DANNY LENNON: Sophie, thank you so much for joining me on the show today.

SOPHIE KILLER: Thank you very much for having me.

DANNY LENNON: It's my absolute pleasure and I am very interested to ask a lot of the questions around work you're doing with a number of elite level athletes as we'll get into later in the show, but maybe just to provide some context for people listening. Maybe can you bring them through a bit around your background and all the way up to your current work that you're now doing?

SOPHIE KILLER: Of course. So, currently I am the Lead Performance Nutritionist for British Athletics. I am responsible for the Olympic and Paralympic track and field programs there and I have been in position just under 3 years – 3 years in May. Prior to this role I spent 4 years in Premier League Football at two different clubs, and did a short stint with British Sailing and worked with British Basketball during the London 2012 Olympic Games. I completed my Ph.D. from Loughborough University under the supervision of Professor Asker Jeukendop and Professor Mike Gleeson looking at a few different areas but the main study was focusing around 'Overtraining any impact on immunity and endocrine function in periods of intensified training in pretty well trained cyclists' that was a really

interesting study. So, that probably brings us up-to-date.

DANNY LENNON: Brilliant and lots there that I'm planning to get into later in the show. One thing that's probably clear to people listening from that is you obviously have an exposure and experience to large range of sports in the past. And I think even within your current role at British Athletics you're still going to be working with athletes across a wide spectrum of sports that have very different demands. Can you maybe give people an idea of what that spectrum encompasses for you and what type of different sports and athletes that you are working with on a day-to-day basis?

SOPHIE KILLER: Of course. I think that's why athletics such a unique and special sport to be working in, because it's just one sport. It's track and field but it encompasses so many different aspects of physiology and skill requirement. It keeps you on your toes one minute I'll be talking to a 120 kilo hammer thrower about hypertrophy in the next minute helping a 45 kilo middle-distance female about how much to cycle back. So, it really does keep you on your toes as it includes all of the jumping, throwing events, combined events, track events and then of course working with the Paralympic guys too opens up a whole extra range of different classifications or all the different Paralympic classifications from wheelchair racing to athletes with cerebral palsy, and amputees who'll have very interesting and different metabolic requirements for their sport. So, yes it's pretty varied. It doesn't really feel like you work in one sport when you work in athletics.

DANNY LENNON: Yea, for sure and I can imagine just with the huge number of different athletes that's going to be included there it can be quite a challenge or at least keep you on your toes of trying to program that throughout the year. When it comes down to your day-to-day work, because a lot of the people listening here are either nutritionists or aspiring performance nutritionists that may want to get into the field or working in various different areas like strength and conditioning, when it comes to your work on what you actually do with the athletes on a day-to-day basis can you maybe give people an idea of what that might be

or what type of tasks that you might do and just how different I suppose that could be from day-to-day?

SOPHIE KILLER: Yeah, of course. So, I am based at Loughborough University where we have a number of our athletes that are on the world class performance plan based in Loughborough, so obviously I have day-to-day access to some of the athletes that I work with and because we have athletes that are based remote from Loughborough either some athletes are within Great Britain or abroad as well. So, clearly communications with them are slightly different. It might be over Skype or sometimes just WhatsApp and that obviously I'll catch up with them at camps and competitions but for a day-to-day it's really difficult actually. Probably no two days look the same, but there are things that really underpin my role is to try and encourage or try and promote maximum performance in each session that the athletes are doing, so whether that's optimizing diet in terms of pre-training meals, recovery meals, in terms education and so running kitchen coaching sessions with some of the younger athletes to make sure that when I say this is what you need to be having post-training that they're actually go ahead and deliver that and so while I'm going to telling to do, but they haven't got the skill set then it doesn't really help. So, yeah I suppose trying to support that day-to-day training trying to make sure we reduce the number of days that are lost throughout an Olympic cycle to either illness or injury; I suppose trying to get them back to training as quickly as possible if they do pickup an injury or an illness. And I suppose a big part of my role is working within the multidisciplinary teams, so we have a fantastic huge team at British Athletics comprised of numerous doctors, a massive therapy team with physios, sports massage, osteos, there's myself as a lead nutritionist and we've just taken on a Ph.D. student last year who also works a day to day-and-a-half a week with me, and then we have the odd intern from time-to-time coming in, we've got a couple of biomechanists, we've got three S&C coaches one Paralympic specific, the physiologists and psychologists and performance lifestyle advisors too so really, really big team and it works so well and we all work together to try and support the athletes as best as possible. When I am

