American Journal of Medicine Open 7 (2022) 100011

Contents lists available at ScienceDirect

American Journal of Medicine Open

journal homepage: www.elsevier.com/locate/ajmo

Brief Observation

Peak performance: Putting type 1 diabetes management recommendations for athletes to the test

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A B S T R A C T

Background: Athletes with type 1 diabetes (T1D) face unique challenges to maintain optimal glucose levels and therefore require tailored guidance from their healthcare providers. Herein, we aim to summarize and compare recommendations targeted at T1D management in athletes in commonly used clinical practice guidelines and topical position statements. The objective is to assess if the available recommendations are comprehensive enough for athletes to apply to high-performance sport.

Methods: From seven clinical practice guidelines and positions statements, we identified recommendations relevant to athletes with T1D, based on a specific hierarchy. For included recommendations, we extracted relevant information including the year of publication, author(s), chapter name or number, text for the recommendation, and level of evidence. Based, on the clinical topic covered, we grouped included recommendations to five themes.

Results: We screened a total of 126 recommendations, of which 60 recommendations were included. The National Athletic Trainers' Association provided the highest number of recommendations relevant to athletes with T1D ($n = 27$). Insulin modifications was the most covered clinical theme ($n = 18$). The 2018 Diabetes Canada and 2021 American Diabetic Association guidelines linked recommendations directly with levels and grades of evidence. None of the recommendations had level 1 or grade A evidence. Three recommendations from Diabetes Canada reported level 2, grade B evidence. American Diabetic Association reported 1 recommendation with grade B evidence, and 2 recommendations with grade C evidence.

Conclusions: There is an opportunity for expansion of clinical practice guidelines to increase the depth and breadth of recommendations for high performance athletes with T1D.

Introduction

Physical activity, including aerobic and resistance exercise is recommended for type 1 diabetes (T1D) management; however, participating in competitive sports or high-level physical activity imposes a unique set of challenges. These include maintaining glycemic control, administering insulin, and consuming adequate carbohydrates, while training and competing at high-performance levels. Training for competitive sports typically involves a substantive number of hours of continuous and intermittent exercise with varying intensity levels. Therefore, without proper management and guidance from their health care providers, athletes are at an increased risk of acute and life-threatening complications, such as hypoglycemia and ketoacidosis.

Clinical practice guidelines and position statements by professional organizations are often a primary source of succinct recommendations for health care providers. Herein, we aim to summarize and compare relevant recommendations for T1D management in athletes listed in commonly used clinical practice guidelines and topical position statements.

Methods

First, we screened all formal English language recommendations from the following clinical practice guidelines and position statements that were identified a priori based on our own knowledge of the literature and a Pubmed literature search: (1) American Diabetes Association (ADA) 2021 Standards of Medical Care in Diabetes,[1] (2) European Society of Cardiology Guidelines on diabetes, pre-diabetes, and cardiovascular disease developed in collaboration with the European Association for the Study of Diabetes (EASD),[2] (3) Diabetes Canada (DC) 2018 Clinical Practice Guidelines,[3] (4) Type 1 diabetes in adults: diagnosis and management – National Institute for Health and Care Excellence Guidelines (NICE),[4] (5) Australian Diabetes Society (ADS) National Evidence-Based Clinical Care Guidelines for Type 1 Diabetes in Children, Adolescents and Adults,[5] (6) Position of the American Dietetic Association (Dietetic), Dieticians of Canada, and the American College of Sports Medicine: Nutrition and Athletic Performance,[6] and (7) National Athletic Trainers' Association (NATA) Position Statement: Management of the Athlete with Type 1 Diabetes Mellitus.[7] We identified recommendations relevant for athletes with T1D based on the following hierarchy: A. All recommendations from a guideline or position statement designed specifically for athletes with T1D; B. All recommendations published in a specific chapter for T1D athletes, and C. Recommendations that contain the following keywords: athletes, exercise, activity, sport, aerobic, resistance, endurance, workout, or training. Keywords were based on authors expertise and specified a priori. Recommendations specific for

