

Interview

# Exercise is medicine for type 2 diabetes: An interview with Dr. Sheri R. Colberg

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Diabetes, mainly type 2 diabetes (T2D), is a major cause of blindness, kidney failure, heart attack, stroke, and lower limb amputation. Worldwide, the number of people with diabetes rose from 108 million in 1980 to 422 million in 2014 and further to 537 million in 2021, and the prevalence has been rising more rapidly in low- and middle-income countries according to a report by the World Health Organization<sup>1</sup> and the latest data from the International Diabetes Federation.<sup>2</sup>

The positive role of physical activity (PA) and exercise as a prevention and treatment medicine for T2D has been well documented, and both the American College of Sports Medicine (ACSM) and the American Diabetes Association (ADA) have issued position statements on the effects of PA and exercise on diabetes.<sup>3–5</sup>

Based on the latest information, ACSM just issued a new consensus statement on exercise/PA and T2D.<sup>6</sup> This consensus statement updates the 2010 position stand<sup>3,4</sup> on exercise and T2D taken by the ACSM and ADA. Considerable research has been conducted over the ensuing decade, and this statement provides a summary of the current evidence. People with T2D should engage in PA regularly and be encouraged to reduce sedentary time. Various types of PA and planned exercise can greatly enhance the health and glycemic management of individuals of all ages with T2D; flexibility and balance exercise are especially useful in adults. New topics discussed include bariatric surgery, exercise timing, high-intensity interval training, mental health and cognitive function, and disparities in access and barriers to PA. Lifestyle interventions that include PA and possible weight loss remain important approaches in the management of T2D and cardiovascular disease (CVD) risks.

I noticed that Dr. Sheri R. Colberg, Fellow of ACSM, who is a professor emerita of Exercise Science at Old Dominion University and who was involved in developing several previous position statements related to exercise/PA and diabetes, was again playing an active leadership role in developing the latest statement.<sup>6</sup> I conducted an interview with Dr. Colberg on these topics, as shown below.

**Zhu:** Dr. Colberg, congratulations for leading another very important T2D-related exercise statement. While PA is now an important part of diabetes management, its role in preventing and treating diabetes was recognized a long time ago. Would you please provide a brief historical review on the benchmark studies that made exercise become a medicine for diabetes?

**Colberg:** Thank you. Yes, we felt it was time to update the 2010 information since so many studies have shed light on these and related areas of research in the past decade. As for landmark studies on using exercise as medicine, many have been done around the world,<sup>7,8</sup> including one in Da Qing, China, which also just published a 30-year follow-up discussing the importance of lifestyle changes in preventing T2D or at least delaying its onset.<sup>9</sup>

The one that I am most familiar with, focusing on preventing T2D and reversing prediabetes, is the landmark U.S. Diabetes Prevention Program (DPP) and its follow-up outcomes studies (DPPOS).<sup>7,10–15</sup> The original study showed that lifestyle management, including goals of dietary improvements, increased PA, and modest weight loss (5%–7%), reduced the risk of developing T2D in high-risk populations by 58%.<sup>7</sup> Many follow-up reports have been based on that initial study, with some stating that weight loss was the most important factor; however, more of the original DPP study data published in 2006<sup>10</sup> showed that in terms of weight maintenance (after loss), only the regular exercisers kept the weight off. In fact, a 2021 DPPOS<sup>11</sup> just demonstrated the importance of PA in the prevention of T2D and that those

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with the lowest fitness levels at baseline gained the most from being active.

As for medicine for T2D itself, many studies have shown that regular activity can help prevent or delay the onset of diabetes complications, even if diabetes is still present (albeit well managed). The first was a Japanese trial looking at glycemia and microvascular complications.<sup>16</sup> Soon thereafter, the United Kingdom Prospective Diabetes Study (UKPDS), which was focused on glycemic management using pharmaceuticals to lower average blood glucose levels, attempted to set glycemic targets for the prevention of CVD in particular.<sup>17,18</sup> The U.S. Action to Control Cardiovascular Risk in Diabetes (ACCORD) study was an extensive follow-up to that, and it was focused on intensive glycemic management,<sup>19</sup> as were the ADVANCE study and others.<sup>20,21</sup> However, none of these looked at lifestyle management for prevention of complications.

