Why CGM readings drift during a marathon in type 1 diabetes

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> Continuous glucose monitoring has changed how people with type 1 diabetes exercise, and most of the evidence for its accuracy during exercise comes from short sessions in a clinic. A study presented at EASD 2026 followed runners through a full marathon instead, and the sensors behaved very differently over four hours on the road. The runners themselves did well. The devices they relied on did not.

KEY TAKEAWAYS

- Across a real marathon, CGM error reached a MARD of 43.1% for intermittently scanned systems and 36.6% for real-time systems, far above manufacturer figures.
- A one-hour in-clinic exercise study reported MARD of 10.7% to 17.2%, so a short laboratory test does not predict sensor performance over a four-hour race.
- Runners with type 1 diabetes finished as fast as controls, with comparable aerobic capacity, taking a median of 53.5 g of carbohydrate per hour.
- Two hypoglycaemic episodes occurred in one runner despite 49.5 g of carbohydrate per hour, and the authors link the risk to a starting glucose below 140 mg/dL.
- The practical advice is to use a glucometer alongside CGM during prolonged endurance exercise rather than relying on the sensor alone.
- Ten runners with type 1 diabetes, all experienced and well controlled, is a small and selected group, and this is a conference abstract rather than a full paper.

What did the Poznan team actually measure?

Researchers in Poznan followed 20 amateur runners through a real marathon: 10 people with type 1 diabetes of at least a year's duration and 10 controls without it, all of whom finished the race.1 The aim was to measure three things that almost never get studied together outside a laboratory: how glucose behaves across the full distance, how much carbohydrate people with type 1 diabetes actually need to hold it steady, and how accurate their continuous glucose monitors are while it happens.

The insulin protocol was set in advance rather than left to the runners. Participants with type 1 diabetes aimed for a pre-race glucose between 140 and 200 mg/dL. Those on multiple daily injections cut their basal insulin by 25%, and those on insulin pumps without automated delivery cut it by 50%. Runners using hybrid closed-loop systems raised their target glucose to 150 mg/dL instead, leaving the algorithm to do the rest.1 Carbohydrate or insulin was given during the race as the situation required.

Glucose was checked at five fixed points: the start, 10 km, 19 km, 30 km and the finish. At each one the team took a capillary reading from a glucometer alongside readings from two CGM systems, one intermittently scanned and one real-time.1 Using the fingerstick as the reference, they calculated the mean absolute relative difference (MARD) for each sensor, which is the standard way of expressing how far a CGM reading typically sits from the true value.

That design matters for how the results should be read. This was not a treadmill session in a clinic, where heat, hydration, pacing and the duration of effort are all controlled. It was a race run by amateurs over roughly four hours, which is the situation a clinician's patient will actually be in on the day. That is the study's main strength, and as later sections show, it is also the source of its most useful finding.

How did glucose behave over 42 kilometres?

Glucose fell across the race, but not in a straight line. Median capillary glucose was 183.5 mg/dL at the start, dropped to 119.5 mg/dL by 10 km, recovered to 142.5 mg/dL at 19 km, then fell again to 121.5 mg/dL at 30 km and 108.5 mg/dL at the finish.1 The early fall, the mid-race rebound and the late decline suggest runners were responding to their numbers in real time, correcting a drop with carbohydrate and then drifting down again as the effort continued.

Carbohydrate intake was substantial. Runners with type 1 diabetes consumed a median of 53.5 g per hour, equivalent to 2.61 g per kilogram of body weight over the whole marathon.1 That is a deliberate, sustained intake rather than an occasional correction, and in all but one runner it was enough to avoid hypoglycaemia at the checkpoints where glucose was measured.

Broadly, but not universally. Two hypoglycaemic episodes occurred, both in a single participant, and that runner was taking in 49.5 g of carbohydrate per hour when they happened.1 The authors' conclusion points to the variable they believe mattered most: hypoglycaemia is more likely when glucose at the start is below 140 mg/dL. A runner who begins at the bottom of the target range has almost no buffer against a fall that, on this evidence, arrives within the first 10 km.

Performance offered some reassurance. Finishing times did not differ significantly between the two groups, at 227.9 minutes with type 1 diabetes and 247.8 minutes without, and nor did aerobic capacity measured by cardiopulmonary exercise testing.1 Both groups were similar in age and both were 80% men. Participants with diabetes had a median diabetes duration of 16.5 years and a median HbA1c of 6.4%, which describes an experienced, well-controlled group rather than a typical clinic population, and that point comes back later.