not around pump which I do have a quite a lot then I am either at a track or maybe in the lab, so we do blood analysis which we can come to a little bit later, 4 or 5 times a year to make sure the athletes are healthy and optimizing performance. I need to run their supplement strategy program to make sure that everything that the athletes are consuming if they are going to use supplements they're safe and are well placed in UK Anti-Doping and with WADA to make sure that we're completely compliant and everything is not just safe but obviously well above board for all of our athletes. And then there's all the travel, so altitude camp, holding camps in the preparation phase before competition, and then occasionally being present at the competition as well. It's a bit of whistle stop, but that probably covers most of the things I'd be involved in like on day-to-day, week-by-week, month-by-month process.

DANNY LENNON: Brilliant, yeah that gives lots of context for some of the stuff that I want to get into. Just off the back of that you mentioned right at the start the importance of education, and I think that's probably particularly with the large number of athletes you're going to work with and trying to get them to actually apply some of these recommendations. It's obviously key that education is a part of that, but I'm just wondering with obviously a number of different athletes that are of different ages, different levels of current understanding around nutrition etc, etc. How has or what type of challenges that being from taking evidence based information that you're aware of from your own research and study, and what you would in an ideal world practically like to implement with someone but then being able to translate that into something that is both understandable and actionable by all the athletes ideally that you're going to work with. What type of challenges had been or how has that process been for you since you've been in the role of trying to take what you know and translate that into something that's understandable and usable by athletes?

SOPHIE KILLER: That's a really great question. So, that's kind of what underpinned my fascination with working in sport. Obviously you do your studies at university and then – yeah I mean it's just that fascination about being

able to link the amount of research that's out there with what it actually looks and feels like translating that to an athlete, how you can actually get the athletes to try and understand a little bit about why they're doing it but without overwhelming them with you know literature or with research and they may not have the capacity to understand or the interest to engage in. So, yeah I mean it varies hugely what level of support and education you give. Clearly I've got young athletes coming onto program that may have zero experience in the kitchen, they may not have done science undergrad or may not even done biology or Food Tech-Ed level, so you can be really going right back to basics and trying to explain that a banana has carbohydrates and not protein you know real basics there, and that's quite a fun actually. It's interesting and a lot of that education can be delivered in small group sessions. It's such basic work that you can do, as I said before, kitchen coaching we call it cooking sessions where we get the athletes hands-on with food and challenge them to make a recovery meal in 15 minutes and that kind of stuff. We do lots of different things in kitchen coaching, but then clearly you've got lot more senior athletes that you know they've been doing it for a long time. Previously they may have worked with another nutritionist they're quite well informed, and it's about finding a way to get them engaged and make sure that they're up-to-date with all the best practices as well. So, I think that's when you can really engage with athletes in coaching and really trying to bring in some of that new exciting science and find a way to get them on-board, and also with those athletes the ones that have got the foundations in place is there's a really exciting and new developments that are going to make those incremental impacts on their performance. But clearly taking some new research into some, I don't know, some fancy new supplements or something and giving it to an athlete that's dire. It can be shambles. It's going to have zero impact and actually the impact of clearly really strong foundation of a good diet and a good periodization of nutrients throughout the day can have such a huge impact on an athlete, not even doing that in the first place, so clearly actually you're pitching at all different levels and that is the fascination I think of being a performance nutritionist; find a way to get through to an athlete,

make it interesting, and find a way to have the biggest impact.

DANNY LENNON: Yeah, it certainly is a challenge and I'd just be interested over the years that you've been working in the field has there been any big change or even a shift in how you've gone about doing that. Is there anything you feel you're doing differently now than maybe when you were starting out in the field that you feel is different to when it comes down to practically communicating with people or what you're doing with these athletes is there anything that stands out off the top of your head?

