Episode 2: Against the Odds: Elite Athletes with Type 1 Diabetes

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TRANSCRIPT

Gretchen Repasky 00:06

Have you ever been watching a professional sporting event and wondered if any of the athletes have type 1 diabetes? Can people living with type 1 diabetes rise to the elite level in sports? And if so, what does it take to get there? In this episode, we're going to get to the bottom of these questions with the help of two very interesting people. First, we have Sam Scott, who just recently completed a postdoctoral research fellowship at the University of Bern in Switzerland. Sam currently has a unique role of head of research for Team Novo Nordisk professional cycling team. And Esben Vestergaard, who is chief physician at Aarhus University Hospital Steno Diabetes Center in Denmark. Esben works with people with type 1 diabetes, who exercise recreationally and competitively. He's part of a specialized clinic for athletes at the Steno Diabetes Center Aarhus. I'm your host, Gretchen Repasky. And this is Postdocs Talking, connecting diabetes and metabolism research to society. Sam and Esben are joining us online from Switzerland and Denmark. Sam, if we take a step back for a moment, what real life problem does your research deal with?

Sam Scott 01:24

My research has been looking at the risk of hypoglycemia for people with type 1 diabetes, both during the exercise and then afterwards. And this has been both from a kind of your average individual looking to do something like a 30 minute cycle ride or jogging or going to the gym. And then on the other end of the spectrum with elite level athletes and how they manage their glucose around training, nutrition and competing against other athletes who don't have diabetes.

Gretchen Repasky 02:03

Esben, you see people on a somewhat regular basis in the clinic there in Aarhus, do you ever get the impression that there might be a stigma? I mean, maybe most even in young people or children? Are they embarrassed to participate in sports in any way?

Esben Vestergaard 02:22

The people in our clinic are not, to my experience, embarrassed participating sports because of a sensor, so pumps or pens, but I do hear from the regular outpatient clinic where I also have patients that it is a problem. They don't take insulin in public because they're afraid of what people think about it. And that's a stigma. Yes. I think the people in our clinic are probably more dedicated and pay less attention to what other people think about them having diabetes.

Gretchen Repasky 03:09

Let's step inside the bigger picture now. And try to have a look at some of the details. Let's begin Sam with your main research questions. Tell us what you're trying to figure out in a nutshell.

Sam Scott 03:23

So the overall thing is barriers to exercise for people with both type 1 and type 2 diabetes. But probably just for this podcast, we could focus on type 1 diabetes and the barrier which is hypoglycemia during the exercise. The main way in which I've been looking at this is through laboratory-based interventions, looking at things such as the way in which the intensity of an exercise bout influences glucose, also nutritional or other behavioral adaptations such as insulin modifications before or during the exercise bout.

Gretchen Repasky 04:05

Paint a picture for us of what does an elite athlete have to, with type 1 diabetes, have to manage each day?

Sam Scott 04:15

Well, I think one of the things which I found particularly interesting with the cycling to start off with is, is the fact that just to be an elite level cyclist without type 1 diabetes the amount of attention that needs to be put into training your nutrition. Bodyweight is so important to manage. Making sure that you are strictly adhering to your training. And then when you add on top, the difficulties associated with type 1 diabetes and exercise, you may be doubling that or even more the number of decisions and behaviors that could influence how your training is and how your competition is. So it's something that really astounded me was how they were able to cope with all of these problems. They're doing extremely well.

Esben Vestergaard 05:10

Yes. Sam, can I ask a question about one of the things that you mentioned, that's bodyweight? The athletes that I work with, do have issues with body weight, or at least some of them are also doing sports because of body weight regulation. And many of them do want to lose weight, both from a competitive point of view, but also because it's just a goal for them to have a lower body weight. But is that an issue with the top athletes you work with? Are they more prone to have excessive body weight as compared to people without diabetes?