How far off were the glucose sensors?

Much further than their manufacturers claim. Over the marathon, the intermittently scanned system recorded a MARD of 43.1% and the real-time system 36.6%.1 A sensor with a MARD in that range can be reading well above or well below true glucose at exactly the moment a runner is deciding whether to eat, and that is the decision these devices are meant to support.

The size of that gap becomes clearer against laboratory data. In a study of 13 adults with type 1 diabetes wearing three factory-calibrated sensors through a one-hour in-clinic exercise session, MARD was 12.6% for Dexcom G6, 10.7% for Guardian 4 and 17.2% for FreeStyle Libre 2, with no significant difference between them.2 A separate clamp study in 15 people found that exercise worsened the accuracy of FreeStyle Libre 1 during hypoglycaemia while it improved the accuracy of Dexcom G6, and concluded that exercise had a clinically relevant effect on the ability of these systems to detect low glucose.3

Set side by side, those figures suggest that a one-hour controlled session does not predict how a sensor behaves over four hours on a road. The marathon errors were roughly two to four times larger than those seen in the clinic, depending on which figures are compared. The abstract does not say why, and several plausible contributors, including sustained changes in blood flow, dehydration and the lag between blood and interstitial glucose during rapid change, cannot be separated with these data.

The laboratory work also carries a warning about treating all sensors as one. It found meaningful differences between specific devices in how well they tracked glucose trends during exercise.2 The Poznan abstract reports accuracy by sensor type, intermittently scanned or real-time, rather than by named device, so a runner cannot yet read their own sensor's performance from it.

What this study cannot tell us

The most important limit is size. Ten runners with type 1 diabetes is a small group, and the hypoglycaemia finding rests on two episodes in one person. That is enough to show that hypoglycaemia can happen despite generous fuelling. It is not enough to estimate how often it happens, or to confirm that a starting glucose below 140 mg/dL is the threshold that matters rather than simply the one this participant happened to cross.

The population also limits how far the findings travel. A median HbA1c of 6.4% and 16.5 years of diabetes describe people who have had long practice managing their own glucose, and every participant finished the race. People who struggled, or who were advised not to run, are not represented. A less experienced runner, or one with a history of hypoglycaemia unawareness, may not have the margin these participants did.

The accuracy estimates carry their own caveat. Capillary glucose was the reference, and fingerstick meters have measurement error of their own, particularly when hands are cold, wet or contaminated with sweat and sports drink, all of which are likely late in a marathon. Checking at five points also means that brief excursions between checkpoints were not captured, so the MARD reflects sensor performance at five moments rather than across the whole race.

This is also a conference abstract rather than a peer-reviewed paper. The full analysis, including which sensor models were used, how many readings contributed to each MARD value and how insulin and carbohydrate decisions were made in practice, is not yet available. Until it is, the figures here should be treated as a strong signal rather than a settled estimate.

What should runners and their clinicians do differently?

The practical message is the one the authors draw themselves: during prolonged endurance exercise, a glucometer should be used alongside CGM rather than CGM alone.1 A sensor reading that prompts a decision to eat, or to withhold carbohydrate, is worth confirming with a fingerstick when the stakes are a fall in glucose several kilometres from the next aid station.

This fits existing guidance rather than overturning it. The EASD and ISPAD position statement on CGM around exercise describes fear of hypoglycaemia as one of the strongest barriers to exercise in type 1 diabetes, and notes that the complexity of these systems can make their information hard to interpret even for experienced users.4 The international consensus on exercise management likewise sets out glucose targets for safe exercise alongside nutritional and insulin dose adjustments to protect against exercise-related glucose excursions.5 What the Poznan data add is a sharper sense of how unreliable the sensor can become once the effort runs for hours.

The starting number deserves particular attention in planning. On this evidence, beginning a marathon near the bottom of the 140 to 200 mg/dL target leaves little room for the fall that follows. Runners who start low may need either to delay the start of the race until glucose rises or to take carbohydrate earlier than they otherwise would, and that is a conversation worth having well before race day rather than at the start line.

For clinicians, the finding also reframes a common reassurance. Patients who rely on CGM in daily life may reasonably assume the same device will serve them just as well in competition. The honest counsel is that it probably will not, that the error can be several times larger during long efforts, and that the old habit of a fingerstick check at key moments still earns its place. The study also offers something encouraging to pass on: people with type 1 diabetes in this group ran a marathon as fast as their peers without it, and did so safely.

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