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https://doi.org/10.1016/j.ajmo.2022.100011
Received 9 July 2021; Accepted 7 March 2022
Available online 11 March 2022

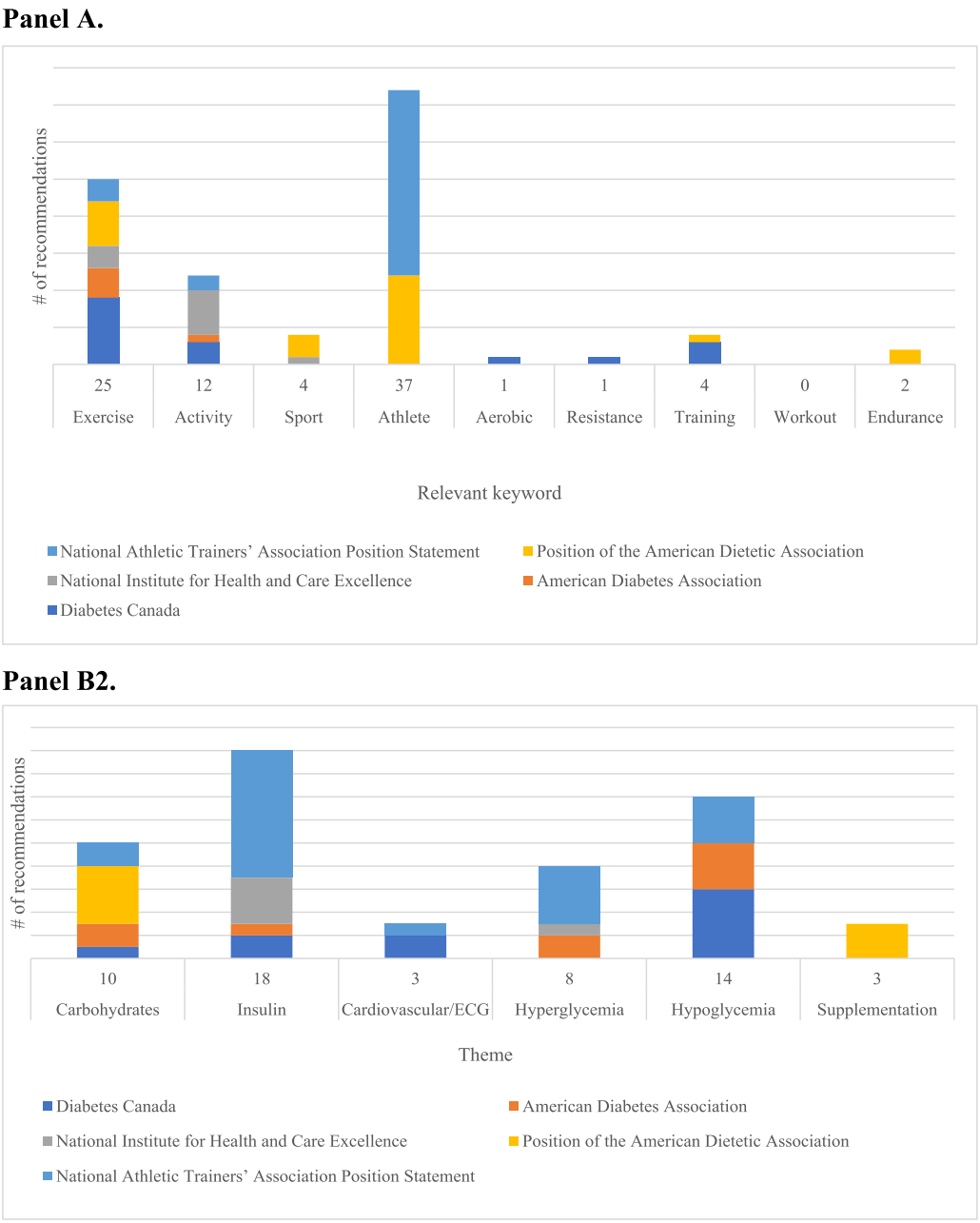

Fig. 1. Keyword and themed recommendations gathered from inclusion criteria.

type 2 diabetes, gestational diabetes, or other specific types of diabetes were excluded.