Sam Scott 05:57

Yeah, actually, I would say this is one of the biggest challenges for the team. I can't be sure whether it's because of the type 1 diabetes per se, because every athlete competing at that level struggles with managing body weight just because of how important it is to have such a low body fat percentage. But I know that at certain points of the season, it becomes much more difficult. They tend to find it easier, actually, over the offseason, where they're in their own home, they have their own routine, and they can follow their own diet. But when you get into the competitive training season, you've got the challenges associated with things like long haul flights, the food at the races is not controlled by the team. It tends to be like hotel food. And so it varies, and so that routine, again becomes a little bit more challenging. You've also got the fact that you will have the cycles of trying to increase your carbohydrate intake in the lead up to races, which is fine for somebody who has races at regular or spaced intervals. But these guys are racing, and then flying to the next place, racing again. So you don't really get enough time to get back into that normal routine, get your body mass back down. And so you find towards the end of the summer, they're just finding it more and more difficult. And also the challenges of every time you have to treat hyperglycemia, this again, is calories that you're taking on the with wise wouldn't have to if you didn't have type 1 diabetes.

Gretchen Repasky 07:50

So in the day-to-day management, then it sounds like there's monitoring glucose, there's carbohydrate or macronutrient counting, or at least determination. And there's the insulin dosing and then there's the management of the travel and the training and perhaps the stress that comes with those things as well.

Sam Scott 08:17

Yeah, absolutely. And the last point that you make, as well, the stress, this is something where it becomes even more difficult to manage if you have type 1 diabetes. So if you don't have type 1 diabetes, you might not realize that when you get stressed you have this big surge in catecholamines, so adrenaline, noradrenaline, and this can cause your blood glucose concentration to spike quite sharply. And there's some of the riders on our team who experience a lot of nerves before big events. This means their blood glucose tends to be very high at this point. And they're then faced with a decision of do they administer additional insulin before the

race. This means that they might put themselves at quite large risk of hypoglycemia as soon as they start exercising. It also means that they might decide not to fuel as much as they otherwise would. So they haven't got the nutrition in kind of the same way as somebody who didn't have to deal with that extra decision if you don't have type 1 diabetes.

Gretchen Repasky 09:36

How does the insulin dosing work in those situations - pre-race or even during the race? What kind of options are there for insulin intake?

Sam Scott 09:52

So, kind of broadly speaking, you can use Multijet multiple daily injections, which is injections that you will give, usually, where you will take one longer acting insulin in the morning or in the evening, or you can split the doses so that you can take a dose in the morning and in the evening. And then you will take additional, what's called bolus dosing of insulin as and when is needed. For example, with a meal if your blood glucose is anticipated to rise. The other main method is with an insulin pump, which will is a device which will gradually give you insulin over the course of the day. And the user can adjust the amount that they are receiving, again, based on anticipated rises or falls in their glucose. There's more advanced technologies now becoming available such as closed-loop systems and these are where a continuous glucose monitor would kind of interact, or for want of a better word, with the pump, and then the pump automatically adjusts based on the glucose levels at that time. Esben, you can probably step in here. You have much experience with this.

Esben Vestergaard 11:33

Yes, we do have athletes, both on multiple daily injections with pens and also with pumps. It's I think it's something like 50-50%. But I'm a little curious about that top athletes at Team Novo Nordisk because I understand that they are not. Some of them are on pens and some uses pumps. But what makes an elite athlete choose one way to treat diabetes, as compared to the other. I mean, a pump would, in my experience, open up for much a much more dynamic way to treat diabetes. It's easier and faster to adjust the basal insulin and to take smaller boluses as compared to pens. But in other words, why would an top athlete choose to have a pen instead of a pump?

Sam Scott 12:36

Yeah. So if we go back to when I first started with the team, maybe three years ago, all of the professional athletes were using pens. And we were quite surprised about this as well. And the first thing we did was before we did any research or implemented any changes at all, we spent a lot of time asking the athletes why this was. We spent a lot of time doing kind of informal interviews, speaking to them. We also created questionnaires, and this was one of the main questions we were interested in why they would choose the treatment they did and where they

were getting the advice from and how open they would be to changing in the future. And it seems as though, with those individuals, the main reason is they find something that works, and they don't want to change it. Professional athletes, it's really about routine, if you find something that's good, you don't want to change it. The other thing is that there were some athletes who had used pumps, and they had had bad experience with them. So for example, having a bad crash, and then finding that the device gets very severely damaged. Or it can get caught on something. And also that feeling of not being attached to something. However, we're seeing quite a big change, just in the last year, where the younger guys. And these guys are maybe 20 years old, as compared to the pros I'm talking about who were maybe five years older. And these younger guys are using a much greater variety of methods. So there's the some of whom are looping. Almost all of these guys are using pumps. So it's really quite a quite a difference that we're seeing that seems to be just because they've started off their routine differently and they found something different that works for them. It seems as though you can cycle at this top level with different treatment options. There's no right or wrong.

