Case Study: "Diabetes Fits" Sports and Education Camps: Putting Research Into Action

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Participation in regular physical exercise is an important component of diabetes management because it can help to delay many long-term diabetes-related complications.[1] Paradoxically, exercise is also associated with short-term complications that include unpredictable changes to blood glucose and increases in the risk of hypoglycemia.

Beyond their own experience, there are very few ways for individuals with diabetes to learn how exercise influences their blood glucose levels or preventive techniques to minimize the risk of exercise-related hypo- and hyperglycemia. Health care providers can most often only recommend a trial-and-error approach because of the variability among patients in blood glucose responses to exercise.

For this reason, a sports and education camp called Diabetes Fits has been developed to provide a practical way for individuals with diabetes, their families, and even health care providers to learn how to improve glycemic control based on current diabetes- and exercise-related research in an enjoyable atmosphere.

Diabetes Fits programs focus on three primary elements. First, they teach participants how diabetes can influence normal physiological functioning and thus blood glucose control during exercise. Indeed, such knowledge is key to empowering individuals with diabetes to better control their blood glucose. If patients understand the physiological reasons why their blood glucose may change as a result of specific types or intensity levels of exercise, they may be better able to prevent such changes and reduce harmful glucose fluctuations.

Second, the program teaches insulin and carbohydrate-related strategies (and their physiological basis) to prevent exercise-related hypo- and hyperglycemia. For example, most individuals may feel more comfortable supplementing exercise with extra carbohydrate because such an approach is quick and easy. However, techniques to reduce either bolus or basal insulin may minimize the need for consuming these added calories.

Finally, Diabetes Fits programs also provide participants with an opportunity to learn new sports and exercise regimens in a safe atmosphere while gaining practical experience using the glucose management techniques and other concepts they have learned during lectures.

Diabetes Fits 2009

The Diabetes Fits camp was held in April 2009 in Perth, Australia. It included 53 participants with diabetes and 30 of their family members and friends. Other attendees included 10 diabetes educator nurses and an endocrinologist who served as volunteer staff. There were several other volunteers including students, university staff members, and parents of children with diabetes.

Camp structure

Diabetes Fits was held during two 8-hour days and consisted of a mix of practical and theoretical sessions covering several aspects of physical activity. The practical components included lessons in swimming, cycling, running, and strength conditioning in both indoor and outdoor environments. Depending on the fitness level of each participant, these sessions offered everything from basic skills acquisition to more advanced endurance training. Theoretical sessions included lectures on exercise physiology and diabetes, nutrition, training techniques, and sports psychology. The camp concluded with a mini "try-a-triathlon" that allowed participants to combine the sports skills they learned during the 2 days.

Participant characteristics

The 2009 program participants ranged in age, fitness, and duration of diabetes, with 15% diagnosed within the previous 2 months (Table 1). All participants under the age of 18 years were accompanied by a parent or guardian. Those using insulin pumps had a significantly lower A1C (7.1 ± 0.01%) than those on multiple daily injection therapy (7.7 ± 0.01%; P = 0.03; mean ± SD), a finding consistent with previous reports.[2] There was no relationship between the amount of weekly exercise and A1C (r^2 = 0.03).

Continuous glucose monitoring

Twelve of the 53 participants were selected at random and offered use of a continuous glucose monitoring (CGM)

Table 1.Diabetes Fits 2009 Participant Characteristics

Age (years)*	Duration of Diabetes (years)*	Sex	Insulin Regimen	A1C (%)*	Exercise (hours/week)*
29.3 ± 15.2 (6–65)	8.9 ± 9.0 (0–37)	37 Female 16 Male	20 Insulin pump 33 Multiple daily injections	7.4 ± 0.9 (5.1–10.0)	6.1 ± 3.8 (1–18)

Values represent mean ± SD; range provided in parentheses.

system for the weekend. All gave informed consent before using the system. CGM users ranged in age from 8 to 65 years. Five used the GuardianRT, and seven used the ParadigmRT (both by Minimed Medtronic, Northridge, Calif.). Two monitors, however, did not pick up the sensor signal despite repeated attempts.