Second, for each included recommendation, we extracted the guideline or position statement, the year published, the author(s), the chapter name or number, the text for the recommendation, and the level of evidence of that recommendation. For the latter, the level of evidence must have been assessed by the guideline/position statement and linked directly to a specific recommendation.

Third, we categorized each included recommendation according to the 9 keywords listed above and subsequently grouped recommendations into five themes: insulin modifications, carbohydrate intake requirements, hypoglycemia and hyperglycemia avoidance, supplementation, and cardiovascular and electrocardiogram (ECG) screening requirements. We considered stand-alone statements that were nested under a common recommendation to be separate recommendations to assess for keywords and themes. The themes were identified by the authors a priori and were designed to be not only useful for athletes, but also for clinicians to reference when discussing these topics with their patients.

Fourth, based on frequency of recommendations, level of evidence, and clinical significance, we developed a summarized checklist of discussion points to guide a collaborative discussion between athletes and their healthcare providers to increase physical activity capacity and improve outcomes. Specifically, the checklist is the author's compilation of key recommendations from the clinical practice guidelines and statements reviewed. The checklist recommendations are summary statements based on (1) the most frequently mentioned concepts; (2) recommendations with a high level of evidence; (3) recommendations that are deemed clinically significant by author consensus. We considered recommendations about insulin dosing, glucose monitoring, carbohydrate and fluid intake, or physical activity to be of clinical significance.

Table 1
Athletes with Type 1 Diabetes Checklist. This checklist is to be reviewed collaboratively between the athlete with type 1 diabetes and the health-care provider to increase physical activity and improve outcomes

Topics	Discussion Points
Goal Setting	Athletes with diabetes should have a diabetes care plan for practices, games, and competitions
	Establish strategies for hypoglycemia prevention
	Identify barriers to achieve goals
	Provide information on when and where to exercise
Insulin Dosing	Consider reducing the bolus dose of insulin that is most active at the time of exercise
	Athletes should review their specific insulin dosage requirements with a specialist to determine if an adjustment is necessary
Glucose Monitoring	Encourage frequent glucose monitoring before, during, and after exercise, or the use of continuous glucose monitoring devices
	Ensure athletes have a pre-exercise glucose level that is sustainable for the type and duration of exercise the athlete is planning
	Supplies to treat diabetes-related emergencies, such as hypoglycemia, should be available at all practices and games
Carbohydrate and Fluid Intake	Athletes with diabetes should discuss specific carbohydrate requirements with their clinician
	Required carbohydrate intake will vary depending on the type of exercise that the athlete participates in
	After exercise, the athlete should drink adequate fluids to replace sweat losses during exercise
Activity Considerations	Educate on performing brief, maximal-intensity sprints at the start of exercise, periodically during the activity, or at the end of exercise
	Interval training can be recommended to reduce risk of hypoglycemia during exercise in type 1 diabetes
	Perform resistance exercise before aerobic exercise\
	Considering recent evident, aerobic exercise may have advantages over intermittent exercise especially for glycemic control in the 24-hour period following exercise

Note this checklist should not be used independently of other resources when counselling an athlete on their management of exercise and type 1 diabetes.