SOPHIE KILLER: I do hope I've improved over the years. I think when I was starting out, because I was quite young I really wanted to come across really knowledgeable and I actually think that probably went to my detriment and I probably did talk a little bit too sciency, especially when I was working in football where you know you're lucky if the players, and no offense to anyone listening, but you're lucky if players have got GCSE A levels, so actually trying to pitch a really complicated metabolic theories or whatever it might be to make yourself sound clever and to think that that's going to impress them and get some buy-in is certainly not the right thing to be doing and actually teaching them some really simple skills that they can feel like they've achieved something is so much more important. So, I think I've definitely become better at gauging the level of sport nutrition support of an athlete and a coach in a need to complete their little team is definitely something I feel I've improved on, and I think it's so important to have really good understanding where your athletes at you know what they teach and actually is needed and then find a way to communicate as best as possible not just try and come across little smart and fancy and try and impress and – it's difficult because I think the current state of social media and the fact that everybody is a nutritionist you know nutrition can be really sexy and you know there's little hype around fat diets and biz and Bob sets. It's important to make sure your athletes don't get too distracted by that and a lot of a good you know theoretically sound nutrition advice isn't that sexy you know sometimes if you get the basics right you'll have such great improvements. So,

it's try and get them engaged in the right stuff as opposed to the super fancy stuff.

DANNY LENNON: Yeah, for sure. I'm so glad you gave that point because it's something I think I've mentioned a number of times in the show before. My biggest issue for sure going back many years has been, again that thing as you said, when you're starting out having all the stuff that we find exciting and interesting and wanting just to dump that on our client, and going too far and it's often counterproductive, so I think that's a super important point. I'm so glad you bring that up. To get into some of the specifics of potential strategies we can use with athletes, some of which you mentioned earlier Sophie, one that you mentioned you've obviously done some work in but I think is becoming more and more important issue when working with athletes is just that idea of how do we keep them away from illness or reduce the time that they're ill or how do we decrease injury time to allow them to be able to compete more. So, with that idea of improving those areas and really I suppose looking at diet role and immune function what are some of the fundamentals that you would talk to with athletes or that you believe are currently good evidence based recommendations right now for dietary intervention with athletes to improve immune function both from a preventative and then maybe afterwards we can talk about if it's an injury case, but first from maybe preventative and boosting immune function?

SOPHIE KILLER: So, I guess first and foremost we do engage with experts on quite a regular basis actually, so whether that's attending conferences to make sure that we are up-to-date or actually invite experts both to British Athletics where I work, but also the English Institute of Sport where I'm technically employed. So, I am employed by the English Institute of Sport and kind of well seconded is the word, out to British Athletics full-time, so I suppose I have that benefit of two networks where we do engage with you know the best people that are out there to make sure they're up-to-date. So, that's very lucky and I really enjoy that process. But some of the strategies that we implement, so I think sometimes especially with the current – perhaps not so much of fat but maybe carb-phobia would be a good word for it that no athletes want to eat

carbohydrate. It seems to be that the micronutrient at the times that's the only maybe 20 years is fat. Certain carbohydrate now is you know it's fear in some of our athletes and actually not having enough carbohydrate can have a significant impact on the stress post exercise and very low carbohydrate diets can result in high cortisol levels and obviously that can have negative impact on immune functions. So, I think if athletes have then issues about to do ITIs one of the most important thing before looking into any fancy stuff would just need to look at their diet, look at how they periodize their energy and take around training, are they training with low energy availability because they not wanted to eat carbohydrate throughout the day but then actually they're starving at night and they end up eating a load of carbohydrates just before bed which obviously isn't necessary what we want, so sometimes just re-juggling where they're putting their energy intake around the day and making sure that they're training with high energy availability. So, if it's track session in the morning we encourage them to have porridge maybe bananas in the breakfast and moderate or high carbohydrate for lunch time just try and help modulate that endocrine response which we know can have an impact on immunity and sure if they want to go on a lower carbohydrate throughout the rest of the day and actually eat in the evening fine. But we do know is that the training session has been optimal in terms of having energy to deliver a good session, and we know adaptation will be supported by the end-availability but also hopefully that that stress post-training will it be attenuated slightly by having carbohydrate. So, looking at those kind of basics would certainly be a start, and then some of it is just that exercising in dehydrated state may put you at higher risk of catching a upper respiratory tract infections, if it's slightly flow-rates reduced or then you have some nose reduced then you're going to have a reduction in anti-microbial proteins which are the first line of defense for the immune system. To what extent dehydrated you are starts to have an impact I am not entirely sure. We did a study on this with cyclists at a moderate level of dehydration, I think it was around 2% – 1.5% to 2%, and then found key implications that they clearly effect these are carrying over at moderate level of dehydration each day that

