



An Extra 1,000 Steps Per Day Relates to Improved Cardiovascular Health in Children With Type 1 Diabetes

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Children with type 1 diabetes report lower physical activity levels than those given in the current recommendations (1), and the effect of this on vascular health, measured objectively, is not well described. Children with type 1 diabetes have vascular structural changes (increased carotid and aortic intima-media thickness [cIMT and aIMT, respectively]) (2,3). aIMT relates to cIMT and both relate to cardiovascular risk factors. aIMT has been shown to be an earlier marker of atherosclerosis in children (2,3). We aimed to determine the relationship between activity levels and IMT in children with type 1 diabetes. We hypothesized that lower activity levels would relate to thicker IMT.

The study included 90 children with type 1 diabetes (41 boys, aged 13.6 ± 3.5 years) and was approved by ethics committees (4). Children had evaluation of cIMT and aIMT as previously described (2–4). Inter- and intraobserver coefficients of variation for cIMT were 1.2% and 2.4% and for aIMT were 1.6% and 1.2%, respectively (3). Activity levels (step count/day) were measured using a SenseWear MiniForm Factor Armband (Body Media Inc., Pittsburgh, PA) worn for a minimum of five consecutive days including one weekend day.

The mean \pm SD BMI was 22.43 ± 3.23 kg/m² and diabetes duration was 5.5 ± 3.9 years, and median (IQR) HbA_{1c} was 8.7% (8.1–9.9) (72 mmol/mol [65–85]). Eighty-eight of 90 (98%)

children wore the armband for $23.2 (\pm \text{SD } 0.76)$ h/day. Forty-eight of 88 (55%) children took less than 10,000 steps a day (lower limit of recommended steps) (5).

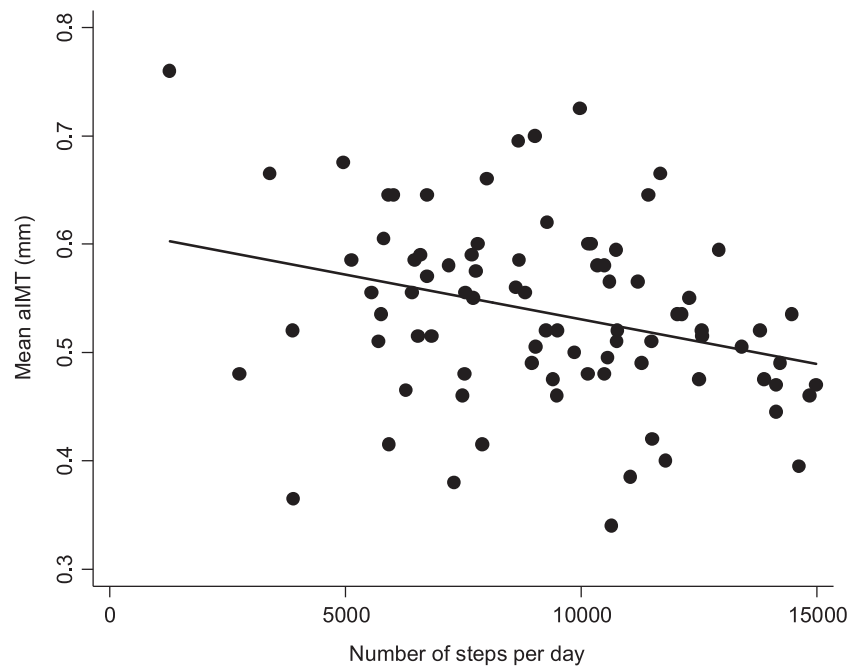


Figure 1—Mean aIMT related to average steps taken per day ($r = -0.30$, $P = 0.005$) in children with type 1 diabetes.

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Mean and maximum aIMT related to average steps taken per day ($r = -0.30$, $P = 0.005$ and $r = -0.29$, $P = 0.007$, respectively) (Fig. 1). An increase in step count of 1,000 steps/day related to a decrease in mean/maximum aIMT of 0.0082/0.0093 mm (95% CI -0.014 , -0.002 ; $P = 0.005$, and 95% CI -0.016 , -0.003 ; $P = 0.007$, respectively). The association was independent of age, HbA_{1c}, BMI z-score, blood pressure, triglycerides, LDL, HDL, and total cholesterol. Children with a daily step count lower than 10,000 steps/day had higher mean and maximum aIMT than those with higher step counts (0.56 ± 0.09 vs. 0.51 ± 0.07 , $P = 0.01$ and 0.65 ± 0.09 vs. 0.60 ± 0.09 , $P = 0.02$, respectively). An increase in 1,000 steps per day was related to lower cardiovascular risk: 1.6 kg (95% CI -2.66 , -0.54 ; $P = 0.004$) reduction in weight; 1.02 mmHg (-1.55 , -0.49 ; $P < 0.001$) and 0.50 mmHg (-0.85 , -0.15 ; $P = 0.005$) reduction in systolic and diastolic blood pressure, respectively; 0.03 mmol/L (0.003, 0.05; $P = 0.03$) increase in HDL cholesterol; and 0.02 mmol/L (-0.04 , -0.001 ; $P =$

0.04) reduction in triglycerides. There were no associations with cIMT.

We have demonstrated for the first time that the daily number of steps relates to early signs of atherosclerosis and adverse cardiovascular risk in children with type 1 diabetes. An important clinical message is that even a small increase in activity relates to better vascular structure and risk factors. Limitations of the study are the small cohort size and the cross-sectional analysis preventing exploration of causal factors. However, we achieved power of 0.91 to detect the correlation of 0.31 between steps per day and aIMT (assuming $\alpha = 0.05$). Our findings emphasize the importance of including advice for the benefits of exercise in routine education for children with type 1 diabetes.

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coordinated one center. All authors reviewed, edited, and approved the final manuscript. J.A., L.C.G., and A.S.P. are the guarantors of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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