Results

There were 126 recommendations screened for inclusion, of which 60 recommendations were deemed relevant to athletes with T1D after applying our inclusion hierarchy and exclusion criteria. NATA had the highest number of recommendations at 27, followed by Dietetic with 13 recommendations, DC with 9 recommendations, NICE with 7 recommendations, and the ADA with 4 recommendations. Both EASD and ADS had 0 recommendations that met our eligibility criteria. Fig. 1 shows the number of recommendations according to keywords (panel A) and clinical themes (panel B). The 2018 DC and 2021 ADA guidelines linked recommendations directly with levels and grades of evidence. None of the recommendations had level 1 or grade A evidence. Three recommendations from DC reported level 2, grade B evidence. ADA reported 1 recommendation with grade B evidence, and 2 recommendations with grade C evidence. Although evidence summaries were provided for NICE and Dietetic, the other guidelines/position statements did report an evidence grade for their recommendations. In our checklist (Table 1), the highest level of evidence reported for the discussion points were grade B from DC (evidence from RCTs or systematic reviews of RCTs that do not meet certain methodologic criteria) or level B from the ADA (evidence from well-conducted cohort or case-control studies). Other evidence levels that were included were grade C for DC (evidence from non-randomized trial or cohort study), level C from the ADA (evidence from poorly controlled studies, RCTs with major flaws, observational studies at high risk of bias, case series or case reports), and grade D/level E (expert consensus/clinical experience).

Discussion

We identified 60 clinical practice recommendations regarding diabetes management that are relevant to athletes with T1D. The recommendations varied in source, content, detail of recommendation, and grade/level of evidence. There was not a single guideline/position statement that contained all recommendations. In fact, 5 of the 7 guidelines/position statements contained fewer than 10 of the 60 recommendations. Although most of the guidelines/position statements discussed the relevant themes in their publications, there were no identical recommendations when comparing them individually. Most guidelines/position statements did not directly link the level of evidence to recommendations and those which assessed the level evidence reported grade or level B and C evidence.

Importantly, our summarized checklist covers multiple clinical aspects of patient care tailored to athletes. The checklist starts with goal setting and covers essential discussion points for athletes to have with their diabetes health care provider. Insulin dosing concepts are highlighted to ensure discussions about specific adjustments that an athlete can make to their basal and bolus insulins. The recommendations that were included in this section also help to promote adequate carbohydrate and fluid intake as well as a healthy recovery process for the athlete. The activity considerations section provides recommendations that an athlete can implement to their training regimen. Many of these strategies within the checklist aim to prevent the risk of hypoglycemia and will ultimately help athletes perform training with less risks to their health.

Limitations of our study includes the restriction of sampling frame to seven common practice guidelines/position statements, no formal comparison of clinical utility of content, and lack of duplicate screening and data extraction. We intentionally limited our sampling frame to well known guidelines and other position statements as clinicians frequently refer to their recommendations to inform their clinical decision making. It must be acknowledged that the information in the checklist should not be used independently of other resources when counselling an athlete on their management of exercise and T1D. The content in the checklist was selected from current guidelines and publications, which may emphasize the need for updated guidelines with new recommendations based on the most up to date scientific literature. We are aware that excellent review articles have been published on the topic of the competitive athlete with type 1 diabetes.[8,9] Furthermore, we did not assess the level of evidence for each recommendation independently as the

goal of our project was to identify if the guideline/position statement authors considered and reported grades or levels of evidence for individual recommendations.

Conclusion

Our findings suggest that commonly used clinical practice guidelines may not provide sufficient depth and breadth of recommendations for high performance athletes with T1D. We recommend that specialized guidelines or chapters be developed to help guide health care providers and athletes in the management of T1D within the context of high-performance sport.

Clinical significance

- Commonly used clinical practice guidelines provide a limited number of specific recommendations for high-performance athletes with T1D.
- Although most of the guidelines/position statements discussed the relevant themes in their publications, there were no identical recommendations when comparing them individually, which demonstrates variability in the available information.
- There is an opportunity for clinical practice guideline committees to create additional recommendations specifically for athletes with T1D.

Funding

There was no direct funding for this project.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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