could be something that could be contributing, so we certainly look at that as well.

One thing I'm particularly interested in antioxidant capacity as well and how that might I suppose contribute to an athlete's ability to handle training load and lot more travel and that kind of stuff and maybe just keep them healthier and maybe prevent them from catching infections. So, one of the training studies that we did we looked at how 9 days of intensified training, so it was I think 5 hours a day on a bike for very well trained cyclists. So, 9 days of training with a couple of time charts trying to get good measure had a significant reduction in antioxidant capacity just within I think it happened by 7 days and quite significantly full by day-9. So, clearly your ability to handle cellular damage that's taking place and the implications that that might have on immunity are going to be increased. And some other really nice research from within the EIS form Nathan Lewis looking at antioxidant capacity and how this plays a role in athletes ability to recover and to keep them fit and strong, and really a nice thing about this research is that antioxidants are in the diet so encouraging athletes to eat more fruit and veg we've actually got a really strong rationale to be doing that now. And of course you can buy antioxidant supplements too which we do from time-to-time especially when we're traveling to countries where we think that there the food might not be optimum, so some really interesting strategies around there. Clearly there's whole wealth of other things that we would need to explore that be vitamin D status or using zinc lozenges which potentially have some research behind them to suggest that high exposure to zinc – oral zinc in the mouth you know couple of days after the onset of sore throat or signs of upper respiratory tract infection might reduce the severity of that infection. And then things like probiotics and we can play around little bit with prebiotics to try and support not just health but overall immunity as well we would look to implement certainly during periods of intense training camps, so when the athletes are on the road, traveling a lot in airplanes there's increased exposure for pathogens. So, those kinds of things are things that we would address you know it's a vast pot of gold.

DANNY LENNON: Perfect. I know that gives a lot of stuff we can get into and I think with the dietary intervention and you mentioned there some supplement interventions that could be kind of timed depending on the phase of the year etc, presumably that's all going to correspond differently to the different athletes as well. Just thinking about for example, two cases you gave already if you have a hammer thrower where there's maybe not as much significance on keeping or is less likely to be maybe in a hypocaloric situation therefore they're probably not going to be short on energy, and obviously then a knock on effect they're probably not goig to be short on taking in food, so maybe micronutrient deficiencies are less likely than if presumably you have a lot of athletes who maybe if they're not up on their nutrition trying to find that balancing act of their trying to keep bodyweight down. Maybe a lot of the track athletes that's going to have a knock on effect on endurance work where they're trying to keep bodyweight down, but they obviously have this huge demand for energy. Is that a huge challenge not only for just providing enough energy for the workouts, but then when we see the stuff on their immune function are they typically the athletes who seem to see more of these issues in?

SOPHIE KILLER: Yea. It's a really good question. Yeah, I suppose the athletes that travel the most we tend to see an increase in upper respiratory tract infections and yes those that have more of a low energy availability we do tend to see probably increases across the board in terms of illness and the susceptibility to injury, and all those kinds of things that circulate around I suppose REDs if it's a paradigm that people talk about. So, clearly there are higher risk group, but then there are whole wealth of challenges with some of the throwers in terms of joint health, healthy blood profiles in terms of cholesterol levels and the things you perhaps wouldn't necessarily think about with elite athletes but when you're consuming that many calories a day you have to be pretty careful to make sure you're getting enough of the right calories and that's not always that easy for some of the larger throwers – the larger body mass athletes.