Based on numerous discussions, most CGM users felt the system provided a useful tool for glycemic management by providing information on trends and rate arrows, and a few found that CGM helped stabilize their glucose within the 72-hour period (Figure 1). In contrast, users also found the differences between CGM sensor glucose readings and glucose meter readings at times frustrating; indeed, CGM has been reported to be less accurate during glycemic instability, such as during exercise.[3]

Because all of the exercise sessions and provided meals were novel to all participants, many found it challenging to minimize their glucose fluctuations. There were no reports of site infection from sensor insertion or tape.

Camp outcomes

Questionnaires were completed at the end of the 2009 program by 41 of the 53 participants. Answers were based on a 5-point Likert scale (1 = strongly agree; 5 = strongly disagree). Ninety-two percent of the respondents "learned a lot from the education lectures" (mean response 1.5; standard deviation [SD] ± 0.7), and 78% believed they will "increase their levels of fitness after [the Diabetes Fits] camp" (mean response 1.8; SD ± 1.0). However, many participants were already involved in intense training (> 10 hours/week) and thus noted in writing that this was the reason for their "disagreement" with this question (responses ≥ 3). All respondents agreed they would recommend the camp to others (mean response 1.2; SD ± 0.4), and 95% indicated that they would attend the camp again if it were designed to be specific for their age and fitness level (mean response 1.3; SD ± 0.6). Other indicators of camp success were apparent from the overwhelming expressions of gratitude and e-mails sent after the camp.

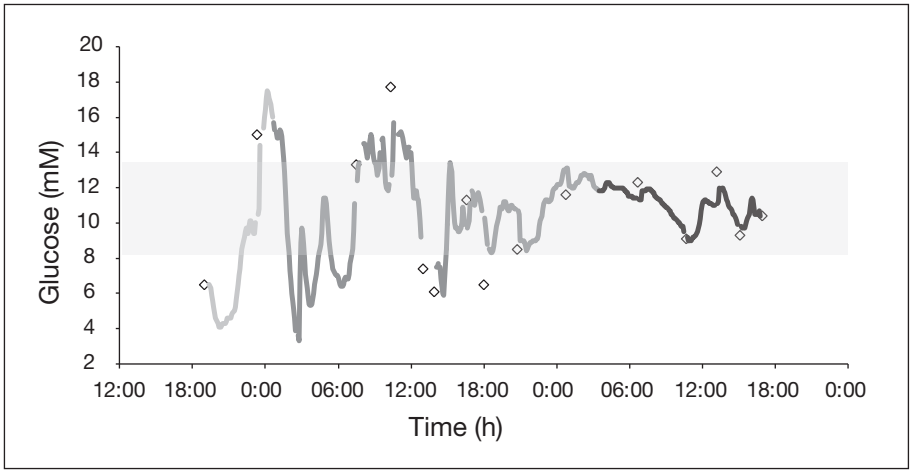

Figure 1. CGM data from one participant. Shaded lines represent different (consecutive) days. Open diamonds represent glucose meter readings entered into the monitor. The shaded area emphasizes changes in glycemic profile over time.

Conclusion

As MacKnight et al.[4] noted, "appropriate glucose management in diabetic athletes is dependent on both the athlete and the care provider having a firm understanding of the pathophysiology of diabetes and its nuances with respect to athletic participation." However, for health care providers to provide such detailed knowledge is not possible in a single clinic visit or even in a series of medical consultations.

Diabetes Fits programs are therefore designed to supplement information provided by participants' health care providers in an attempt to improve diabetes management and thus participants' confidence in engaging in physical activity. The success of the 2009 camp program and the current waiting list of > 70 prospective participants suggest that such programs

are not only needed, but also may be a very effective method of increasing and improving exercise participation in this population.

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