Many studies have investigated the impact of PA and other lifestyle changes on the glycemic management of T2D since the focus became lowering hemoglobin A1c levels to prevent health complications—too many to list here and, unfortunately, an underutilized tool.<sup>22</sup> Let's just say it works well for diabetes of any type, even gestational.<sup>23–29</sup>

**Zhu:** You have been a leader in the development of a number of guidelines and statements related to exercise for diabetes. Would you please provide a brief introduction of the major guidelines and statements developed by major exercise (e.g., ACSM) and medical (e.g., ADA) associations so far?

**Colberg:** There have been many. Dr. Ron Sigal headed up 2 of them for the ADA in 2004<sup>30</sup> and 2006.<sup>31</sup> The one I was involved with initially was a statement issued jointly (with my initiative) by the ADA and ACSM, which was focused on T2D only and published in 2010.<sup>3,4</sup> The ADA had one that covered both type 1 diabetes (T1D) and T2D in 2016, which I chaired.<sup>5</sup> An international consensus statement on T1D and exercise was published in 2017.<sup>32</sup> This latest one in 2022,<sup>6</sup> done for the ACSM, is only a consensus statement of experts rather than a formal position statement.

**Zhu:** Looking back, how have these guidelines and statements evolved? What are the key points that were added in the latest ACSM consensus statement?

**Colberg:** When I was first involved in writing a position statement in 2010, while the ACSM had put out PA guidelines for everyone in 2007,<sup>33</sup> the U.S. federal government had issued guidelines as well for all Americans in 2008.<sup>34</sup> We attempted to compare and contrast those for use in populations with T2D and only made slight modifications related to exercise capacity and CVD risk.<sup>3,4</sup> Since that time, the ACSM has published updated guidelines for various types of activities,<sup>35</sup> and many more studies have been released in support of the inclusion of regular resistance training, balance training, and flexibility training in populations with diabetes. The United States also updated its guidelines after a decade.<sup>36</sup> We incorporated and updated anything pertaining to these types of training, and we included high-intensity interval exercise and training in T2D. This latest statement also covers timely topics like PA around bariatric surgery, exercise timing, mental health and cognitive function, and disparities in access and barriers to PA, along with reducing sedentary time and incorporating activity breaks.<sup>6</sup>

**Zhu:** You have also written many books related to exercise and diabetes management. I especially like *Exercise and Diabetes: A Clinician's Guide to Prescribing Physical Activity*<sup>37</sup> and *Diabetes & Keeping Fit for Dummies*<sup>38</sup>—the former for professionals on the frontlines of medical management of diabetes and the latter for individuals with diabetes. I noticed the ADA published and/or endorsed both books, which are excellent in terms of the integration of exercise with medicine. Would you please briefly introduce both books and tell me when you started to work with the ADA to promote exercise and PA through their platforms?

**Colberg:** I had been a long-time professional volunteer for the ADA, and I was involved with exercise-related symposia at their meetings and re-writing the exercise portion of their annual standards of care, but believe me when I say that getting the ADA on board with focusing solely on PA was not easy. They literally had scores of books on nutrition, diet, and cooking, but only 1 related to activity, which was aimed at a very basic level. I worked on them for many years before finally convincing them to let me write the book for clinicians in 2013.<sup>37</sup> In 25 chapters, that book covers every possible type of diabetes, activity, and health complications that may need to be considered when recommending PA to patients. (I am hoping to update it in the next year or 2 as well.) As for the one for individuals with diabetes, I pushed the ADA to let me do a lay publication, and they had a deal that they had worked out with the publisher (Wiley) to try a couple of books in Wiley's "For Dummies" series. It addresses every aspect of being active that someone with any type of diabetes would need to know—in understandable language. In fact, my parents loved that book so much that they bought copies and gave them to everyone they knew, even though none of them had diabetes. It is very easy to read and really just talks about making appropriate lifestyle choices, no matter who you are.

**Zhu:** I also like your book *50 Secrets of the Longest Living People with Diabetes*<sup>39</sup> very much. It is a great extension of the popular book *50 Secrets of the Longest Living People*,<sup>40</sup> and it provided hope, knowledge, and needed skills for individuals with diabetes. Who initiated the book idea, you or the publisher? What are the 5 most important secrets if I asked you to make a selection?

**Colberg:** I brought up the idea of a book about people who had lived successfully with diabetes for many decades, and the publisher came up with the title since they had done the other "Secrets" book. I heard of these older brothers in New York who had been diagnosed in 1925 (just barely after insulin was available) and 1933 who had over 150 years of living with T1D between them. They were just so inspirational that I wanted everyone to know about their story and how to live long and well with diabetes of any type.