Gretchen Repasky 15:18

Let's go back just a minute. And, Sam, you mentioned that your research focuses on the intensity of the exercise. It focuses on the nutritional aspects that are required, and it focuses on the insulin dosing. And so we've talked a bit about the insulin dosing. I'm also interested to hear what you have determined regarding the intensity of the exercise as well as the nutritional aspects. Could you talk a little bit more in depth about those findings?

Sam Scott 15:52

Yes, so starting off with the intensity. This was the first focus of my, when I when I started my PhD. We were looking at whether high intensity interval training, so HIIT training, which is a very popular form of exercise, because it's timesaving could also be a way to help manage glycemia for people with type 1 diabetes. The reason being is that, in general, the intensity of the exercise will impact glucose concentration. So if you do a moderate intensity bout of exercise, in general, you will see a decline. But if you do a very intense bouts of exercise, generally you will see a very sharp increase. And the reason for that increase is because you'll get hormones such as adrenaline being released, that will act on the liver and cause quite a big increase in blood glucose concentration. So the idea behind those initial studies was to see whether mixing the high intensity with the moderate intensity, so HIIT, could help to have more of a stable or stabilizing effect on blood glucose, but also be time efficient. As with other people, and in that study, we did find that it was very good actually at doing that. That study we did in a lab. And but the thing that I really liked is that the following one which wasn't planned within my PhD we looked at that in people's homes. So we compared the effects of doing a form of home-based high intensity interval training at home. And we also found that that was good at keeping blood glucose within a safe range, not too high, not too low, and was also time efficient. Have you looked at anything like that, Esben?

Esben Vestergaard 18:03

Well, we haven't studied it. But patients have reports to us or to me. And they have found their own way to stabilize blood glucose during training. Well, it's not people that are connected to our athlete clinic but to our general, outpatient clinic and they come back and without having had any advice just telling me that they have seen sometimes that blood glucose decrease, and they have found out that they can just go to the sort of running mill and do some HIIT training and you can help stabilize blood glucose. So that's really interesting. Definitely also something that we can use to help more recreational athletes to if the main if their main purpose is for body weight management or just health being, part of the daily routine. So it's definitely very good tool start last blood glucose.

Gretchen Repasky 19:11

Good. Let's touch then on the nutritional aspect of your work and what you have determined there.

Sam Scott 19:20

So we've done a couple of studies. There's one that we have going on at the moment that's looking at caffeine and the response that that has on blood glucose concentration. We don't have any results there. It's something that could potentially have kind of a stabilizing effect on blood glucose potentially help to avoid hypoglycemia during the exercise. The other thing that we've been looking at is different types of carbohydrates. So carbohydrate isn't always a carbohydrate. It's a depends on the type that you're consuming and also what you're consuming that with. So, glucose will have a very kind of high level on the blood glucose, it will cause a very sharp increase because the glycemic index is very high. But there are other sugars, for example, fructose or galactose, that are metabolized very differently. And this means that they have a completely different effect on blood glucose concentration. So this is what we've been looking in the lab. From a professional cyclist point of view, this is also very interesting, and something that we haven't been able to look at. The first things that we started doing was quantifying the amount of carbohydrates that these guys were consuming. And looking at the patterns, and what we were finding was that they weren't taking into account the type of carbohydrates. And this is important, because if they're always consuming glucose, it will have a very different impact compared to a mixture, also on the rate at which it's absorbed by the gut. So this is something that, again, requires quite a lot more research in this area.

Esben Vestergaard 21:29

Do you have a dietician connected to your team? Is that some work that you do yourself?

