DANNY LENNON: Dr. Shona Halson welcome to the podcast. Thanks so much for joining us.

SHONA HALSON: Great, thanks Danny.

DANNY LENNON: Yeah, it's my absolute pleasure. As I had mentioned to you I've been reading a lot of your work recently and it's been very informative and fascinating area of research that we're going to look into this whole area of recovery for elite level performance. So maybe just to get started here and to get all the listeners on the kind of same wavelength when we think of that term recovery it could be quite a loaded term because in many senses it might be quite a generic term to people. So when we're thinking about this idea of recovery, how should we just even think about that term, how should we try and start defining of what recovery essentially is for these athletes?

SHONA HALSON: It's a really good question. The way that we tend to look at recovery is restoring the athlete back to a baseline level both psychologically and physiologically as quickly as possible. So we don't look at recovery from injuries. My area is not so much nutrition although I dabble in that area a little bit but the most of the work that we do is looking at just trying to get the athlete back to where they were before they trained as quickly as possible or before they competed. So they can

either train better or more importantly for us, compete better.

DANNY LENNON: Perfect and so with that there is obviously a whole host of different strategies that could be used and we might talk about a few different ones throughout the course of this conversation but one that I'm particularly interested to start with centers around your work based on hydrotherapy for recovery. And so some of these different variations of how to do this I'm sure some people will be familiar with, whether that's cold water immersion, whether it's contrast water therapy, there are various other forms that can also be used. Can we maybe start with what different types of hydrotherapy there are and really what are the differences between the main ones that have been used in different settings for recovery.

SHONA HALSON: Yes, I guess the major ones that people would be most familiar with are cold water immersion, hot water immersion, the combination of cold and hot water immersion so the contrast bath and then the other one is really active recovery in water so moving in water. So the major differences are around the temperature of the water and whether or not the athlete is active in that water or not. So at sometimes there may be different occasions where you may use different recovery strategies based on either the type of athlete you are or the type of training session that you've done. So now I'm trying to move towards, okay there's different strategies we know may have some slightly different physiological effects so how do we now tailor those strategies to the athlete individually and in the best way possible?

DANNY LENNON: Perfect and is there typical durations that are used for each of these therapies or does that very much vary from protocol to protocol as well?

SHONA HALSON: I guess now over the last couple of years there's been quite a bit of research in the area and if you look specifically at research first rather than practice so research tends to be in terms of the scientific evidence that's shown benefits of these strategies. So cold water for example is something like 10 to 15 degrees temperature for 10 to 15 minutes. Contrast water

there's been sort of less research in that area but again suggesting around about that sort of 10 to 15 minute top approach. When it comes to practice there's obviously a lot of things that are going to depend on whether you can have that amount of time in the water.

So some of the things that we think about are; what's the schedule of the athlete, are they a footballer who has just played and then they have to go and have media commitments and travel commitments et cetera, what is the size of the equipment that you've got available? If you got a large number of athletes to get through fairly small facilities then that obviously makes things difficult as well. And then you also have considerations around what's the water temperature? So if you are out in the field and you're trying to do these recovery strategies or you're a competition setting and you may not be able to get water temperatures very low so what you might do is have the athlete hop in water that's slightly warmer for longer periods of time.

But if you look at…people are interested in what's a generic kind of protocol so you probably look at 10 to 15 minutes, 10 to 15 degrees for cold water. We like to keep the ratio the same for the hot to cold when you're talking contrast therapy so one minute – one minute or two minutes – two minutes. So two minutes hot-two minutes cold, two minutes hot-two minutes cold, something like that. And again you probably don't need to go more than about 15 minutes and the hot water the only thing that we really take into consideration there potentially is we don't want people sitting in a hot spa for too long. Mainly in our experience we find that it's hard to get athletes to remain hydrated at the best of times so not overcooking the body by staying in hot water too long.

So again the sort of 10 to 15 minutes in a spa is pretty good. The temperatures that we use in Canberra are 38 degrees for our spa.

DANNY LENNON: Right, thanks for that. That's a great breakdown, gives us a good place to start from and there are certainly a lot of specific things I want to ask about some of the specific papers that you've published. But from maybe an overview

level first, when we think of just all the work that you and your colleagues have done and maybe from other independent labs that you've seen as well when it comes down to these different types of hydrotherapy for recovery what are some of the big overview takeaways that we can probably take from this area right now or that we are safe to conclude in your opinion about these strategies and about their efficacy?

