Techniques for Exercise Preparation and Management in Adults with Type 1 Diabetes

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ABSTRACT

Objectives: People with type 1 diabetes are at risk for early- and late-onset hypoglycemia following exercise. Reducing this risk may be possible with strategic modifications in carbohydrate intake and insulin use. We examined the exercise preparations and management techniques used by individuals with type 1 diabetes before and after physical activity and sought to determine whether use of differing diabetes technologies affects these health-related behaviours.
Methods: We studied 502 adults from the Type 1 Diabetes Exchange's online patient community, Glu, who had completed an online survey focused on diabetes self-management and exercise.
Results: Many respondents reported increasing carbohydrate intake before (79%) and after (66%) exercise as well as decreasing their meal boluses before (53%) and after (46%) exercise. Most reported adhering to a target glucose level before starting exercise (77%). Despite these accommodations, the majority reported low blood glucose (BG) levels after exercise (70%). The majority of users of both insulin pump therapy (CSII) and continuous glucose monitoring (CGM) (Combined) reported reducing basal insulin around exercise (55%), with fewer participants adjusting basal insulin when using other devices (SMBG only = 20%; CGM = 34%; CSII = 42%; p<0.001). However, CSII and Combined users reported that exercise makes their BG levels harder to control (p<0.05) and makes them feel less able to predict their BG levels while exercising (p<0.001); they show agreement that fear of low BG levels keeps them from exercising (p<0.01).
Conclusions: These findings highlight the need for exercise-management strategies tailored to individuals' overall diabetes management, for despite making exercise-specific adjustments for care, many people with type 1 diabetes still report significant difficulties with BG control when it comes to exercise.

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RÉSUMÉ

Objectifs : Les personnes atteintes de diabète de type 1 sont à risque de développer une hypoglycémie avec un déclenchement précoce et tardif après l'exercice. La réduction de ce risque peut être possible par des modifications stratégiques dans l'apport en glucides et dans l'usage de l'insuline. Nous avons examiné les préparatifs de l'exercice et les techniques de gestion utilisées par les individus atteints de diabète de type 1 avant et après l'activité physique, et avons cherché à déterminer si l'utilisation de différentes techniques de traitement du diabète affecte ces comportements liés à la santé.
Méthodes : Nous avons étudié 502 adultes issus de la communauté d'échange en ligne de patients atteints de diabète de type 1, Glu, qui avaient complété un sondage en ligne axé sur l'autogestion du diabète et l'exercice.
Résultats : De nombreux répondants ont rapporté augmenter l'apport en glucides avant (79%) et après (66%) l'exercice, et aussi réduire leurs bols alimentaires avant (53%) et après (46%) l'exercice. La plupart ont rapporté se baser sur un niveau cible de glucose avant de commencer l'exercice (77%). En dépit de ces ajustements, la majorité a rapporté de faibles taux de glucose sanguin (BG) après l'exercice (70%). La

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majorité des utilisateurs à la fois de la thérapie par pompe à insuline (CSII) et de la surveillance continue du glucose (CGM) (Combiné) a rapporté réduire l'insuline basale jouxtant l'exercice (55%), avec moins de participants ajustant l'insuline basale lors de l'utilisation d'autres appareils (autosurveillance de la glycémie (SMBG) seulement=20%; CGM=34%; CSII=42%; p<0,001). Cependant, les utilisateurs de la CSII et les utilisateurs combinés ont rapporté que l'exercice rend leurs niveaux de glycémie plus difficiles à contrôler (p<0,05), et les fait se sentir moins capables de prédire leurs niveaux de glycémie pendant l'exercice (p<0,001); ils se montrent d'accord sur le fait qu'une crainte de niveaux faibles de glycémie les empêchent de faire de l'exercice (p<0,01).

Conclusions : Ces résultats mettent en évidence la nécessité de développer des stratégies de gestion de l'exercice ajustées à la gestion d'ensemble du diabète des individualités, car malgré des ajustements spécifiques à l'exercice dans un but curatif, beaucoup de personnes avec un diabète de type 1 rapportent encore des difficultés importantes dans le contrôle de la glycémie pour ce qui a trait à l'activité physique.