DANNY LENNON: Perfect. So, one think I wanted to tag onto the end of that was you mention their travel and obviously that

can for a number of reasons increase risk of illness. With the travel arrangements you have or recommendations for athletes is that a time where they just – okay anytime you're going to be traveling here's some stuff you want to supplement with, be particularly conscious of these types of meals or how does that work in terms of making sure that you can navigate travel and obviously the stuff that comes with that including jetlag if they're traveling across time zones. What does that practically look like?

SOPHIE KILLER: Well, it's always a really big project and always a really multidisciplinary approach. So, yeah we have jetlag strategies in place for all the different places that our athletes travel to so whether that's a team event where all the athletes traveling or just some of our really high priorities that are nipping off to a diamond league that we'll always do everything we can to make sure that we're optimizing the jetlag strategies. Everything from manipulating light exposure, I would obviously advice on what time to eat, what kinds of meals to be eating. The physiologists would help the coaches figure out what time the training sessions should be and what kinds of training sessions should be before the athlete leaves and on arrival. Obviously the therapists and the docs would give advice about maintaining the blood flow during the flight and trying to prevent any invasion or soreness from travel. Obviously I'll communicate with hotels so that we know that the food on arrival is going to be appropriate. Sometimes we send athletes with packed lunches. We were lucky during the Rio Olympics that we had a meal sponsor that provided packed lunches for all the Olympic athletes on the BA Flights, so we were able to determine exactly what an athlete eats you know. Flight food isn't always brilliant, and then on the flight we'd encourage hydration. Maybe using insight first defense is try and boost that in case of immunity. See lots and lots gets included into that. We have experimented with tryptotan and melatonin to try and help sync circadian with them. We've done experiments with core body temperature change to see when the T-lymps are at the lowest temperature – lowest core body temperature in your circadian, and then how long that takes to shift to try and identify individual athlete's ability to shift into new time zones when they travel really long distances. See it's a huge

project as you can imagine you can't really afford to train all year, and then have your performance scattered on the line because of the really poor travel strategy. So, lot of work goes into this. We've had circadian biology expert come in and have a chat with us as well, so that was really interesting. Yeah, it's a really big part of what we do to try and keep athletes safe and well on the road.

DANNY LENNON: Yeah, that's pretty amazing to see all that goes into it and obviously with the huge focus on circadian rhythms when they're traveling across these time zones. When it comes to their diet what is the typical way you navigate that like is there anything in particular with meal timing that you do with the athletes once they've traveled across the time zone to try and in some way sync it up with that circadian rhythm. What way does that work with say meal timing and so on?

SOPHIE KILLER: So with meal timings what we try to do is get athletes to shift as soon as possible, so we have played around with pre-shifting so trying to get athletes to just slowly move into their new time zone a week before their flight. So, it might be going to bed half-an-hour later a day or maybe 10 minutes later every day, waking up 10 minutes later to try and start a bit of a shift before they travel. With regards to food we always try and get the athletes to eat in line with the time zone that they're arriving in as opposed to continuing to eat in the time zone they're leaving. So for example, if you were boarding a flight in the evening time but when you were going to be landing it was going to be say morning or the evening. This is complicated let me think of a good example here. But basically we try and encourage the athletes to as soon as they board that flight to get onto the new time zone in terms of staying awake when they should be and they're not napping being really strict so using caffeine to try and keep them awake if they're going to be landing in the evening and need to be going straight to bed. And therefore to try and have them to eat meals that would be in line with that, so breakfast type meals and if we think the flight are going to support the athletes with that we encourage to take on porridge pod added to some boiling water, take on different types of snacks with them if we don't think the meals would be served

at the right times to try and encourage that new circadian rhythm and dietary plan. So, yeah it can be quite complicated but it's always a really fascinating challenge.

DANNY LENNON: Yeah, no that's super interesting. I like looking a lot of stuff on circadian rhythm, so it's just interesting to see how practically it's going about navigating that from a dietary perspective. One thing I did want to get onto Sophie and there's probably kind of two arms to this is the monitoring process for an athlete. So, on one end in a moment we can perhaps talk about some of the testing whether that's physiological or blood testing to check things up, but first on the way of actually monitoring what they're doing with their diet. How do you go about putting that process in place for actually seeing what the athletes are doing with their diet and like what do you kind of look into to gauge from that?