SHONA HALSON: Yeah good question. Look I think when it comes to acute recovery so we're talking performances between less than 48 hours to train athletes I think you can be pretty confident that is you use cold water that's not too extreme so not too cold and not for too long you do cold water well and use proper strategies and proper techniques then you should have an increased performance acutely. Then comes the big question now, the big debate which I'm sure you're aware of is periodization of recovery and can you do too much recovery and may potentially dampen adaptation by doing some of these strategies too much.

So that's the big question at the moment and I could talk about that for a long time but that's the kind of debate at the moment is and we don't have a lot of science in that area and the science that's out there is not in high level athletes. So at the moment we're really basing what we know about adaptation in athletes on anecdotal information and some very small amounts of science in the area.

DANNY LENNON: And I suppose the interesting thing is that it's hard to maybe quantify some of this stuff because there's maybe a lot of second and third order effects, right. So we can look at performance because I think I remember reading a paper you did on weight training where I think they did a squat jump and at least there seems to be no harm at all to performance. I think there might even actually be seem to benefit in the recovery there but then if we're talking about these adaptations and dampening those in say response to a weight training session because that's what typically might talk about when there's muscle damage, that inflammation we get we actually might want it. It's hard to quantify well if you are kind of dampening some of that like where will we

see that actually show up in performance if at all? So it becomes a bit messy, right?

SHONA HALSON: Yeah, that's definitely the case and 100% what you say is correct in that depending on what sort of performance test that you use to assess whether or not you've adapted or not adapted you may see very different responses. So again you're correct when you talk about the weight training area seems to be the area where potentially there could be some minimization of adaptation with using hydrotherapy. Again I need to put a big caveat out there and say that there's been some good studies but the best study is still one in looking at athletes who train twice a week and we're dealing with athletes that train twice a day.

So yes there's the potential there that we don't want to ignore the research because some of that work is out there. So I guess from a practical perspective what we would do is say, look if there is one area of training where there may be issues with adaptation it could be around light training so if we're going to be conservative and we want recovery out, we'll take it out after those types of training sessions. But as I sort of mentioned about periodization earlier you know there are times where you may not want any recovery at all, you might be trying to drive a massive adaptation response.

So for example it might be track cyclists and they might be doing long periods of endurance case at the start of the season on the road you might just say, look no recovery for you guys but then when they start getting on the track and they want to start doing some more high intensity quality sessions on the track you might start to add a little more recovery. And then again as I was saying earlier we think that the acute benefits of recovery are fairly strong and there's evidence for those. So we would obviously throw every recovery strategy that we can at an athlete during the competition setting

DANNY LENNON: Yeah I'm really glad you bring up the periodization point because it's such an important factor when trying to plan for athletes and people listening to this so maybe if be familiar with…we've talked about previously more of a nutritional

sense looking at say carbohydrate periodization which I know Louis Bark has of course done a lot of work on the same thing that not every training session the goal has to be best performance. You actually might take a worst performance in a particular training session to get some sort of adaptation in the carbohydrate sends to mitochondria for example and the same thing here I'm really glad that you bring up that.

Not every training session like the main goal is let's see how much we can kind of recover we might be trying to do different things at different stages over the course of the year. Is that something you definitely see that is probably not so much the cutting edge it might not be the right term but where more of the top level teams and athletes and coaching organizations that are working with the athletes are probably at in comparison with others is that they understand the importance of these different modalities at different times?

SHONA HALSON: Yes, most definitely and because now people really are talking about this periodization and adaptation response. There's a lot of thought that's now going into it and one of the things that we're sort of thinking at the moment is well maybe you're not recovering from a session but you're recovering to prepare for a future session and that can be sleep, it can be hydrotherapy, it can be a range of things but really if the coach is after a super high quality session and wants to get the most out of the athlete then potentially you might be looking at recovery in different phases of the training week that you might have not looked at before.

And as I said earlier there is not much science at all so it's really the better scientists and the more experienced they are that have been working with athletes for a while and know their athletes. They are really making some of these decisions based on just their knowledge and experience working with these high level athletes. One of the things we do find interesting is athletes don't always like it when you take recovery away and like most areas of sports science often the athletes are further ahead than the scientists.