All of the secrets are important, but my top 5 favorites are the following:

1. Live first and be diabetic second.
2. Live an active life.
3. Keep a positive attitude.
4. Lose the stress and the guilt.
5. Be your own best advocate.

**Zhu:** You were diagnosed with T1D when you were very young. Yet, not only are you healthy with a happy family including 3 grown sons, but you are also one of the most respected scholars in exercise and diabetes research. So, what are your secrets to manage your own diabetes so well?

**Colberg:** When people used to ask me how I handle my kids, career, marriage, and life in general all at once, I always replied, “I work out.” I think PA has always been my sanity in life as well as the means to my physical health. Even in my first 18 years with diabetes and without a blood glucose meter (as they had not been developed for consumer use) or any real way to know how effectively I was managing my glucose levels, I always felt physically better and more “in control” when I exercised. I started being active regularly when I was a pre-teen and have maintained being regularly active throughout my adolescent and adult years.

As for being a researcher, I have always sought out knowledge about my own condition and love to share what I have learned with others. This started when I helped my grandmother (who had T2D) when I visited her as a teenager. She was on yet another diet to lose weight, and I told her I would help while I was visiting. I had her running laps around her back yard, measuring out her food, and weighing herself daily. I helped her lose 8 pounds (over 3.6 kg) in the first week—but then I am sure she gained it all back again later, unfortunately. She later suffered from terrible CVD complications related to diabetes that caused a major heart attack and then multiple strokes that ultimately took her life, but that was long after her quality of life was completely gone. I saw what happened to her and vowed to do everything I could to keep myself from following the same downward path. Everything I have learned about living long and well with diabetes—through research and my own experiences—I have tried to pass on to others.

**Zhu:** One of the scariest things now is that diabetes, the traditional “adult-disease”, has increased in children and adolescents rapidly. Besides a poor diet and too many sugary drinks, a lack of PA is believed to be one of the primary causes. What is your advice to schools, communities, and parents about this dangerous trend?

**Colberg:** As a society, we all have to do more to promote PA and good nutrition. At the local level, that includes increasing accessibility to places for activity and to good, affordable foods. We need more green spaces and safe and convenient places to walk and bicycle. Schools should be encouraged to keep their physical education programs and give youth frequent activity breaks during the day (even when they are teenagers), since research has shown that kids learn better when they are able to be active and not just forced to sit for long periods of time. Giving youth access to good school foods and snacks is also important.

Parents are largely in control of what food comes into the household, so they should adopt good eating practices for themselves and their kids by extension. I remember when I developed T1D at the age of 4, I loved this sugary cereal available in the United States called Froot Loops (the fact that “fruit” is misspelled should give you some indication of how unhealthy it is). For some reason I loved it, and giving it up was worse for me than taking shots when it came to having diabetes. To make the

transition easier for me, my mother changed my whole family’s diet, making my brother and father eat the same healthier foods that were on my “diabetes diet” at the time. It really has to be a family affair to work well at that level.

**Zhu:** As you know, coronavirus disease 2019 (COVID-19) has hit hard on individuals with diabetes, especially those who are overweight and obese. What is your advice to this high-risk population in terms of exercise and PA during the COVID-19 pandemic?

**Colberg:** Everyone needs to try to remain as physically active as possible, which I know has been a challenge to many, especially during lockdowns in the United States, Europe, and elsewhere. If nothing else, people have been expending fewer calories by working and schooling from home and not having to go anywhere. That drop in daily movement has led many people to gain some extra “COVID weight”, even if they were still able to be regularly active otherwise. The best practice is to continue being conscious of the breaking up of sedentary time by taking frequent activity breaks (even if working at home) and by finding activities to do at home if no other venues are available due to COVID restrictions or other limitations. Many home-based activities have been publicized online and are accessible for download. I would encourage everyone to take advantage of those to do body-weight resistance training and other activities that they may not have tried before.

**Zhu:** You were invited by China to give lectures on exercise and diabetes before the COVID-19 pandemic. Prediabetes and T2D were already known to be a major public health problem in China then. So, based on the lessons learned in the United States and other parts of the world, what is your advice to Chinese public health and exercise science leaders with respect to how promoting PA and exercise can help prevent and treat T2D?

