

# Graeme Close, PhD

## Nutritional Strategies for Jockeys to Make Weight, Perform Better & Improve Health

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Danny Lennon:

Hello and welcome to Sigma Nutrition Radio, the podcast that brings you evidence-based discussions with the world's leading researchers in fields related to nutrition and health. I am your host, Danny Lennon, and you are listening to Episode 121. And today, Dr. Graeme Close of Liverpool John Moores University is on the show to talk about some really, really fascinating work that he has done with professional jockeys in particular. And what I love about Graeme is that not only is he involved in the frontline academic research in his sports science lab, but he works directly in elite sport, applying all this stuff with world-class athletes. So Graeme is currently the Head Performance Nutritionist and Consultant to England Rugby, he's the Lead Nutritionist to Team GB Ski and Snowboard, and he works with some of the world's leading golfers, rugby lead players, and a whole host of others. And on top of this, in line with today's topic, he currently is involved in researching and consulting with the top professional jockeys in the world to help them make weight safely and really, in a broader sense, to improve their day-to-day lives as I'm sure you'll see soon.

The show notes to this episode will be at [SigmaNutrition.com/episode121](https://www.SigmaNutrition.com/episode121), and if you go there you will get a link to all the stuff we mention today, any research papers, where you can find more about the lab, etc., etc. And also, if you've not done so already, you can sign up to receive the transcripts to each podcast episode including this one, which will be

delivered direct to your inbox as a PDF completely free each week as the podcast is released. So you can go and get that stuff there.

Now, let's get into the show with Dr. Graeme Close. Hey Graeme, welcome to the show. Thanks so much for taking the time out to do this.

Graeme Close: No problem, Danny. Great to be on.

Danny Lennon: Just maybe for those listening, maybe just give them a brief background of a bit around your summary and in terms of what you're doing in academia and the main area of research that you're involved with, I suppose.

Graeme Close: Okay. Well, I'm currently a reader in applied physiology and sport nutrition at Liverpool John Moores University, and on top of that as you all know, I do a lot of consultancy work with the likes of England Rugby and jockey and the British ski and snowboard team just to name a few of the people that I have the privilege of working with. From a research perspective, I started off, my PhD was in delayed onset muscle soreness and looking at the role of free radicals and therapeutics such as antioxidants to help with DOMS. I then moved to the University of Liverpool to spend seven years in the biochemistry laboratory to really pick up on my free radical techniques. Free radicals and antioxidants is always an emerging theme that goes through a lot of my work and I guess it always will be. Over the last few years, I've become very interested in things like vitamin D, and as I do more applied work, trying to answer a lot of the questions that we don't know in an applied sense. So that obviously goes without saying, but spent the last three or four years doing a lot of work on rugby, trying to understand some basic metabolism in elite rugby, and then a lot of work trying to help jockeys to make weight, probably the most understudied group of athletes in existence and perhaps a group that need the most studying.

Danny Lennon: Right, and I think that's going to be pretty obvious once we start getting into some of this stuff. And I think maybe why the research that you and your colleagues are putting out is so fascinating is because of that component like you said, that it's taken from what we're seeing in practical circles, seeing what people are applying, and trying to understand the better way of doing things. And so maybe just first with this stuff on the jockeys because for me this is fascinating. Because when you just look at what they actually do, it's so different from other weight-making sports that people would have seen in that they are making weight on a daily basis consistently for these long periods as opposed to if we had a fighter

or boxer – they make weight for every three or four months if they're professional, just for example, and there's also the possibility of having to make different weights in the same day and all this sort of thing.

So before we talk about specifically some of the work you've done with these guys, maybe it might be a good place to start by maybe explaining for those people who are maybe not familiar with horseracing exactly what demands are placed on jockeys both in terms of this whole weight-making area but then also maybe the physiological demands of the sport, because I'm sure some people will think, "Oh, it's just sitting on a horse casually," but there is of course this high anaerobic output, but at the same time I'd assume it's hardly carrying the same energy expenditure as some other sports you've looked at. So what are the physiological demands we're looking at in both the actual sport itself, but then also this kind of weight-making thing as well?

Graeme Close:

Yeah, there's a lot to get through because when I give these talks now, and maybe people who understand that I work in rugby a lot might find it surprising that I say this, but I actually think jockeys have it the toughest of any athlete and I actually think they are probably the toughest of any athlete as well, and there are many reasons that I would say that. So you rightly said before that they're unique in that they have a daily battle to make weight. With the advent of all-weather racetracks, floodlit racing, the season's now pretty much every day of the year. They may get Christmas Day off, but a lot of these guys are racing every day of their life. So yeah, they've got a daily battle to make weight and that's the first challenge.