They sort of know what to do and what doesn't and so if you are taking away recovery from an athlete I find it's very important to give them that rationale and to say, look this is what we are thinking at the moment and of course combining that with some good monitoring. And also of course factoring in what is the sport so cycling and swimming there is obviously very little muscle damage that occurs in this sport except for obviously in the weight room and you can generally push these athletes pretty hard before they break.

Totally different story if you are working with a professional football team like rugby team for example where there is a lot of physical contact, there is a lot of running, there is the gym sessions as well their frequency of competition is greater. These guys might be playing every week and therefore the you know whether you would include recovery or not becomes sort of an easier question to answer because the requirement to back up and the physical nature of what they are doing is say potentially very different from a swimmer who might have one or two races a year that are important and really one race every four years that's actually really important. So I think it's people looking for black and white answers and when they read some of these papers that might suggest that our spas should be outlawed I think it's definitely not as simple as that and to look at the type of athlete, the type of training, where they are in their training phase and where they are in their competition phase and they certainly know blanket rules for when and where you should do recovery with which athletes.

DANNY LENNON: For sure and I think that's probably the big distinction. We were looking at actually applying this stuff in practice and it's a trap that maybe could be easy to fall into for those of us within this evidence based sphere so to speak. We have trained always, based what we're doing on good quality evidence and then some of the areas where there is still much more to figure out. In this case if someone just says, "Oh well, I haven't seen good enough evidence for…," I'll just like scrap all these strategies. And we have the example you just gave of an athlete who really enjoys it and I think you've mentioned this in one of your papers a belief effect of if an

athlete believes in a recovery strategy they are doing there is something to that, right?

SHONA HALSON: Yeah, most definitely. We see this all the time in their recoveries at the IAS. Athletes come into the center and obviously they have finished hard training and they're very different individuals when they leave. So there is something about being in water, there is something about being a social environment whether it's temperature changes, whether it's hydrostatic pressure, whether it's hanging out with your mates the coach usually doesn't come in so it's usually quite a relaxed environment. And if the athletes kind of get used to this and they feel that they get benefits from them whatever benefits they may think that is to take that away from them when they believe in something can be problematic. But on the flip side of that we do have athletes who really don't like doing ice baths and if I know that they've tried it I trust them. I know they're not just complaining and being lazy. I wouldn't force them to do it if it's something that's really unpleasant for them. It will be about, okay let's try and find an alternative recovery strategy that you feel works for them because the last thing you want to do is have a stressed, unhappy athlete doing recovery every day and thinks that either it harms them or it doesn't work for them. So as long as they've tried it and they've experienced it then I think it's okay not to push them to do strategies even though we might think that it's a good science for it.

DANNY LENNON: 100% I mean there is a clear irony there of stressing out an athlete but in trying to improve the recovery. It's kind of funny when people think of that stressed allocation model. One of the things I want to pull back on is when we looked over the course of a week you mentioned how you might try and plan out recovery and that kind of throws up some of the time frames we might want to look like here. So obviously with all these different inventions so if we look at water therapy first maybe and we're trying to look at trying to see when we get this recovery of their performance back to baseline quicker and that's going to highlight our quicker recovery, what sort of timeframes are we typically looking like for these certain interventions to be useful?

So if an athlete is training like you mentioned earlier someone trains twice a week there is probably so much time in between it's going to be hard to detect any difference where it becomes really important is probably when we see these athletes with much more frequent training sessions. So what's this timeframe for recovery that we're actually seeing benefits for over a roll of time of lengths?

SHONA HALSON: Yeah so the research has shown from as short as 30 minutes out to 96 hours. And so some of the differences in the timeframes are going to be related to firstly how fatigued the athletes are. So I guess a good example of that is some studies don't find any effect of the hydrotherapy but the athletes are also not fatigued. So the control group doesn't do anything either. And so therefore if you don't have a fatigued athlete you probably obviously don't have the requirement for recovery.

The more fatigued the athlete is or the more muscle damage they have so these studies that have shown positive benefits of up to like 96 hours tend to be the ones where they've used pretty extreme eccentrics and we've done those studies too early on to try and identify if there really is anything going on. So you obviously start with extreme model and you move down to something a bit simpler and so in that instance even up to 96 hours can be effective. The 30 minute studies are often done in the heat so in this instance the ice bath are almost use is pre-cooling for the second effort and again you obviously have to be clever in the way that you do that and not overcool people because that can be a problem.

