Prevention of Exercise-Associated Dysglycemia: A Case Study–Based Approach

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Regular physical activity is associated with many health benefits for people with type 1 diabetes, including improved quality of life, increased vigor, enhanced insulin sensitivity, and protection against cardiovascular disease and other diabetes-related complications (1). Despite its benefits, exercise can aggravate dysglycemia because it causes major changes to glucose production and utilization rates (2). For example, mild to intense aerobic exercise (e.g., walking, cycling, jogging, and most individual and team sports) increases the risk of hypoglycemia during the activity and in recovery because of impaired rates of glucose production, whereas very intense aerobic exercise (>80% of maximal aerobic capacity) and anaerobic exercise (e.g., sprinting and heavy weightlifting) can cause glucose levels to rise because of reduced rates of glucose disposal (3,4).

Numerous strategies have been developed to help limit hypoglycemia during exercise in individuals with type 1 diabetes. One of the main reasons hypoglycemia occurs is the inability to naturally reduce insulin levels at the onset of exercise (1). Strategies to help limit hypoglycemia include exercising in the fasted state (5), reducing the insulin for the meal before exercise (6,7), interrupting basal insulin infusion for patients on insulin pump therapy (8–10), and increasing carbohydrate intake (11–14). Continuous glucose monitoring (CGM) can also help to prevent hypoglycemia in people with type 1 diabetes (15).

In contrast, very little has been done to develop strategies for exercise-associated hyperglycemia, even though the mechanisms for this effect are largely established (16). The inability to naturally raise insulin levels after intense exercise to combat a rise in catecholamines is the main reason why post-exercise hyperglycemia occurs (17), although excursions associated with aggressive insulin reductions or excessive carbohydrate intake also likely bear some blame (18). In instances of exercise-associated hyperglycemia caused by intense exercise, insulin concentrations must increase rapidly in the bloodstream to help stabilize glucose levels (3), although evidence is lacking to guide the amount of insulin that should be administered as a correction dose.

Unfortunately, glucose control in the hours after exercise is also challenging. There may be increased meal-associated hyperglycemia as a result of insulin dose reductions before exercise or excess carbohydrate consumption to prevent hypoglycemia (19–21). There also may be late-onset hypoglycemia because of heightened skeletal muscle insulin sensitivity (22) and reduced glucose counterregulatory responses (23). The risk of nocturnal hypoglycemia has been estimated to be as high as 30% when individuals perform moderate-intensity, steady-state, aerobic

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TABLE 1. Carbohydrate Intake Strategies Based on Pre-Exercise Blood Glucose Level

Pre-Exercise Blood Glucose Concentration	Action
<90 mg/dL	Ingest 15–30 g of fast-acting carbohydrates before the onset of exercise, depending on the size of the individual. Follow with extra carbs throughout exercise.
90–149 mg/dL	Start consuming extra carbs at the onset of exercise (~0.5–1.0 g/kg body mass/hour of exercise), depending on the energy expenditure and the amount of circulating insulin at the time of exercise.
150–249 mg/dL	Initiate exercise and delay consumption of extra carbs until blood glucose levels drop to <150 mg/dL.
250–349 mg/dL	Test for ketones: do not perform any exercise if moderate to large amounts of ketones are present (27); contact your health care team. Initiate mild- to moderate-intensity exercise. Intense exercise should be delayed until glucose levels drop to <250 mg/dL because intense exercise may exaggerate the hyperglycemia.
≥350 mg/dL	Test for ketones: do not perform any exercise if moderate to large amounts of ketones are present (27); contact your health care team. If ketones are negative (or trace), consider conservative insulin correction (e.g., 50% correction) before exercise, depending on current "on board" (active) insulin status. Initiate mild to moderate exercise and avoid intense exercise (aerobic or anaerobic) until glucose levels drop.

Blood glucose concentrations should always be checked before exercise, and if glucose is dramatically elevated (≥350 mg/dL), the urine or blood should also be tested for ketones. The target range for blood glucose before exercise is 90–250 mg/dL. Carbohydrate intake should depend on the glucose concentration at the start of exercise. Regardless of their initial blood glucose concentration, patients should continue to monitor blood glucose regularly during exercise (every 30–45 minutes) using an accurate glucose meter and to adjust insulin and carbohydrate intake accordingly. In general, adjusting insulin doses before exercise will reduce the need for increased carbohydrate intake. Adapted from Refs. 26 and 27.

exercise for 45 minutes in the late afternoon (24,25).