SOPHIE KILLER: It's really difficult I should start by saying that. So, I don't carefully and accurately or at least attempting to be accurately monitor exactly what all of our athletes eat. I think I've got over 120 athletes on program, so clearly that wouldn't even be possible if I wanted to. So, the way that we work we prioritize our time with our highest priority athletes, so with those guys yes I probably would do some dietary analysis from time-to-time as you know diet diaries and even using apps to record food – there's going to be a margin of error there whether that's that the forgetting to record food or hiding food, but I do think it's a really valuable process because it really gets them thinking about food which they might not have done before. So for example, if they were going to have four digestive biscuits but they have to write it down and then maybe they'll only have one because they don't want to write down four or maybe they'll have the four but they'll only write down one and that has actually made them stop and think, "Should I be having four." So, I do think it's quite a tool to have athletes to start thinking about food. But I do always take a diet diary with a pinch of salt and leave it more as a I suppose as a starting point for the communication as opposed to spending hours and hours laboring over calculating the exact micronutrients and macro-nutrients that they consume because I think the error is so great, and then you add in error of the diet software that you

use I think it's very difficult to be very accurate. But actually I'm not particularly concerned about that because if you take an event or you could take a sport like athletics for almost all of the events with an exception of maybe a very efficient long-distance runner it is very difficult to calculate energy expenditure, especially if you're trying to calculate it in different sessions. So, if I can't even estimate accurately how many you know calories or whatever it might be that the athlete actually needs then what's the point in me trying to get them to very accurately tell me how much they need, and then for me to try and set targets – isn't very accurate targets because the numbers could just be so misaligned. I think until we learn more about energy expenditure you know in a high jump session or whatever it might be then to try and set very specific caloric intakes I think is just a bit pointless and probably dangerous because you don't really know what it is that they're expending. So, the best thing I can do is to spend as much time track side as possible. I was really interested watching some of the hammer throwers and realizing that they walk maybe up to 10 k in the training session because every time they throw the hammer they have to go collect it which foolishly may not have crossed my mind beforehand, but you know that training session is quite different from what you might just think of a throwing session being 50 really explosive throws and checking a bit of endurance in that as well become quite an energy expensive session and potentially there is a big role for carbohydrate which maybe you wouldn't necessarily think in a power event. So, wherever possible I do encourage and try to get myself trackside to try and understand physiological demands of the sport, and then I can start to use my knowledge of diet and metabolism to try and make some accurate as possible predictions on what the micronutrient and micro-nutrients might be, but it's still pretty loose the way I work.

DANNY LENNON: Yeah, no that makes so much sense and I think that's so valuable for people to hear because earlier we talked about how these online nutrition experts can give people wrong ideas and I think one of those is this simple idea of workout this very specific number of micronutrients of some equation and like that's exactly what someone should eat, and especially for

an elite athlete that's never going to work out for the number of reasons you've mentioned whether that's accuracy of food logs versus being it just able to know what energy expenditure is never mind individual differences, and so therefore probably on one hand I'm guessing you have that role around strong education of what the athlete probably should be doing. Giving them a good ballpark of what a day might look like, and then presumably to gauge whether that is enough or whether something needs to be tweaked going more on training performance, recover, bodyweight as opposed to well this equation told me this is how much they should be eating?

SOPHIE KILLER: Exactly. Yeah, and I do body composition assessments regularly when we are working with athletes that are undergoing body composition changes and slightly less regularly but those that are weight stable and happy with their body composition.

DANNY LENNON: Perfect. Yeah, I think that's just such a valuable thing for people to hear if that's the only thing to take away. So, with that you touched on body composition assessments. Other kind of tools that you use to assess various different athletes, I know you mentioned earlier blood testing. Can you maybe get into some of the different modalities you're using or different things you're using to monitor athletes health status, nutritional status, performance all that type of stuff and maybe give an idea of what you're looking for with each of those?