But yeah, the timeframes really are fairly large and it is as I said dependent on either how much fatigue the athlete has, if they have muscle damage or still see benefits if you do recovery every day up until five days later if they've got an extreme amount of saunas. And I guess there's a practical example of that say swimmers who may do a swim session in the morning, early, a gym session you know they might have half an hour or an hour and they'll do a gym session and then they've got another swim session at night. They might do some recovery after that gym session to sort of get them ready for the afternoon training session in the pool. If you're

a rugby player and you've played and you've been beat up and you're sore and you've got lots of damage you might continue to do recovery.

You might do it after the game, do it the next day and you might continue to do it three or four days after just to get rid of that soreness as quickly as possible so that when they come to midweek or early in the week where they're trying to do some hard training sessions to try and fit those hard training sessions within the week then you've got some you know your players are a little bit less sore and can maybe give a little bit more in those training sessions. So little variable on the timeframes but the time frames are probably larger than people think and there's definitely some benefits there short-term as well as longer term.

DANNY LENNON: Brilliant and when you mention obviously the importance of fatigue to try and test this stuff it kind of stands to reason that if someone's not fatigued you're probably not going to be able to detect some sort of recovery because there's nothing really to recover from in certain sense. Do you find or do you believe that that is maybe one of number one the kind of big flaws in certain study designs and maybe potentially a reason why we have at least some sort of conflicting results that can come out from time to time looking at for example hydrotherapy?

SHONA HALSON: Yeah without question. I think that is one of the major issues is what performance task is chosen. So if you're not doing a fairly long high intensity session then the athlete might automatically be recovered a few hours later if it's an easy session and in the real world we probably wouldn't do recovery after an easy session anyway. So yes, 100% that's a factor I think the type of performance task that people use to assess whether they are recovered is really important. So an example is a lot of people use kind of movement jumps. Of course they are easy to do, there's a bit of data behind them. The problem is that you don't…we tend to see the effects of fatigue more in a longer performance task.

So for example if I was to ask a track sprinter to do a 30 second sprint after recovery or after a hard session and then

gave them so me recovery and then asked them to do a 30 second sprint they might be able to do that okay. Ask them to do a 30-minute tom trail and that's probably where you're going to see more of this fatigue exposed. So when we do these research studies where we do repeated performance tests we like to do longer tests because that's where you see the potential for the fatigue. So that's another area that I think is why some of the studies are different.

Different temperatures are also one and different levels of immersion so some people use up to the hips, some people use over the shoulders, the different water temperatures may also have an effect and then… I've actually got a PhD student who's just finished her name was Jess Stevens and some of her work is just starting to come out now and she has started to look at body composition. So does body composition affect hydrotherapy and yes the answer is it does. So I guess we all know it would but she is starting to put some real data behind it so an example is a young gymnast who weighs 25 kilos with almost no body fat is going to have very different physiological and thermal responses to say a heavyweight rower or a front rower in rugby union.

So the more insulation they have whether that's fat mass or muscle mass can be protective against the cooling and heating. So I think body composition is another factor in that area. So it is obviously really hard to say, okay we all need to test using 60-minute time trials and 15 degree water and subjects with a certain body composition and then we'll probably get very similar data and say yes I think there's a number of factors why. And what we try to do is say, okay when we design our studies first and foremost is our research is obviously to identify what we should do in athletes in the real world.

So we try to puck a research design that is something that an athlete would do, the timeframes represent what might be realistic for a rower or a swimmer or a cyclist and we do a performance task that's meaningful for those athletes. And I think when I see studies, obviously we're not the only ones that do this kind of work and when I see studies that do that that's when I tend to go, yes I believe what you have… I

believe the numbers that I see and I think that's really good relevant research. And then there's other occasions where the studies out there that have done two 30 second Wingate tests and separated by very short periods of time, used cold water immersion in between. The subject hasn't warmed up again of course there is no question that the performance is going to be reduced in the second task with cold water because the individual is too cold.

We know you need warm muscles to sprint so I think that being a little bit observational in the studies and reading and going, okay well I probably wouldn't do two 30 second Wingate's separated by a short period of time like would we do that with track sprinters, no we certainly wouldn't. If they had a race with 30 minutes in between we might even think hot water is better for these athletes. So yeah just really thinking about what's relevant for athletes and physiologically what's going to happen if you put someone in water and then ask them to do a performance task. If it's a short sprint effort, it's probably not going to help you, if it's s longer effort then yes it may be helpful.