The simplest approach for prevention of hypoglycemia during exercise may be to increase carbohydrate intake based on the pre-exercise blood glucose concentration (Table 1) (26). This strategy can be used both for exercise that occurs after a meal when circulating insulin levels are high and for exercise performed in a fasting or postabsorptive state, although the latter typically requires less carbohydrate intake because circulating insulin levels are lower. Consuming extra carbohydrates (henceforth called "extra carbs"), and therefore extra calories, may not be desirable, however; insulin dose adjustments may be preferable. Knowing how many extra carbs to consume is also a challenge.

An additional strategy to help limit hypoglycemia is to use CGM and to initiate carbohydrate intake only when needed, perhaps in conjunction with pre-exercise insulin dose adjustments (15). Table 2 shows the recommended intake amounts of fast-acting carbohydrate based on measured CGM glucose values and the directional blood glucose trend arrows observed during exercise (15).

A more physiological approach to preventing hypoglycemia is to attempt to lower circulating insulin levels for exercise. However, this can be difficult to manage precisely because of the pharmacokinetics of the various forms of insulin used and the ways in which they are delivered (i.e., subcutaneous rather than in the portal system). In general, basal insulin reductions and/or mealtime insulin adjustments should be considered for patients who can forecast the timing and intensity of their aerobic activity to help mimic normal physiology. Table 3 provides general adjustment strategies for bolus insulin based on one study conducted in adults with type 1 diabetes (6), and Table 4 provides basal rate reductions for insulin pump users based on the authors' experience and studies conducted on basal rate interruptions for exercise (8–10). Even when insulin adjustments are made, some additional carbohydrates may be needed if the exercise is prolonged or glucose levels drop to a critical level (<90 mg/dL). In such situations, directional trend arrows on CGM devices are particularly helpful in identifying when to initiate carbohydrate intake.

In the following case studies, we highlight some common examples of exercise-associated dysglycemia and possible strategies to help improve glycemic control. These cases are hypothetical, and the recommendations have not been tested in real patients.

Case 1. Aerobic Exercise and Hypoglycemia

A 26-year-old woman (weight 55 kg) who has had type 1 diabetes for 12 years expresses concern to her health care team about repeated episodes of hypoglycemia during her aerobic workout (cycling and training on an elliptical machine). She is using a multiple daily injection (MDI) insulin regimen, taking insulin glargine at bedtime and insulin aspart at mealtimes. She takes her aspart with every meal and glargine each night. She begins exercising 4 hours af-

TABLE 2. Carbohydrate Intake Strategies Based on CGM Readings

Sensor Glucose (mg/dL)	Trend Arrows	Carbohydrate Intake (g)
109–124	↓ or ↓↓	8 (2 glucose tablets)
90–108	↓	16 (4 glucose tablets)
	↓↓	20 (5 glucose tablets)
<90	No arrow	16 (4 glucose tablets)
	↓ or ↓↓	20 (5 glucose tablets)

This carbohydrate protocol can be used if CGM-measured glucose is <125 mg/dL and dropping. Because this algorithm was tested in adolescents with type 1 diabetes (15), adults may require more carbohydrate. For safety, people with diabetes should stop exercising if hypoglycemia develops (capillary blood glucose ≤65 mg/dL) and treat with 15–20 g of rapid-acting carbohydrates (28). CGM is not a substitute for capillary glucose monitoring. It should be noted that the CGM trend arrows differ slightly in appearance and display messaging, depending on the type of CGM system used. This table represents the trending arrows for the Medtronic CGM system that was used in this study. The Medtronic system shows a single downward arrow to indicate a rate of decrease in the glucose level of 1–2 mg/dL/minute; two downward arrows indicates that glucose levels are falling by ≥2 mg/dL/minute. The Dexcom CGM system displays a single downward-pointing diagonal arrow to indicate a drop in glucose of 1–2 mg/dL/minute, a single vertical downward-pointing arrow to indicate a drop rate of 2–3 mg/dL/minute, and two downward-pointing vertical arrows to indicate a drop rate >3 mg/dL/minute.