SOPHIE KILLER: Yeah, so let's start at body comp and so we just use the basic ISAK Skinfold Sum of 8 as a base for most of our athletes, and then we do use DEXA when we need additional information, so for some of our higher risk athletes whether that's female endurance athletes or athletes with cerebral palsy where the impact forces through bones might not be as expected and that therefore might be a higher risk of stress injuries and some of wheelchairs is they're offloaded would you like to monitor their bone-mineral density. So we use DEXA from time-to-time just to make sure whether we get some insight to bone health and not just body composition.

With regards to the blood screening as I said, we run screens 4 or 5 times a year, so we kind of kick off our athletic season in I suppose October time for most athletes depending on when the camps ended in the summer and we'll start up with their care; a general quick health screen, so looking at vitamin D status, iron, maybe a couple of micronutrients magnesium and B-12 kind of thing and just check everybody is optimal at that point before they're kicking off the season. And then we do a couple of extra screens throughout the year kind of pre-comp to make sure that you know their iron status isn't falling off, especially if athletes going up to the altitude we'd always test them a couple of weeks beforehand. As you know this is not a huge point going up the altitude if you're iron status is very low because it plays such a fundamental of growing that hemoglobin-mass adaptation. So, it's something we really carefully monitor with all of our endurance team. Vitamin D status despite our athletes traveling quite a lot you know lots of them will be training mostly in the UK over the winters, so we'd see huge deficiencies although as we've got better in monitoring and try and maintain vitamin D status we are seeing much better results consistently now. Magnesium is something I'm particularly interested in. I've got a few case studies over the – well I've got projects as I was at the university over the last few years looking at magnesium status and the doctor and I going to shortly be publishing some data we've collected on 6 years worth of magnesium status correlated with tendon injuries, bone injuries, and then things like ethnicity and athletic history but we think it's very interesting. So, we're putting it out there soon, so that's something we like to monitor as well. We don't do huge amount of day-to-day monitoring of things like cortisol and testosterone, at least I don't. I think until this kind of real accurate point of care or the kind of handheld analyzers that we can use for that. I don't really know if it's really that valuable to be looking at that, certainly in saliva actually highly variable anyway. What other you wanted me to do. Have I mentioned anything else you want me to cover?

DANNY LENNON: No. I think that's great. It kind of gives the view of just what people can look at over the course of the year,

but beyond that I think what was particularly pointed right at the end you mentioned is I think maybe some people can think they need to go too far down the testing rabbit hole when maybe nothing is actually an issue. So for example, I know of people who actually go and try and order these tests online to check cortisol like extremely regularly when everything else seems to be going fine, and so there is – sure like testing I think can be extremely informative but I think the big thing that I got from what you just said Sophie is that you're doing it for the reason that it's going to show you something that's actually going to inform your practice or change an intervention. Like if working out something is going to not change the actual dietary intervention someone is going to use them that doesn't necessarily have to be looked at?

SOPHIE KILLER: Yeah, absolutely. I think when you're working with athletes that are high level you know they are not really bugged by testing all the time but they will engage if they get something out of it. So, we're really careful to make sure that if anything we do that's above and beyond them just training and spending time with their coach it is going to be beneficial. So, you know we always try to be very timely we're getting results back to you then demonstrating interventions if necessary or just reassuring that they're still on track. But clearly what's not appropriate when you're working with these athletes is to just be finger pricking or taking blood day in day out if you're into it to maybe learn something but perhaps not to be able to use it to help them.

DANNY LENNON: Right, yeah using them as a nice experiment to see what's going on!

SOPHIE KILLER: Yeah, that would be fun, but that's why we have to use university students or…

DANNY LENNON: Right, exactly. No, that's extremely useful and so for maybe people listening is there anything that typically pops up as the most maybe a common finding or just a general thing that if people aren't looking at in group of athletes they either work with or maybe they are an athlete is there something that you would pop there as some real low hanging fruit that is probably

worthwhile going getting tested regularly if they don't currently do it?