DANNY LENNON: Yeah, I think they're just such important points and I think probably when it comes to putting this stuff into practice like you said that that key of specificity for what you're looking at in the research. Both I suppose two terms that are kind of could be quite general athlete and performance and what each of those is defined by in a specific study will obviously tell a lot.

With that then I was interested to ask kind of keeping with the idea of individuality of some of the individual data points and the variability in response we're seeing even within one particular study whether that's something that's positive and we see an average beneficial response. How much typical inter-individual variation do we see and then again what does that probably mean for us in practice?

SHONA HALSON: It's a great question and I think in studies we tend to try and look for a fairly homogenous population. So we'll try to find you know we do a lot of cycling work and you go out and you find the highest level of cyclists you can get and they really

they are all kind of similar in terms of their body composition and their training ability, if you can that's ideal. But we know in the real world if you've got…even swimmers, we work with sprint swimmers and more endurance based swimmers. In a football team like a rugby team you're going to have smaller wingers and larger front run forwards so there is the potential in the real world to have a lot of variability.

In research we tend to try and tighten it up as much as possible so it really does depend on the cohort that you get. And one of the things that as I said Jess Stevens work was looking at body composition and measuring that with DEXA and really trying to get an understanding of how that may influence performance. But there is a lot of things that would contribute to the variability and I think that variability is quite high. I don't have exact numbers on it but I think that inter-individual variability is going to have a significant role in why we see some of these different findings across the research.

DANNY LENNON: Right and just to come back to that body composition research that's been carried out and this isolating effect of more fat mass and/or more muscle mass is in the practical takeaway for people that for those individuals carrying more mass we may mean to alter the duration that they're going to be spending into the cold water immersion et cetera, et cetera or how do we piece apart like the practically how does the protocol change?

SHONA HALSON: Yeah so again an excellent question. We would tend to now try to encourage those athletes who have the bigger body masses to potentially spend more time in the water immersion to get a similar effect. It probably becomes a little bit more important if we're looking at pre-cooling and we want to get the body temperature really right before they go and do a task or if they're competing. But yes it just basically means that especially from a cold water immersion perspective that they would need to stay in the water longer to have a similar thermal effect as those who either have less muscle mass or less body fat.

DANNY LENNON: Perfect. And just the other point I wanted to come back to was you mentioned around the potential for water being used certain training sessions and if we're talking about a short intensive burst it's probably a bad idea and for more long duration stuff it can potentially be a good idea, is that purely coming down to it's going to have some sort of central cooling effect on the body which will then mean it's a longer time for that body to kind of overheat and the kind of stress from that to cause a deterioration that kind of long duration issue that that's why there's the benefit for long duration stuff and then the negative on the short side is that it's just potentially that cold water before or something that is probably not a good idea for explosive athletes?

SHONA HALSON: Yeah, you've pretty much nailed it. We know that…and this is really probably most relevant exercise in heat. So people do pre-cooling before competition in the heat quite a bit you see it in circus a reasonable amount and the idea is that when the body gets to a critical core temperature during exercise what happens is you either have to slow down or in extreme cases just stop. And so what the idea of pre-cooling is if you can start that core body temperature from a lower point you've got a bigger gradient to go before you will slow down or lower your intensity or worst case scenario stop.

And basically some of the research says anything over six minutes you're probably going to get a benefit of pre-cooling and yes exactly as you were saying with the pre-cooling before sprint activities not something that should occur and because the cooling of the muscles decreases obviously the contraction of that muscle and can have a detrimental effect on their ability to produce force.

DANNY LENNON: Sure and I'm not sure if this has been studied or not but just be interested to hear your kind of personal thoughts. When we were talking about either pre-cooling or even hydrotherapy as a recovery modality do you feel then the climate that the athlete is in is going to have a difference because I mean a lot of track athletes here in Ireland are probably going to be in a very different training environment than what they are facing in Australia. So is that going to

potentially modify what protocol you might recommend for a particular athlete?

SHONA HALSON: Yeah, that is a really good question because yes we do in Australia have a focus on cold because of the environmental temperatures and because there's obviously a history of having Olympic Games in warm environments. However, we do work with some athletes where they compete in cooler conditions so sailing for us is an example where they may be about in the water all day; they could be wet and cold. Certainly I wouldn't be suggesting for them to jump in in our spa, for them maybe a warm spa or something that would be nice.