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Introduction

Regular exercise has numerous physiologic and psychological benefits for people of all ages who are living with type 1 diabetes (1) and currently, the American Diabetes Association recommends physical activity as part of managing all forms of diabetes (2). Despite these recommendations, however, most adults with type 1 diabetes participate less frequently in physical activity than people without diabetes (3). Although the reasons for this are multifactorial, including low fitness levels, the overriding barrier to participating in exercise for individuals with type 1 diabetes appears to be fear of severe hypoglycemia coupled with a lack of knowledge of effective strategies for hypoglycemia avoidance (4).

The impact of exercise on blood glucose (BG) levels in type 1 diabetes is influenced by the type and intensity of the activity, with aerobic activities associated with a greater risk for hypoglycemia than anaerobic activities (5–10). Duration of physical activity also has an impact, with longer periods of exercise increasing the risk for hypoglycemia. Therefore, for individuals with type 1 diabetes interested in participating in exercise, there is an unmet need to understand the risks, benefits and potential consequences associated with sustained physical activity and also to develop strategies to minimize their personal risks for hypo- or hyperglycemia. Recommendations include modifying rates of basal insulin, changing the dose of rapid-acting mealtime insulin before and after exercise, consuming additional carbohydrates and using continuous glucose monitoring (CGM) to monitor glucose levels more closely than can be achieved by fingerstick alone (1,11–13).

The aim of this study was to identify the current strategies that free-living adults with type 1 diabetes use to prepare, monitor and adjust their diabetes management regimens before, during and after physical activity and to determine how overall diabetes management of physical activity may be influenced by the use of differing diabetes-related technologies for glucose monitoring and insulin delivery.

Methods

We conducted an online survey of individuals with type 1 diabetes that assessed exercise-management techniques and evaluated how these techniques vary depending on the technologies relied upon for diabetes management. These technologies included use of 1) CGM without continuous subcutaneous insulin infusion (CSII); 2) CSII without CGM; 3) CSII and CGM together (Combined) or 4) fingerstick self-monitoring of blood glucose (SMBG) only (without CSII or CGM). The survey also focused on target BG levels before and after exercise; whether there were BG levels for which individuals with type 1 diabetes wait to attain before participating in exercise; and whether exercise causes changes in BG levels and when these changes occur. This survey also contained questions focused on a priori adjustments in insulin dosages and whether participants usually consume carbohydrates before planned physical activity. Information concerning the intensity and duration of exercise undertaken by subjects was also captured.

Study procedure

Participants were recruited from the Type 1 Diabetes Exchange's online patient community, Glu (myGlu.org). Registered Glu users who indicated preferences to be contacted about research opportunities were informed of the study through e-mail, a listing on the Glu website or social media channels (Facebook and Twitter). Participants were required to be 18 years of age or older and to have self-reported diagnoses of type 1 diabetes. Prior to participating in the study, each participant provided informed consent. All study materials were approved by the Institutional Review Board at the Jaeb Center for Health Research (Tampa, Florida, USA). Participants received no compensation for taking part in the study. Study participants completed an online questionnaire that included questions related to their diabetes histories, exercise regimens, diabetes management before, during and after exercise, diabetes management for different types of exercise, and feelings about the impact of exercise and the latest technologies on their glycemic control. Data verification and quality assessments were performed to ensure completeness and accuracy of the dataset. At least 50% of the survey items required valid responses so as to include the participants' data in the final analysis.

Statistical analysis

Data were analyzed using SPSS 23 Statistical Software (IBM, Chicago, Illinois, USA). All scale data were tested for normality prior to analyses by using Kolmogorov-Smirnov and Shapiro-Wilks tests in addition to Q-Q plots. No transformations of the data were required. Descriptive analyses included means, standard deviations and cross-tabulations of multiple categoric variables. When appropriate, we computed 1-way analyses of variance (ANOVA) and chi-square values to evaluate group differences. For significance testing, the alpha was set at 0.05.

Results

Participant characteristics, device uses and exercise behaviours

The 85-item survey (Supplement) was available on Glu for 23 days. Individual items were optional (participants were permitted to skip an item and go forward). A total of 502 Glu users completed at least 70% of the survey and were included in the analysis. Of this sample, 68% were women, and the mean age was 42.4±15.3 years (range, 18 to 82 years). For further analysis, participants were divided into groups based on which devices they currently used to manage their type 1 diabetes: SMBG only (n=81); CSII