SOPHIE KILLER: Well, if it's really just track and field I don't remember looking at iron particularly when I was in football and basketball, but it can have such a huge implications for recovery and fatigue. So, I think especially female athletes if they're not – it doesn't have to be super regular, but if they're not monitoring their iron status I think they're kind of running up against a brick wall a little bit, especially if they're some kind of endurance athletes and you know even taking iron supplementation is not particularly straightforward because we're learning more and more about hephaestin cycle with iron and how if you're regularly taking iron actually your hephaestin is going up but perhaps not absorbing iron that well, so that we're optimally supplement iron is changing and we're learning more and more about that. So, to go and have a nice ones, so then to put yourself on some iron supplementation strategy you may not actually see the results you'd expect. So, I think you'd be playing around with that if you're working with any female – certainly with any female endurance athletes if you're not already testing that. And then as I said magnesium is something particularly I'm interested in but we could debate that whole day.

DANNY LENNON: No, that's super useful and I think as much of this has been already, so we're going to start wrapping up. Before I get to the final question or two there's obviously like I mentioned earlier a lot of people listening who are either in early stages of a career in performance nutrition or maybe they're aspiring to get into performance nutrition and work with athletes specifically. For those people in those kind of early stages or just starting along that journey is there any pieces of advice that you would give that you think would be particularly useful?

SOPHIE KILLER: Well, I think if it's nutrition that any of the listeners are interested in going into clearly they need university education, but what I think traditionally what's been really lacking in university education in nutrition or sports nutrition or human nutrition or whatever is they're studying is their relationship with food, so don't really learn about actual food when

you're at university or at least I didn't really. So you know you go into first role as a performance nutritionist you know that an athlete might need 25 to 35 grams of protein post training but what does that actually mean and I was with few students recently and asked this question and some of them were widely off how much food you actually need to consume to get 15 grams of carbs or 40 grams of protein. So, if you say to an athlete go off and eat 20 grams of protein or you need to eat 60 grams of carbs an hour if you're on the bike or something. Now, it's really, really no good to them. What you need to know is how many grams of carbohydrates, how many grams of proteins you need to consume all that kind of stuff, so when you talk to them you talk to them a few time you never say you need 30 grams of protein you say you need a chicken breast with blah, blah, blah whatever it might be that's what they can understand and that's what they listen to and I still feel like those students that interned that ever get that just don't have that understanding and it's not complicated they know much more complicated information. It's about stopping and understanding the basics because that's what can have a really big impact on the athletes.

DANNY LENNON: Yeah, I love that that's a great point and it's essentially thinking of that end goal in mind if you're working with someone it's about building that relationship and allowing them to be able to understand the information as opposed to technically knowing, like you say, in terms of grams of protein your carbohydrate what you want them to be doing, so yeah super important point. Before we get to the final question Sophie if people are interested in finding you on social media or any of your work online or contacting you where is the best place for them to go?

SOPHIE KILLER: Well, I do have a Twitter account it's Sophie_Killer, so probably there.

DANNY LENNON: Perfect and for people listening I will link that in the show notes if you want to go over and follow Sophie and keep up-to-date with what she is doing. So, that brings us to the final question that I always end the show on and this can be to do with any topic completely outside of nutrition if you wish, and it's simply if you could advice people to do one thing each

day that would have some positive benefit on any area of their life what would that one thing be?

SOPHIE KILLER: I love this question. I think it would be a reason to smile, because I obviously think if you're happy at what you do you would do such better job than you'd do if you're not. And when I speak to young students I always say to them the first thing they need to do is find their inspiration, find what is it that they're really interested in and what makes them happy because a lot of jobs they might sound like fun but if they're job for you, you won't do a good job and all the hours you need to put in to becoming very good would just be a struggle. So, it's something you do every day would be is to reflect on if you're actually enjoying what you do and if it's a few days in a row you realize you're not then probably time to change that.

DANNY LENNON: Perfect, brilliant and Sophie that's a great way to end out this conversation. I really appreciate your time today, but also the great information you've given and I am sure people are going to get tremendous value from this. So, thank you so much for being part of the show today.

SOPHIE KILLER: Oh well, thank you very much for having me. It's been a pleasure.

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