Sam Scott 21:36

No. So there is a specific - there's a dietician who works with the team, and she creates plans for the team. The athletes also tend to have their own private dietician that they see, and the diets that they have, tend to be managed on quite an individual basis. Also, the way in which they follow those diets over the course of a season, so the offseason will be very different to the training season, and the way that they prepare for each race.

Gretchen Repasky 22:16

Metabolic responses must also be different depending upon the sort of fitness level of the athlete as well. So elite athletes must have different metabolic responses, regardless of what sugar it is that they're receiving, compared to perhaps the everyday recreational athlete. I don't know, what do you two think about this?

Sam Scott 22:43

Well, I mean, the guys on the team, they require very high carbohydrate intakes. We did a study where we were looking at how much they were consuming during a world-class road cycling race. And we found that it was between 65 and 90 grams of carbohydrate per hour. And they were cycling up to five or six hours during that. So really high carbohydrate intakes and alongside that very low insulin dosage, which demonstrates the power, if you like, of the muscle contraction induced glucose uptake. This isn't something that somebody who isn't cycling at that level can consume without experiencing extremely high blood glucose concentrations.

Gretchen Repasky 23:47

Esben how about from your side? What do you think about this? What kind of metabolic responses may there may there be any sort of the different fitness levels? Or even we can even think about the different types of exercise?

Esben Vestergaard 24:01

Yes, it's, I think it's important to focus on intensity and duration as well as the type of sport in question because we do see that large amount of carbs are needed during endurance sports like cycling or long distance running, where we also see amounts are similar to the ones that Sam mentioned, like up to a gram per kilogram body weight per hour. So during the athletes with we have in our clinic, whether they participate in long-lasting sports trainings and competitions. So that's directly similar to what I experienced. But, it's very different from other kinds of sports like weightlifting or short-lasting, or very intense sports, where there can be almost no immediate carb demand. But afterwards of course, when skeletal muscles are refueling and rebuilding glycogen storages there's a more delayed need for carbs. So that's what we see in our clinic when working with different kinds of athletes and different kinds of sports.

Gretchen Repasky 25:43

Type 1 diabetes is caused by immune system-mediated destruction of insulin producing pancreatic beta cells. This leads to little or no insulin production in the body, making it a challenge to maintain healthy blood glucose values. Insulin administration and regular blood glucose monitoring are needed. In addition, regular exercise is important as it aids in good glycemic management and because of the beneficial effects on cardio-metabolic health. The challenge of blood glucose management and the fear of hypoglycemia mean that many people with type 1 diabetes actually exercise less than 30 minutes a day. Previous studies have looked at the effects of the intensity, duration and time of day of exercise as well as the pattern of carbohydrate intake. Results from these studies have been incorporated into clinical practice and consensus guidelines to help people living with type 1 diabetes exercise more easily. There are examples of individuals with type 1 diabetes that compete in elite level sporting events. An example is Team Novo Nordisk, a professional cycling team consisting exclusively of elite level athletes with type 1 diabetes.

Well, let's go a little bit deeper then into how your studies are conducted. I know we probably want to focus a bit on the tools that you use in order to modulate exercise intensity, and maybe we can also talk about the importance of data science in how you do your research. But before we go to those points, I wonder if you can tell us a little bit more about Team Novo Nordisk, about the background of the team about the sort of context. Do you go where they go? Or are you separate from them? How close contact do you have on a regular basis? Let's start there.

Sam Scott 27:52

Yeah, so the team are very international, everyone is living in another country, actually. So when we meet, it's always either at a training camp or at a race. So I would see the team, probably at two training camps a year, and this will be in the winter. They will have two. Usually they're always just somewhere warm. And then over the course of the year, the races will be conducted in different countries, according to the racing calendar. As far as the research is concerned, the first thing that we did was, as I say, we just watched. This included, asking a lot of questions. Kind of creating questionnaires to find out a bit more about them, understanding what challenges they faced, what they would like to improve. And the other aspect of this was watching them kind of in terms of the physical demands. And the nice thing now is that we have a lot of technology, which means that this can be done from quite a far distance. So initially, this involved kind of being in the cars, watching how the race were going, and then collecting data from continuous glucose monitors and cycling computers. Now, because we have a system set up where we're able to remotely monitor that, I don't actually have to physically go to so many races. The data is being collected. This is both for a performance point-of-view for their coaches, so that they can see how well that training is going how well the races are going and also from a diabetes management point-of-view. And then because we've put this within a research context, and we have the informed consent from each of the riders to use their data, we're able to look at that for research purposes. And because of the amount of data that we've been able to collect in different