The next challenge is really unique to jockeys. I can't think of many other sports where they're actually weighed in and weighed out. So before a race, they have to be a certain weight and they also need to be within a pound of that at the end of the race. So where maybe a fighter may dehydrate to make weight, these guys would have to compete dehydrated as well if that's the technique that they have used to make weight.

The other thing that makes it very different is there are not really the same opportunities to go up a weight like there is in other sports like boxing and MMA. In the UK, the minimum riding weight for a flat jockey is 50.8 kilograms, which is right about 8 stone. Now, some of the jockeys we're working with, they're touching on 6-foot tall yet still trying to ride at 8 stone. It's not only they have to be 8 stone but some of the apprentice jockeys, they get what's called a claim, and a claim is a weight allowance

which will give them an advantage to get them a chance so they can be 7 pound lighter than the more experienced jockeys in the race. And if they're riding for their owner who employs them, they can be an additional 3 pounds on top of that. Plus, if they're weighed in with the saddle and the silks and the breeches, then 8 stone suddenly comes closer to 7 stone. If you think about guys who are touching on 6-foot riding at 7 stone, you can then begin to see why this is a real, real challenge.

The second point to what you said, Danny, is, but yeah, once we get on this wild animal, they then have to control it. So during the entire race, they're often in quite a strong isometric contraction holding the horse back, keeping it ready, and then with around about two furlongs to go, maybe 30 seconds to a minute, it's almost like doing a Wingate test where, in riding terminology, we throw the kitchen sink at it and try and ride it home as hard as we can.

The other thing to bear in mind is then they're asked to do this six, sometimes seven times per day. So it's a daily battle, it's a multiple-times-per-day battle, and it's a throughout-their-entire-career battle, which makes me think they are a really unique tough group of athletes.

Danny Lennon: Yeah, sure. I mean, that's just kind of mind-boggling in itself when you think of some of the cases you outlined, if people were just to think of someone who's probably touching close and get down to 7 stone at any of the heights that you mentioned, someone would probably first pop in their mind someone that maybe is perhaps quite frail, but then when you think, "Well, actually, this is someone that's an athlete that is going to be having these races with this anaerobic output during it as well, using this isometric contraction all day, every day," and you start to see just how probably mentally tough they are in a lot of ways. So just when we talk about that whole process of them having to make this daily weight, before you got involved working through some of the protocols that we'll talk about in a minute, what has been the conventional or typical way that most of these guys would have navigated that process in the past before you got to working and advising any of them?

Graeme Close: Yeah. Well, the first thing to say is that I was very fortunate that around about six years ago a mature student came to me about a PhD, and to cut a long story short, when I found out he was an ex-jockey, a lot of his friends were jockeys and he was still helping jockeys, suddenly George Wilson turned his PhD into weight-making in jockeys. So not only did we have

somebody keen to research this but we had a former jockey who understands the culture inside out to try and guide us.

Danny Lennon: Mm-hmm.

Graeme Close: And it came as a shock to me when George was explaining that some things that you might think is quite normal such as they might go for a run in a sweat suit—so you get to a racetrack early, you might see jockeys jogging around in their sweat suits. All the racetracks, the vast majority certainly, have a sauna, so we might sit in a hot box and try and sweat it down, and I guess they're the standard ones. Then you start seeing some more extreme measures. So there's the use of diuretics, although that is now prohibited, so jockeys shouldn't be doing that. There's a horrible technique which in the jockey world is called flipping, which is basically false vomiting. So the jockeys would maybe drink a pint of Coke very quickly and then try and vomit that back up and bring up some additional weight at the same time. Apparently, in some countries, there are even designated flipping areas to allow this technique to happen. Jockeys will do things like spitting to try and make weight, to try and get that last little bit off. And I even heard recently about the stables, actually jockeys getting in in a sweat suit within manure to try and sweat down at the stables that way. The other technique we've heard a lot though is actually traveling to the racetrack to get the car as hot as it possibly can when the heat is on, in a sweat suit, and then try and turn the car into a sauna as they're traveling to the racetrack. So as you can see, some really extreme measures which we have to do every day of life.

Danny Lennon: And then so on the dietary side, were there any kind of typical dietary approaches that you saw in these guys when you first kind of looked at what they were typically doing?

