Factory Calibrated Continuous Glucose Monitoring System Accuracy During Exercise In Adolescents With Type 1 Diabetes Mellitus

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BACKGROUND

Continuous glucose monitors (CGM) are used for individuals with type 1 diabetes (T1D) and are associated with improved glycemic control[1]. Advancements in CGM technology have included the Dexcom G6 being factory calibrated and used in conjunction with insulin pumps, creating a hybrid closed loop. The FDA approved locations of the Dexcom G6 are the buttocks & abdomen.

Exercise is an essential component of diabetes management. However, exercise imposes challenges in achieving optimal glycemic control including increased risk of hypoglycemia.

Studies have investigated the impact of exercise on accuracy of CGM devices with varying results but overall raised concerns of lower accuracy during exercise [2 3 4 5]. These studies were primarily in the adult populations with older generation CGM devices which required calibration.

To our knowledge there are no studies that investigated the accuracy of the Dexcom G6 during exercise in youth or adolescents with T1D.

METHODS

- 30 participants using a Dexcom G6, age ≥13 years, with T1D diagnosis ≥ 2 years and HbA1c < 10% were recruited
- Each exercised for 40-mins on a treadmill with a 10-min break at min 20. Speed/incline adjusted to illicit 45 - 50% heart rate reserve (moderate intensity).
- Dexcom values were compared to Contour Next glucometer at 25±10 mins prior, at the beginning of exercise, and every 10 mins after, both during and for 20 mins after exercise
- MARD was calculated and Clarke Error Grid Analyses (EGA) were performed to assess accuracy during exercise.

RESULTS

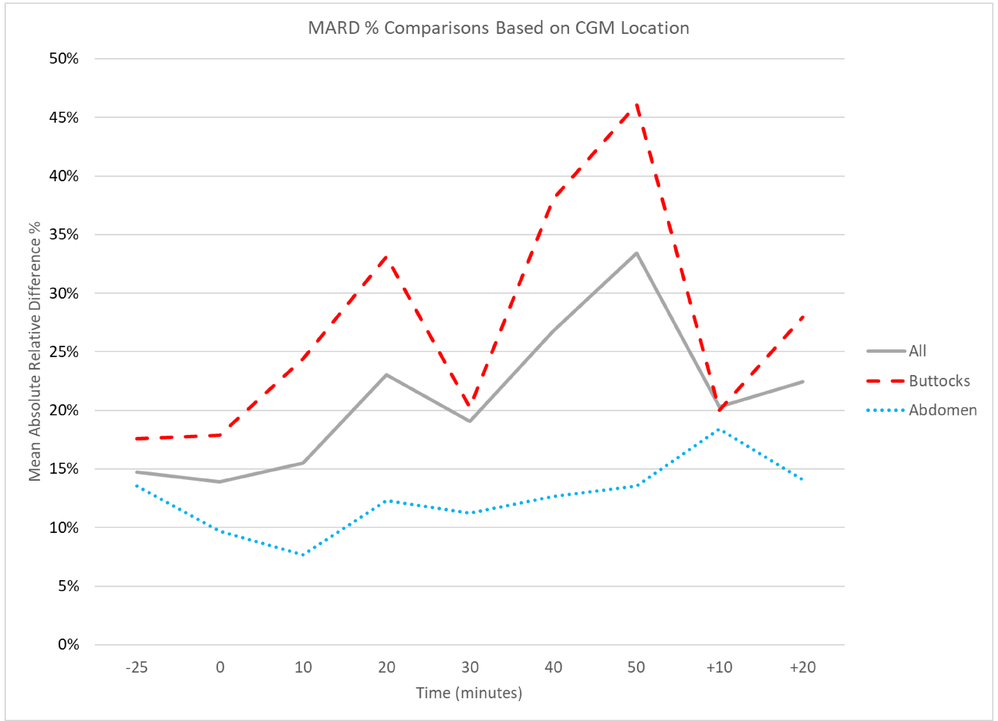
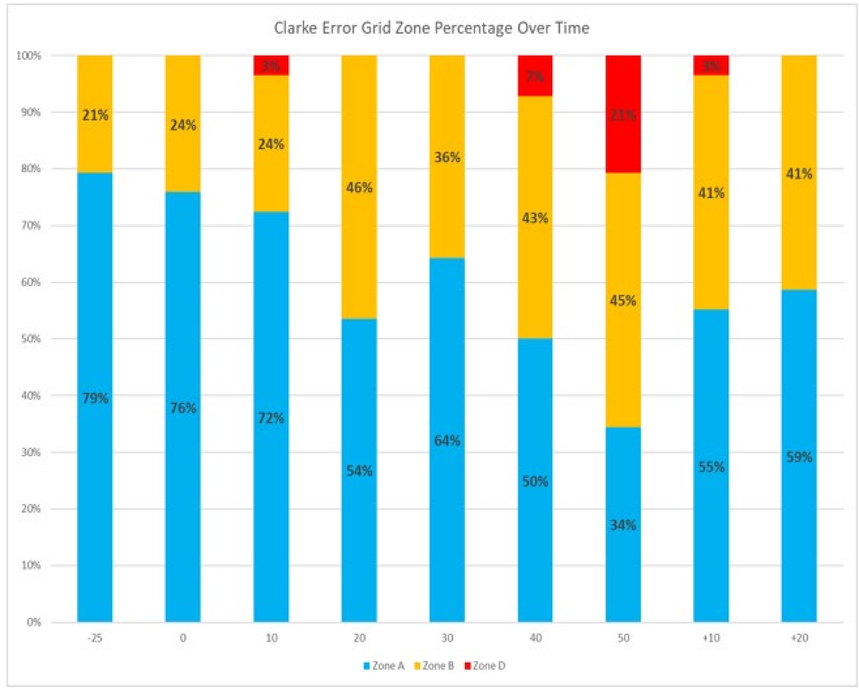