**Colberg:** Make it a national priority for public health to start making PA a more integral part of everyone’s lives on a daily basis. Offer incentives (monetary or otherwise) that make people integrate activity into their lives more frequently, and keep the communications about the benefits coming. Make it more convenient and accessible to everyone. Make it a social thing, and involve families and work settings. Obviously, all these things have been tried around the world already with limited success, but we all are just going to have to do better from here on out for our collective health.

**Zhu:** I am so glad to see both yoga and Tai Chi were mentioned in the new consensus statement, although only briefly.<sup>6</sup> As you know, both activities are so popular now and have been practiced around the world. What are the most important things to do, especially as far as collecting scientific evidence, if we want to make them a part of “exercise medicine”?

**Colberg:** I was glad we were able to include them as well! I have been following the literature on nontraditional types of exercise—like yoga, Tai Chi, Qigong, martial arts, and even balance training—for years because I truly believed, and had experienced for myself, that all types of PA can potentially have health benefits for everyone, and especially for those with diabetes. The earlier studies on these less traditional activities, however, often lacked the scientific rigor that would allow us to include them in any recommendations. What we

have needed are studies that are randomized controlled trials with as many variables managed as possible and with appropriate subject recruitment and study outcomes focused on glycemia and other aspects of health. The literature has moved enough in that direction that we felt comfortable including these activities as part of people's daily movement and, often, part of structured exercise plans to build aerobic endurance, enhance muscular strength, and increase joint flexibility and range of motion. The importance of enhancing balance ability with targeted activities to prevent falls has also gained a lot of support since the last position statement, and many of these alternative activities like yoga and Tai Chi<sup>41–44</sup> work on balance and other aspects of physical function simultaneously, so it has been great to see recent, rigorous scientific studies and meta-analyses prove their benefits for those with T2D.

**Zhu:** Finally, while we have made great progress with respect to the positive role of exercise in diabetes management, there are still many unanswered questions. To help others in the field, especially graduate students and young scholars, to address these questions, would you please provide your top 5 urgent research questions that should be addressed and briefly explain why?

**Colberg:** We brought up most of these questions at the end of the 2022 consensus statement.<sup>6</sup> Here are the 5 I would consider to be most urgent for researchers to address:

1. Further work is warranted to elucidate the cognitive domains that are most responsive to PA and dietary improvements in adults with T2D as well as exercise effects on memory and cognitive function related to glyce-mic management.

Dementia, Alzheimer's disease, and other causes of memory issues and cognitive decline are common in older adults, especially those with diabetes of any type. We need to better understand the factors related to diabetes and its management and how impactful those are on these conditions.

2. More research on the effect of exercise training on vascular function and the microbiome needs to be conducted in individuals with obesity and with and without T2D.

Much research has investigated the CVD complications associated with diabetes, but the knowledge about the influence of the health of the gut and its bacterial populations is still in its infancy. Learning more about the possible associations between a healthy microbiome, diet, exercise, and prevention and management of metabolic diseases is critical.

3. Longer duration training is needed to establish whether exercise timing modifies the glycemic response to meals as well as overnight levels and whether a specific time of day for planned exercise should be prescribed.

The use of continuous glucose monitoring devices in more recent studies has led to many findings about the importance of exercise timing and how to best manage blood glucose levels.<sup>45,46</sup> Much more can be done on these topics, particularly in relation to exercise intensity, duration, frequency, and timing around meals.

4. While prolonged sitting has been found deleterious in research settings, studies on PA breaks in daily life are necessary to determine whether long-term use has clinically relevant glyce-mic benefits in populations with T2D.

We really need to know how much benefit can be derived for metabolic health by simply taking more activity breaks during the day. Not only are they potentially easier to fit in than most structured exercise, but they are also more accessible to a wide range of individuals who may have limitations when it comes to more structured exercise programs.

5. Potential interactions between diabetes medications like metformin and exercise training need to be further investigated with respect to their impact on glyce-mic management.

The research on metformin<sup>47,48</sup> that shows it may lessen the impact of training on insulin sensitivity is important to fully confirm or dispute given that it is the most commonly used medication for diabetes and insulin resistance. No diabetes medications should lower any positive training effects, and if they do, we may need to rethink whether the benefit of using them is outweighed by their negative impact and whether alternative medications should be considered instead.

**Zhu:** Thank you so much for sharing this valuable information and these interesting stories with the readers of *Journal of Sport and Health Science*. I always learn some new things when I chat with you. Thank you again!

### Competing interests

The author declares that he has no competing interests.

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