scenarios, we've been able to answer quite a lot of different questions without physically being with them. And as you say, more and more data science is becoming very important. Initially, we were just looking at relationships between different events and different demands on blood glucose. But more and more as we move into the future, we're looking at prediction. And we have a project going on at the moment, where we're looking to see whether we can predict the future changes in glucose, particularly after a bout of exercise, based on information that's coming from the continuous glucose monitor, and the exercise wearable data. This is something that might not be possible. Exercise is really complicated. The changes in physiology that are happening are very complicated during exercise. But seeing as we have so much of this data, if we were able to, this would be a really nice avenue for us to go down, which could be useful for the team, but then could also be applied to other people living with diabetes.

Esben Vestergaard 31:42

Yes, I agree. What we see is that diabetes and sports are not always predictable. We do have a model for each patient to follow. We work with clients, to what to do with insulin basal, bolus insulin, carbs, meals, basal rates and sensor values before and during and after training and competitions. And of course, also focus on hydration. But sometimes it just doesn't go as predicted. And what seems to be a black box for us is the glycogen levels, the skeletal muscle glycogen levels. And it would be so nice to have some method to estimate the fuel store storage in their skeletal muscles. But this remains to be a problem that we don't really know – the glycogen levels. So we need to use our experience and to have a plan B if blood glucose seems to get too low or too high during training and compensation. But actually my question to you Sam is do you experience the same? Do you also see that there must be some kind of factor that you cannot control or you don't know about?

Sam Scott 33:22

Yeah, absolutely. And the athletes say this themselves. Sometimes they will just have days, which are more difficult. And they will say that I'm following exactly what I usually do, and my glucose isn't doing what I expected to do. And this is type 1 diabetes. It is extremely challenging. And it's important to remember that these guys are human, and they're faced with all of these decisions every single day. They're often very tired. And yeah, it's not possible to know every single factor. But that's what we're trying to help them, trying to help with those decision making processes to kind of alleviate that burden on them.

Gretchen Repasky 34:16

That's where the predictive studies become really interesting, too, I think.

Sam Scott 34:21

It could potentially. I mean, I don't know if it will work. There's other people who have looked at this in other contexts in free-living conditions. And we're just looking at this on a very extreme level. For example, a way in which this could be particularly useful that we see as in the overnight period. There's been a few instances where some of the riders have experienced hyperglycemia overnight, and this is this is extremely dangerous. If there's a way to predict whether there's an increased risk or on a given day, based on the exercise or some other factor that's happened. This is what we would like to prevent these really severe hypos that happen while they're asleep.

Gretchen Repasky 35:13

So is your goal to be able to do these kinds of predictive studies then on an individual basis?

Sam Scott 35:20

Yeah. So I think what, what we need to do first is, we'll look to see, based on the data that we have, which might not be enough, whether it's if it's possible to create some kind of model that can predict this. And then I think we would need to test it in the lab. So we might need to do some studies to validate the model. And then there's all kinds of other processes in machine learning, AI research where you would validate your model. So for example, compare it to a prediction that a clinician might make based on the data that's available to them. And then it's kind of like, looking in a in a very extreme setting where you've got all of this data are available, and then looking to see whether you can apply this to everyone else living with type 1 diabetes.

Gretchen Repasky 36:21

What about the access to the technology? Is this expensive? Is it readily available to not only the elite level, but to the recreational athlete?

Sam Scott 36:34

The athletes on the team, they don't get necessarily immediate access to the best technology or the best treatment. That's what everybody would assume. It actually depends on which country they're from and which health care access they have. So as I said, our athletes are from all different countries around the world. And so for example, an athlete who's from Switzerland will get very different access to somebody from Australia. Yeah, it's not uniform throughout our team. And also we don't provide the insulins or the CGM. It's down to their individual health care provider.