TABLE 3. Percentage Reductions in Bolus Insulin for 30 or 60 Minutes of Aerobic Exercise Performed Within 2–3 Hours After a Meal (6)

	Bolus Dose Reduction for 30 Minutes of Exercise (%)	Bolus Dose Reduction for 60 Minutes of Exercise (%)
Mild (e.g., walking, gardening, or shopping)	25	50
Moderate (e.g., brisk walking, jogging, light cycling, or skating)	50	75
Intense (e.g., intense cycling, running, dancing, or individual or team sports)	75	—

The subjects in this study were all on multiple daily injection insulin regimens using ultralente insulin as their basal insulin and lispro as their mealtime insulin. Using different basal and bolus insulins or using an insulin pump instead of taking multiple daily injections may influence the percentage of reduction in bolus insulin needed for aerobic exercise.

ter her mealtime injection and still cannot control for hypoglycemia. Her mid-afternoon exercise routine consists of 60 minutes of stationary cycling, followed by 20 minutes of elliptical work at a moderate to high intensity, three to four times per week. The health care team must determine whether hypoglycemia is occurring because of too much on-board (active) insulin remaining from her previous mealtime injection, excessive basal insulin for exercise, or too few extra carbs.

Problem: Physiological insulin does not exist for aerobic exercise, and the patient is exercising with relative hyperinsulinemia.

Option 1. Add Extra Carbs

One simple strategy to reduce the likelihood of hypoglycemia for this patient is to recommend that she consume fast-acting carbohydrates just before and throughout the activity. These extra carbs should be consumed without administering insulin.

Additional carbohydrates are often recommended for activities that last >30 minutes (27,29). The amount of extra carbs to consume is based on the size of the individual and the intensity of exercise. Evidence suggests that adolescents and young adults oxidize carbohydrate at a rate of ~1 g/kg/hour of exercise (30,31), whereas carbohydrate absorption from the gastrointestinal tract appears to be limited to ~60 g/hour during exercise (14). Thus, the extra carbs needed may be as much as 60 g/hour of exercise in this patient while she is exercising at a moderate intensity.

A study by Francescato et al. (32) showed that the amount of carbohydrate required before and during exercise to prevent hypoglycemia in individuals with type 1 diabetes is correlated to plasma insulin, but not fitness, level. Therefore, this patient's training status may not affect her extra carbs requirement, but the timing of her exercise in relation to her last meal might. In one study (32), the amount of extra carbs needed by type 1 diabetes patients to prevent hypoglycemia decreased as the time elapsed from insulin administration (regular insulin) increased. However, in another study of people using insulin isophane (Humulin N) and lispro, there was a similar risk of hypoglycemia during early and late postmeal exercise (33). Based on a large survey of people with diabetes (the type of diabetes was not identified), exercising 1–2 hours after a meal was associated with greater drops in glucose than exercising within 30 minutes before or >3 hours after a meal (34).

We have also found that fewer extra carbs will be needed if there is

TABLE 4. Percentage Reductions in Basal Insulin for 60 Minutes of Aerobic Exercise Performed by People Who Use an Insulin Pump and Exercise After a Meal

Aerobic Exercise Intensity	Basal Rate Reduction for 60 Minutes of Exercise (%)
Mild	30
Moderate	50
Intense	90–100

Basal rate reductions should be made 60–90 minutes before the onset of exercise and should last until the activity is completed. Prolonged disconnection of the pump or reductions in the basal rate to 0 may result in hyperglycemia. Individuals should test their glucose levels frequently and resume basal insulin delivery or provide bolus delivery if glucose levels are rising toward the hyperglycemic range.

a low level of on-board insulin from a previous bolus. These extra carbs are meant to be consumed in small portions rather than as one large meal or snack (11). For example, if 55 g of extra carbs are required for 1 hour of exercise for this patient, ~22 g should be consumed before exercise and the remaining 33 g should be divided into two or three small snacks during the exercise session.

Many patients who are on low-carbohydrate diets or who are interested in weight loss might find this amount of carbohydrate excessive. In this case, the woman could consume a total of 55 g of rapid-acting carbohydrate during the first hour of cycling and an additional few grams if needed before her 20-minute elliptical session. Although many patients find this amount of extra carbs excessive, one study of adolescents with type 1 diabetes found that it prevented hypoglycemia without promoting hyperglycemia (11).

Because excessive carbohydrate intake may promote gastric distress (35) and will add to the total daily calories consumed (220 extra kcals in this example), this option may not be preferred for routine exercise, as in this case. Regular exercise reduces total daily insulin needs in lean individuals with type 1 diabetes by ~10–20% (36–38). Moreover, this amount of training would be expected to lower her reliance on carbohydrates as a fuel for exercise (39).

