ACHD Journal Watch:*** Recent studies have demonstrated reduced exercise capacity in young patients with unrepaired small ventricular septal defects (shunt fraction < 1.5) and this is thought to be due to ventricular dysfunction from a small shunt over a prolonged period of time.

Ventricular force – frequency relationships can be studied noninvasively using tissue Doppler techniques to reflect the dynamic myocardial response to exercise.

This elegant study was conducted by Dr. Maagaard and colleagues from Aarhus, Denmark in collaboration with Dr. Redington in Cincinnati, OH, USA. They studied 34 unrepaired VSD patients and 28 healthy controls between the ages of 18 and 40. In the VSD group, 9 were muscular and 23 were perimembranous. All participants had normal resting ejection fraction, tricuspid regurgitation velocity less than 2.8 cm/sec, normal right atrial pressure, and no measurable aortic insufficiency. The average age was 27 years and baseline characteristics were comparable in the patient and control group, including height, weight, gender, body mass index, heart rate, blood pressure, as well as comparable daily exercise levels.

All patients in the small VSD group had isolated VSD without prior surgical intervention and no associated congenital heart disease, arrhythmia, or syndrome. The median shunt fraction was 1.2.

All participants had bicycle exercise echocardiogram with longitudinal incremental tissue Doppler imaging with workload increased until exhaustion. Tissue Doppler measurements were obtained in the apical 4 chamber from the basal septum and basal free walls of the LV and RV.

At baseline, IVA was lower in VSD patients compared with controls in the septum, LV, and RV. LV and RV peak S’ was also lower in VSD patients. However, septal S’, E’, and A’ were similar between VSD patients and controls.

During supine bicycle ergometry, force-frequency relationship curves of IVA in VSD patients were lower than controls in the septum, RV, and LV. This difference increased with intensifying workload. IVV and S’ of the RV, LV, and septum were also lower in VSD patients during exercise.

Smaller shunts had higher LV IVA but this inverse relationship was not true for the septum or RV. Higher RV S’ correlated with better exercise capacity in VSD patients but not in controls.

These findings may be explained by the increased left ventricle volume loading that occurs, even with small shunts over a long period of time. Clearly, even small shunts may be hemodynamically significant in the long run because of the increased LV volume load, left atrial dilation, and amplification of diastolic dysfunction with age. Though a lower threshold for VSD closure could potentially mitigate or avoid the adverse changes associated with small shunts, additional studies are needed before such a conclusion can be reached. However, this study does bolster the argument that unrepaired VSD patients should be followed by a specialized center for adult congenital patients.

This important study adds to the growing body of literature regarding the long-term hemodynamic consequences of unrepaired VSD and increases our understanding in this area.

![A close up of a map

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**Tissue Doppler Parameters during systole and diastole**

AT: Acceleration time (sec)

IVV: Isovolumetric velocity (cm/sec)

IVA: Isovolumetric acceleration (cm/sec2)  
**IVA = IVV/AT (cm/sec2)**

Peak S’ velocity (cm/sec)

IVCT: Isovolumetric contraction

IVRT: Isovolumetric relaxation

E’: Early relaxation

A’: Associated with atrial contraction

ET: ejection time