Esben Vestergaard 37:22

Also, the different pumps and closed loop systems may not be marketed in all countries. It's actually only, as far as I know, just a minority of countries that they are available.

Sam Scott 37:38

Yeah, that's absolutely right, and it includes our team as well.

Gretchen Repasky 37:45

That's an interesting challenge, then that comes up for you for your research, Sam, that there sort of almost, would you say, a lack of standardization?

Sam Scott 37:58

It's becoming much more challenging, really, at a very, very fast pace. As I said, when I first joined the team, they were all basically using the same system. So all on MDI, very similar method of treatment. But now, the number of people who are using insulin pumps, and the differences between those means that the upskilling of the staff has to be increased much more rapidly. There has to be more of an understanding of what's happening. And also, from our point-of-view for collecting of data, the data doesn't just input into one single platform. We're having to manage this in different in different ways. So yeah, it's all kinds of different challenges.

Gretchen Repasky 38:52

Big challenge from the data science perspective, I can see.

Sam Scott 38:55

Yeah, but it's interesting. It's interesting how rapidly that has moved forward.

Esben Vestergaard 39:01

But Sam, how do you manage to collect the data and compare data? Are you working on a system that can integrate herns and sensor values together with insulin doses?

Sam Scott 39:22

We've actually looked at trying to create something ourselves to manage this, kind of like a platform. And at the moment, I have a project going on, in which we're looking to adapt a platform for ourselves, just for research purposes, to see if we can make something that's easier for us to interpret. And then if this is - if it works, well then we might look to see whether the riders themselves find it more intuitive as well. We have been looking at a way in which we can make the exercise data and the glucose data be more connected. And originally, we thought that the best way to do this was more data is better. So having all of the cycling computer data and all of the glucose data, putting it together and showing the athletes but we're starting to think now that that's just too complicated. It's better to have more of a middle ground - show some of

the exercise data, some of the glucose and insulin data, and really focus on usability. Yeah, this is this is something that we are still working on, and we hope that it will help. And then we would try to pass that on to other people, if it's useful.

Gretchen Repasky 40:52

Do you see differences here between men and women, either at the elite level, although Sam, I guess your team is all men, or then maybe at the everyday level?

Sam Scott 41:06

This is something that honestly is quite different, sorry, difficult, to know, actually, the literature on the female athlete, especially with type 1 diabetes in the athlete is almost non-existent. And there are quite a lot of reasons to believe that this would be very different. Unfortunately, in Team Novo Nordisk we don't have a female team. There are some female athletes who so for example, there's this one who competes at an extremely high level in track sprinting. But you wouldn't be able to make a comparison between her and the road cyclists because she's competing, firstly, she's doing an individual sport. She's competing at a very high intensity and competing multiple times per day. This is something which needs to be done a lot more. The problem is when doing these studies that you really need a lot of control for when the exercise bout is done in relation to time of the menstrual cycle. And that makes it very challenging. But I know that there are people who have specifically received grants to look at this question. So hopefully, we'll find out more soon.

Gretchen Repasky 42:50

One of the main reasons we're sitting here today is not only to find out about how the work that you Sam and Esben that you're doing, can help athletes, but also to think about the broader society. So the broader context of this. So maybe I bring us there now. And we start to think a little bit about Sam, what differences your discoveries, working with elite athletes, will help to make for the broader society?

Sam Scott 43:19

Well, I think maybe the best way to start off answering this question is to explain how I got into working with the team and why I did that. So originally, when I was doing my PhD, I was working with regular people looking at ways to make exercise easier. And I was meeting a lot of people within the hospital, who said that they didn't really know anybody else who had type 1 diabetes. And they started to meet within the study setting and I started talking to a lot of people taking part in the projects and it really hit me how challenging exercise could be for people living with type 1 diabetes and how there wasn't that much information that was readily accessible. And then towards the end of my PhD, I saw a video of Team Novo Nordisk cycling up a mountain and I thought that this doesn't make any sense to me. I need to find out how this is happening. So I