Option 2. Adjust Basal Insulin

Because of the timing of her exercise, the health care team has noted that this patient has little to no active on-board prandial insulin at the start of her afternoon workout. During exercise, glucose is taken up into skeletal muscle and then oxidized via a noninsulin-mediated process (40). However, some insulin is still required in the blood during exercise to prevent hyperglycemia caused by excessive hepatic glucose production and impaired glucose uptake into working muscle (41,42). Thus, one strategy might be to lower her bedtime insulin glargine by 20% on the evening before exercise or to split her long-acting insulin into two equal doses (morning and night) and reduce the morning dose on the days she exercises. A reduction in bedtime insulin could also then be made if nocturnal hypoglycemia continued to occur after exercise.

However, for MDI patients, this strategy may increase the risk of hyperglycemia throughout the day before the physical activity. In any case, this patient should measure glucose levels during the night after exercise at 3:00 a.m. to determine how much her glucose drops between bedtime to 3:00 a.m. Anyone whose glucose drops >40 mg/dL overnight should be considered to be at high risk for nocturnal hypoglycemia (43).

Option 3. Frequent Glucose Monitoring and a Change to Insulin Pump Therapy

It is usually recommended that at least two pre-exercise glucose measurements be taken and that monitoring be done intermittently during exercise (e.g., every 30 minutes). Frequent glucose monitoring after exercise should help protect against post-exercise hypoglycemia. Research has shown that the greatest susceptibility to hypoglycemia after exercise occurs at ~2:00–3:00 a.m. (43,44). However, nocturnal hypoglycemia can occur any time after exercise (45).

If hypoglycemia cannot be managed through any of these recommendations, the health care team should ask this patient to consider continuous subcutaneous insulin infusion (CSII, or insulin pump therapy). Since the late 1970s, many studies have shown that CSII leads to significant improvements in glycemic control, with resulting improvements in A1C (46). Increased flexibility with regard to exercise has also been reported with CSII (19). For this patient, CGM and pump therapy should provide added flexibility with regard to basal insulin adjustments and carbohydrate intake based on directional trend arrows from the CGM. It should be acknowledged, however, that insulin pumps and CGM have not yet been widely adopted, perhaps because of accessibility issues, costs, device complexity, and attitudes about ease of use (47).

Case 2. Post-Exercise Hyperglycemia and Nocturnal Hypoglycemia

A 17-year-old boy who has had type 1 diabetes for 6 years has been experiencing nocturnal hypoglycemia after high-intensity interval training with sprints. He has been using an insulin pump for 3 years and has been participating in contact sports for numerous years. He has a low body fat percentage, weighs 84 kg, and is 6 feet, 2 inches tall. Because of the nature of his exercise, he removes his insulin pump during training, usually for ~1 hour. When he reconnects his pump, he always administers a half correction bolus of insulin based on his elevated glycemia in early recovery. He has told his health care team that he knows from experience that without the half correction bolus after reconnecting his pump, he experiences severe rebound hyperglycemia after exercise. He has been noticing that, in the early morning hours after exercise, his blood glucose levels are low (50–70 mg/dL).

Problems: Prolonged disconnection of the insulin pump for high-intensity exercise results in relative hypoinsulinemia by the end of exercise, and heightened insulin sensitivity in recovery (for ~12 hours) predisposes the patient to nocturnal hypoglycemia.

Option 1. Conservative Correction of Post-Exercise Hyperglycemia and a Bedtime Snack

Post-exercise hyperglycemia can result from intense exercise (16), excessive carbohydrate intake (11,19), or large insulin dose reductions (18). Treating post-exercise hyperglycemia must be done cautiously, particularly at bedtime, because severe hypoglycemia may ensue (48). Although no standard guidelines exist for treating post-exercise hypoglycemia, a conservative insulin correction (50% correction dose), along with frequent glucose monitoring, seems prudent.