And I guess the way that I tend to think of it is recovery is about returning to balance or homeostasis so is you're really cold putting someone in an ice bath is only going to give them additional stress and it's probably not what you want to do and it's certainly not going to bring them back to homeostasis. So in that instance a hot bath, hot shower or something like that might be the ideal recovery strategy. So yes most definitely the environmental temperature and in fact the individual's core body temperature is something that we always consider as well.

DANNY LENNON: Excellent, thank you for that. One thing again more kind of on a practicality of this stuff is how someone actually should setup the ice bath. For example if they are going to use that or whatever they are going to be getting into if they are using water immersion because I think I remember in one of your papers you mentioning the importance of hydrostatic pressure to this whole thing.

SHONA HALSON: Yeah so basically we know that if the hydrostatic pressure is greatest the more depth of water that you are in. So for example if you are a six foot tall person then you've covered your shoulders you've probably got about 150 millimeters of mercury pressure down at your ankle. Now so to compare that to say compression tides that probably run about 20 millimeters of mercury pressure at the ankle. So there is a lot of pressure by standing in water and the pressure is proportional to the depth and the amount of the body that's

covered in that water. So best case scenario for doing an ice bath is to stand or to be vertical and have as much of your body covered as possible.

Now that's okay if you've got a purpose built facility. So the one that we have in Canberra, yes we have a six foot deep bath athletes can stand in. Now when you're trying to do it in the real world I know that's almost impossible and so what you may have to sacrifice a little but of hydrostatic pressure. If you're siting you still will get some benefits though from there will be hydrostatic pressure and there will also be the cooling effects of the water. So yes, we set up portable baths and sometimes they're as simple as a kiddies pool, sometimes a little bit more sophisticated where we have inflatable bath type devices and we have chilling systems that keep that water cold. There's lots of things that are becoming available now on the market depending on one, how much money you've got and two, who's going to set these things up because it's not always people's most favorite job to do. But yes if you can have a greater depth of water you will have greater hydrostatic pressure and it is going to be proportional to the depth so standing is better than sitting.

DANNY LENNON: Perfect and we've all seen that there's been research showing that there's a benefit for recovery for cold water immersion, contrast water therapy and we mentioned some of that earlier on but just going a bit deeper on potentially why these things are improving recovery what we know about the potential mechanism behind these or what can we kind of say are probably some good safe bets as to is playing a role and actually improving recovery?

SHONA HALSON: Yeah I would say the three thing… Well the two things that I'm comfortable with is one that I think happens that I don't know if we have any evidence for but the first one is definitely the combination of the hydrostatic pressure and the water temperature. So hydrostatic pressure will have pretty profound effects on blood flow so redistribution of flow. So cold and hot water will have effects on skin blood flow, muscle blood flow so we'll have strong effects. People are now looking at cooling as ways of lowering metabolism

so there's potential thins there that are happening with the water temperature itself.

And then the third thing that we don't have much science on but there's definitely in my opinion something to it is there's a relaxation or there's a nice feeling to being in water. So if you're really, really hot you've been exercising in a hot condition and you could have a cold chair or a swim in a bath, sorry, swim in a pool or the ocean or have a cool bath, there's definitely something that is pleasant about that sensation. Or if you're cold and you have a hoe shower or a hot bath there is something pleasant about being around water and it's something that's been known for you know before we invented drugs we used water as medicine due to its soothing properties you know day spas all these kinds of things. So there is something around there in that area about the brain and that's the area that we really want to get into next because we certainly see athletes that'll say to me, "I'm physically recovered. I feel physically fine but I'm mentally flat and mentally exhausted whether that's from lots of competition or travel or stress or whatever it is. So can we get the brain to start to recover as well as the body?" And I definitely think there is something about being in a water environment with your teammates having a chat and changing your body temperature that I think has some benefits but that's just my thoughts no evidence.

DANNY LENNON: Yeah, I mean it makes complete sense particularly when you start to think about just stress in general and how really with stress perception is reality, right. If somebody can perceive something or feel something to be better or worse that's going to potentially manifest itself or definitely manifest itself in most cases. Doctor Halson one thing I wanted to end on just before we wrap up is when it comes down to either athletes or particularly their coaches or exercise physiologists or anyone that's working with them trying to monitor fatigue to assess the effectiveness of different recovery strategies that thy are using or how much training load is being placed on the athlete of course this is an area we could have done probably a whole podcast on in itself. But to try and give some sort of maybe overview what are some of the key things that you would advise them on when it comes

to monitoring and tracking fatigue to try and assess both their training load and then the recovery strategies and make sure everything is moving along as planned?