actually directly contacted Phil Sutherland, who's the CEO of Team Novo Nordisk. And he responded to me, because I had a lot of questions and I said, I don't understand this, how is this happening? What is the difference? And one thing led to another and I found myself with this position, and I was able to look to answer some of those. And now kind of the biggest – well, the main thing behind our mission statement, when we started the research was to look at bridging the gap between these high level athletes and your average individual with type 1 diabetes and how we can take what these people had been doing to compete at a very high level, which was mostly trial and error and individualized. It wasn't really based on research, because there wasn't so much research in elite level exercise in type 1 diabetes. It was finding something that worked for them, and then keeping to a routine. So if there's a way in which we can look at these guys, and then learn something and pass it on to everybody else, that's kind of the way that I would like to have it go into society. And yeah, as we discussed before, Esben, I think it's really nice with what you do as well. I think you're kind of directly in the, in the middle, if you like, if it was a - if it was a bridge where the three things passed together.

Esben Vestergaard 46:16

Yes, exactly. And it's very interesting to hear why you came into this, Sam. And from my everyday work, I heard it so many times that families had problems with their kids' blood glucose during sports, like soccer, or gymnastics, and they couldn't figure out why blood glucose increased or decreased. And many of the children have stopped sports because the parents had too much work, and they couldn't figure out what to do about the diabetes and sports. Now, I try to use my knowledge about glucose metabolism from my research, and combine it with my knowledge about the daily problems that people and families face. So yes, I'm in the middle of research and daily clinic and try to translate what I know and what other people know from research to the daily work with athletes or more recreational athletes. Probably just try to improve their quality of life and have some leisure activity together with their family lives.

Gretchen Repasky 47:36

Do you think there's a portion of the population that's being missed? We have Sam working with the elite athletes; Esben, you working with the recreational competitive athletes; but what about the other portion of the population that isn't yet active?

Esben Vestergaard 47:53

That is also a focus area for our Steno Diabetes Center in Aarhus. A colleague of mine, actually, two colleagues of mine, started a project with the aim to make the more sedentary patients with type 1 diabetes, more active. And what I hear is that they have a great success with that.

Gretchen Repasky 48:21

Well, Sam and Esben, let's end by going back to where we started. And I wonder - do you think we'll see somebody with type 1 diabetes win the Tour de France at some point? Maybe in other words, can people living with type 1 diabetes rise to the elite level in sports?

Sam Scott 48:40

Well, I think there's no reason to suggest no, because, I mean, the team that I work for, is impossible. It's already a level of impossible. The idea of putting together a team of athletes who compete all around the world, against other elite athletes without diabetes, and also get on the podium. I would say that reaching that next level to competing in the Tour de France, which is which is the aim of the team. There's no reason to suggest not. The main challenge for our team is the number of people with type 1 diabetes. We can't just recruit athletes from other teams. We're limited. That's the main thing. But on the other hand, outside of Team Novo Nordisk we've already seen elite level athletes win gold medals. There's examples of people winning numerous gold medals in events such as swimming, all kinds of sports like football, rugby. They're already people reaching really the top elite.

Esben Vestergaard 49:51

I really hope it happens someday. It would be very grateful - all our athletes and our children with diabetes to have a role model. So they can see yes, it is possible.

Gretchen Repasky 50:04

Well, a very, very big thank you to both of you for spending time with us today and for sharing this really interesting work with our listeners.

Sam Scott 50:13

Thanks so much for the invitation. It's been fun.

Esben Vestergaard 50:17

Thank you very much. It's great to focus on sports and diabetes. It's so important.

Gretchen Repasky 50:23

I think it's really important to draw the light to it too, as you said, Esben about having role models, especially for young people. I wish you all the best as you continue to push these boundaries, to continue to empower people living with diabetes to practice sports, both at a high level but also on an equal footing to people without diabetes. You can learn more about Sam and Esben, the

guests of our show today at our website, DanishDiabetesAcademy.dk/podcasts, where we have short bios, additional information about their research and photos of them at work. Our show today was produced by the podcast agency Kontekst & Lyd. If you like what you've heard, remember to leave us a review. A very warm thank you to the Danish Diabetes Academy for keeping Postdocs Talking. Thanks for listening. Hope you'll join again next time.