Episodes of nocturnal hypoglycemia are a concern for active people with type 1 diabetes (49). Strategies for preventing nocturnal hypoglycemia differ for patients who are on MDI versus those on CSII. Kalergis et al. (50) suggest that patients on MDI should consume a bedtime snack that consists of protein and complex carbohydrates. Those on CSII can do this as well, but they also have the capacity to adjust their basal insulin infusion rate both during exercise and in recovery. Small bolus corrections are also more easily calculated and performed with pump therapy. In addition to consuming a bedtime snack, insulin adjustments may be required as discussed in option 2 below. Although low–glycemic index meals and bedtime snacks often help to limit postprandial hyperglycemia in MDI or CSII patients, it appears that this strategy does not entirely protect against post-exercise, late-onset hypoglycemia (21).

Either way, some examples of appropriate snacks in the recovery period once post-exercise hyperglycemia has been resolved include fruit smoothies (dairy-based), yogurt drinks, or fruit mixed with yogurt. Studies have shown that dairy (e.g., chocolate milk) consists of a 4:1 ratio of carbohydrate to protein, is beneficial for muscle glycogen resynthesis, and aids in rehydration (51). For individuals who are lactose intolerant, protein options include nuts and seeds (e.g., almonds, peanuts, or pumpkin seeds), quinoa, and soy milk. Lactose-free yogurt or dairy options are also available. Because protein requirements are greater in athletes than in nonathletes (~1.2–1.7 $g \cdot kg \cdot day^{-1}$ in endurance-trained and strength-trained athletes) (52), this patient would require ~100–140 g of protein daily. This could include a snack containing 7–10 g of protein and 30–40 g of carbohydrates.

Option 2. Program a New Basal Insulin Infusion Pattern on the Pump

Another recommendation would be to reduce the basal insulin infusion rate at bedtime on the evening after interval training. For young patients using CSII, Taplin et al. (53) demonstrated that reducing the basal rate by ~20% between 9:00 p.m. and 3:00 a.m. largely prevented nocturnal hypoglycemia caused by afternoon aerobic exercise. On days when this patient is active, the health care team might consider setting a new preprogrammed basal insulin pattern on his pump (i.e., a 20% basal rate reduction starting at bedtime and continuing for 6 hours). Once again, the post-exercise hyperglycemia would need to be resolved before initiating an overnight basal rate reduction.

Option 3. Stay Connected If Possible

It is common for individuals with type 1 diabetes to experience rebound hyperglycemia with intense exercise, particularly after an extended period of time (>1–2 hours) without basal insulin infusion. Competition stress may also promote hyperglycemia. The health care team might suggest that the patient maintain his insulin pump usage during interval training to help limit the hyperglycemia that occurs after exercise. If the insulin pump is to be worn, a basal rate reduction of 50–80% starting 1 hour before training would be recommended to help limit the risk of hyperglycemia but still offer some protection against hypoglycemia. This strategy should help to minimize the need for a post-exercise correction bolus that could be contributing to late-onset hypoglycemia.

Aggressive post-exercise insulin corrections near bedtime may have contributed to severe hypoglycemia and death in at least one patient with type 1 diabetes (48). One key recommendation would be to perform more frequent glucose monitoring at bedtime. It is also important to stress that hyperglycemia during and after exercise can be caused by a number of factors, including stress, overconsumption of carbohydrates before exercise, or even miscalculating insulin dose adjustments (26). Going to bed with a slightly elevated blood glucose concentration after a bedtime snack or a 20% basal rate reduction would be expected to minimize hypoglycemia risk. Cautious (conservative) correction of post-exercise hyperglycemia close to bedtime is also warranted.

Case 3. Endurance Exercise and Strength Training Exhaustion

A 46-year-old, lean, active man with type 1 diabetes incorporates both aerobic and resistance training into his exercise regimen 4–5 days/week. He likes to run and cycle but also feels it is important to do some resistance activity during every workout to maintain strength and lean mass. The aerobic portion of exercise usually lasts from 30–45 minutes followed by 20–30 minutes of weight-lifting.

The patient has been wearing an insulin pump for 12 years and recently added CGM to provide real-time information about changes in his glucose levels during exercise. He tells his health care team that his blood glucose control is better on an insulin pump than it was on MDI therapy. However, he sometimes still struggles with hypoglycemia during exercise despite a basal rate reduction at the onset of exercise. He also mentions that his glucose sensor appears to be "off" or at least delayed compared to his actual blood glucose levels based on the frequent monitoring he performs with a glucose meter during exercise. Hypoglycemia occurs within 30–40 minutes after the start of his aerobic workout, and this often delays his resistance workout or makes him too weak for weight training.