SHONA HALSON: Yeah, super good question. So we probably take two different approaches and combine together is the ideal setting. So if we can take some measure of the external load in each sport so cycling, SRM, cranks, football it might be GPS or whatever it is. So getting an understanding of what the actual physical load is and that's one aspect and the second aspect is what is the responses to that load and we tend to take more of a subjective approach to this. So key questions, how sore are you, how tired are you, what's your level of motivation, what's your mood because I think everybody knows that you can go out and you can do a really hard session and feel great doing it or you can go out and do a really hard session and feel really bad and that can be exactly the same training load.

So for us it's the combination of the external and the internal load and some of the people that are doing this really, really well I think that's where they're getting the best information from. So we ask obviously sleep questions; how long did you sleep for, what was the quality of your sleep and then the key is obviously tracking that for long enough that you can start t then retrospectively go back and analyze the data and then make decisions on that. So when this particular load happened the particular response was this, the external stresses in this athlete's life potentially had this effect. So you're obviously relying on the athlete to give you good information and honest information. But we have an athlete management system where the athlete is put online, they put in their subjective information and now we've got…

We're fortunate to have to be in a situation where we've had a fair bit of data now collected over a number of years and we can go back and we can start to mine that data. So now I'm looking at things like, okay you've had poor sleep for this number of days, you're more likely to be sick or injured. So I think the key is the combination of the external and the internal, tracking it for a relatively long time before you make decisions which not a lot of coaches like also giving good, quick feedback to the athletes and coaches so that they

are more likely to do it and do it honestly because they think it's worth doing because they're getting some feedback on it. So yes it's not a simple thing to do but I think really this if done well there is so much good information that you can get back to the athlete to change the way they're training and to see if they're really recovering or not.

And if we're going to start…if we're working with a team where we start periodizing training we're asking them simple questions like how recovered do you feel, how fatigued are you and seeing how that changes over time. And just as a very quick side note, my PhD was on overtraining and we did a couple of studies in athletes and measured every single thing under the sun from stable ice to top infusion to look at metabolism, every hormone, every blood marker that you could measure and the best predictor of their performance changes was their subjective rating of how they felt the thing that doesn't cost any money to measure. So I think we shouldn't underestimate the value of asking the athletes good questions.

DANNY LENNON: Brilliant, thank you so much for that comprehensive answer. I think there is a lot to take from that if people even just listen to those kind of few words there, a brilliant way to round up. So Dr. Halson before we get to the final question, if people are interested in finding more of your work, where can they find you online or on social media or any of that type of stuff, where is the best place to track you down?

SHONA HALSON: The best place is probably…any real social media I have is Twitter but to use that reasonable amount to get out the latest papers particularly the students and what they have been doing. So Twitter is just shona.halson. It's probably the best place to keep up.

DANNY LENNON: Perfect and for everyone listening I'll of course link that in the show notes as well as the whole host of show notes papers particularly the ones we've mentioned today as well. You can click through and read through yourself. So that brings us to the final question that we always end the podcast on and this could be to do with a topic completely outside of what we've discussed today and it's simply if you could

advice people to do one thing each day that would have some sort of beneficial impact on any area of their life, what would that one thing be?

SHONA HALSON: Well the first thing that I am going to go with is sleep routine. For me people don't sleep enough, they don't sleep regularly enough and so for me it's the best recovery strategy that we have available psychologically, physically. If we could get more of our athletes and it's not just relevant for athletes, it's relevant for the general population to sleep more I think we'd see a healthier and a much more productive society.

DANNY LENNON: Brilliant. I'm delighted you said that because I'm a big fan of sleep myself and it's one of the things I obsess over quite a lot so I'm delighted that you mentioned that.

SHONA HALSON: Good.

DANNY LENNON: Dr. Halson this has been a wonderful conversation. I really thank you for your time and for your information. It's been fascinating to read your work and now to be able to talk through some of it with you as well so thank you so much for your time.

SHONA HALSON: Thanks Danny. Thanks for the good questions.