Figure 1: Mean Absolute Relative Difference (MARD) over time, before, during, and after exercise. Time 0 represents beginning of exercise session. +10/+20 represent 10 and 20 minutes after exercise cessation. All participants represented by solid line. Subset of participants with CGM on buttocks only represented by dashed line. Subset of participants with CGM on abdomen only represented by dotted line.

Figure 2. Clark Error Grid Zone Percentages from all participants over time. Zone A represents glucose values that deviate from the reference by no more than 20% or are <70 mg/dl when the reference is also <70 mg/dl. Zone B represents values that deviate from the reference by >20% but lead to benign or no erroneous treatment. Zone A and B are both clinically safe zones. Zone D represents dangerous failure to detect and treat errors



CONCLUSIONS

- Our results raise concerns of CGM accuracy in adolescents who are exercising
- The Dexcom G6 demonstrated changes in MARD and Clarke Error Grid Analyses during aerobic exercise which improved quickly after exercise termination
- Subset analyses noted accuracy differences depending on the location where the CGM is worn
- Interstitial fluid changes in exercising muscles may alter the accuracy of CGM during exercise
  - Additional research is needed to support this theory

REFERENCES

1. Laffel LM, Kanapka LG, Beck RW, et al. Effect of Continuous Glucose Monitoring on Glycemic Control in Adolescents and Young Adults With Type 1 Diabetes: A Randomized Clinical Trial. JAMA. 2020:2388-2396.
2. Biagi L, Bertachi A, Quiros C, et al. Accuracy of Continuous Glucose Monitoring before, during, and after Aerobic Exercise in Patients with Type 1 Diabetes Mellitus. 2018.
3. Taleb N, Suppere C, Messier V, et al. Comparison of Two Continuous Glucose Monitoring Systems, Dexcom G4 Platinum and Medtronic Paradigm Veo Enlite System, at Rest and During Exercise. 2016;18(9).
4. Zaharieva DP, Turksoy K, McGaugh SM, et al. Lag Time Remains with Newer Real-Time Continuous Glucose Monitoring Technology During Aerobic Exercise in Adults Living with Type 1 Diabetes. 2019;21(6).
5. Herrington SJ, Gee DL, Dow SD, Monosky KA, Davis E, Pritchett KL. Comparison of Glucose Monitoring Methods during Steady-State Exercise in Women. 2012;4:1282-1292.