Problem: Performing steady-state aerobic exercise before resistance exercise causes rapid hypoglycemia, leaving minimal energy for strength training.

Option 1. Understanding and Responding to CGM-Derived Data

The main concern for this patient is that he experiences hypoglycemia during the aerobic portion of his workout, and this deteriorates his strength for subsequent weight training. As mentioned above, hypoglycemia is a barrier to physical activity (54), and exercise training does not appear to minimize its risk (55). Real-time glucose sensing with a CGM device can help alleviate fear, increase glucose awareness, and improve glucose control during exercise. However, some limitations of CGM need to be acknowledged.

Although exercise does not appear to affect sensor accuracy (55), the delay in equilibrium between interstitial fluid and capillary blood can be troublesome during rapid drops in glycemia, which tend to occur during aerobic exercise. Indeed, CGM readings have been reported to have lag times of anywhere from 5 to 28 minutes compared to capillary or venous glucose measurements in humans, depending on the experimental conditions (56–59). Exercise-mediated acidosis has also been reported to reduce sensor accuracy (60). If blood glucose is increasing or decreasing at a rapid rate (220 mg/dL/hour^{-1}), there may be a more pronounced mismatch between sensor values and actual blood glucose values because of an intrinsic sensor lag (61). However, when calibration conditions are optimized, sensor lag time has been reported to be as short as 1.5 or 8.9 minutes when glucose levels are falling or rising, respectively, in people with type 1 diabetes who are at rest (62). During aerobic (63,64) and resistance (64) exercise, CGM has been shown to track glucose changes accurately with a reduced lag time compared to during rest, perhaps because of increased blood flow–mediated equilibrium.

Although CGM can help to alert patients to drops in glycemia and thus help to prevent hypoglycemia, patients need to develop strategies for carbohydrate intake if downward trend arrows are observed. In one small pilot study of adolescents with type 1 diabetes (15), an intake algorithm for rapid-acting carbohydrate helped to eliminate hypoglycemia in a sports camp setting. Table 2 provides recommendations based on sensor glucose readings and trending arrows.

Also, the starting blood glucose concentration before exercise is extremely important in determining when carbohydrate intake should be initiated. The health care team could suggest the strategies described in Table 1 for the aerobic portion of the exercise session. They should also recommend a basal insulin infusion rate reduction to start well before the start of exercise (Table 4).

Option 2. Change the Order of Exercise: Anaerobic First

The order of this patient's exercise routine needs consideration. Yardley et al. (65) recently published evidence that performing resistance exercise before aerobic exercise reduces the likelihood of developing hypoglycemia in individuals with type 1 diabetes. In this case, the health care team could recommend doing the resistance training before the aerobic exercise, with the caveat to alternate daily the muscle groups used during strength training to help promote muscle recovery. Resistance training before aerobic exercise also has been shown to decrease reliance of fast-acting carbohydrates during exercise (66).

Because resistance exercise may not be done every day for recovery reasons, sprinting either at the start (67) or at the end (68) of aerobic workouts may help boost glucose levels in recovery. It should be noted that for individuals who often experience pre-exercise hyperglycemia, performing an aerobic activity first might be preferable to help lower glucose levels to target before performing any anaerobic or resistance-based activities.

Conclusion

Numerous possible strategies exist for managing blood glucose levels during and after exercise for individuals with type 1 diabetes. These include increasing carbohydrate intake before, during, and after exercise; lowering pre-exercise insulin levels by reducing prandial or basal insulin or both; and changing the type or order of the exercise performed (anaerobic vs. aerobic). Because no strategy can guarantee stable blood glucose levels during and after exercise, using CGM may improve control; CGM can help to facilitate minute-by-minute changes in insulin delivery or nutrient intake.

Patients and caregivers should be made aware of the multiple factors that can affect glucose levels during and after exercise, including the amount of active, or on-board, insulin at the time of exercise; the intensity, duration, and type of activity performed; and the type and amount of carbohydrates consumed before exercise. Although the fear of hypoglycemia during and after exercise may remain, implementing these reasonable management strategies can help to reduce this fear and enhance the overall well-being of active people with type 1 diabetes.

Duality of Interest

D.P.Z. is a speaker for Medtronic Canada. M.C.R. is a speaker for Medtronic Canada and Eli Lilly and Co., and an advisory board member for Sanofi Global. No other potential conflicts of interest relevant to this article were reported.

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