Graeme Close: Yeah, but the main approach is to starve yourself during the day and then binge at night, and then repeat process the day after. And a lot of the advice, despite there being a really talented nutrition support team with the British Horseracing Authority and the Professional Jockeys Association, a lot of the jockeys would kind of ignore this advice and just go off what their peers have done and the techniques that have been passed down through generations, because what you've got to remember is that unlike footballers and other professional athletes perhaps, these guys only get paid to ride a horse. So if they don't make the weight, that's catastrophic. Not only do they not get paid that day, but there's a fair chance that trainer wouldn't use them again because they've let them down. So these guys just

cannot risk trying anything that may result in them not making weight because that could be the end of a career.

Danny Lennon: Right. So they're essentially getting up in the morning, not really eating anything, maybe something small, dehydrating, then going having to perform without being able to properly rehydrate because you said that they're weighed in afterwards.

Graeme Close: Yeah.

Danny Lennon: And so by the time they get to the evening, that's their only chance to eat and it's usually something pretty poor-quality.

Graeme Close: Oh and some of the food diaries we get back... So when I get a food diary back from a rugby player—you generally have to give them more pages to fill it in—some of the food diaries that we've had back recently [for jockeys], it's been things like four digestive biscuits and a cup of hot chocolate and that's like the daily diet. You just wonder, how do they even survive?

Danny Lennon: Yeah. Yeah, like looking at this sort of stuff was a massive eye-opener for me because I think it just astounds me how professional jockeys can continuously perform at the highest level due to the extent of both the caloric restriction and then this massive dehydration on top of it. Because, I mean, we mentioned fighters earlier, so MMA fighters or a boxer, generally if it's a pro fight they'll have maybe somewhere between 24 to 30 hours and they have time to rehydrate between the weigh-in and the fight. So a moderate degree of dehydration via some maybe acute water restriction or maybe a sauna for a last kilo or so is very doable without too much impact on performance because of that window of time to have adequate rehydration, but for guys with a smaller weigh-in, it's generally try and cut that out. So in the context of racing where things are, like you say, even worse because there are restrictions after the race, how much of a detriment to performance is this potentially? Or have we been able to quantify just to what extent this daily dehydration is actually having on any performance metrics?

Graeme Close: So that's a great question about the long-term effects of the daily dehydration, and that's something that's really hard to study because when you get hold of these guys, they've been doing it all their life, so it's hard to actually get a decent baseline. What we have done in our group is get them into the laboratory and do an acute dehydration. The crazy thing is our ethics committee wouldn't let us dehydrate them down anywhere near

what the jockeys actually do because it was deemed unsafe. So ethically we're not allowed to study in a controlled manner even though that's what they do every day of their life.

Danny Lennon: Wow.

Graeme Close: And so all we've been able to sweat off is two or three kilograms. Some jockeys might sweat off double, even more than that. And what we've shown is that the riding ability is impaired. And when we've done some maximum-strength test of the chest and the legs, again, as you expect, quite significantly impaired. What's slightly different is, providing you've still got some degree of cognitive function, some degree of strength, if you're the best horse there's a fair chance you'll still win because, ultimately, it's the horse who's doing the vast majority of the work. And I didn't like to accept this until some really senior jockeys said to me that the horse is the main factor, and that's probably why there's a lot more money and support that goes into the welfare of the horse than what probably goes into the nutrition, health and welfare of the jockey.

Danny Lennon: And I think yeah, they're willing to accept that bit of a tradeoff in performance and certainly health if in the grander scheme of things they're getting a winning ride.

Graeme Close: Mm-hmm.

Danny Lennon: So one of the most interesting piece of research you sent me was the 2015 paper, the intervention study which the aforementioned George Wilson was the lead author on.

Graeme Close: Yeah.

Danny Lennon: That was a really excellent study, really meticulous, and it was a fascinating one to read. Could you maybe just go through some of the methodology for people and then what sort of findings you uncovered?

Graeme Close: So what we wanted to do in this study as proof of concept that jockeys can actually eat! Because at the end of the day as we all know, people have gone on about whether a low-carb, a low-fat, all the different types of diet whether it's paleo, we've heard them all and probably most of them you've covered on this show, but ultimately I think a lot of people still believe, including myself, that you can't go too far from the actual energy balance equation. So in my head, I have we must be able to eat and still lose weight if we actually get it all right and get the food right. So what we

decided to do in this study was use one of these companies where you can actually order meals with specific macros and with specific calories in your meals and feed the jockeys for six weeks. So every single...we got some real top-class jockeys recruited, champion jockeys and all sorts, so we weren't using kids here. We were using highly elite jockeys. And we were very fortunate that we managed to get funding for this study from Abu Dhabi, from His Highness Sheikh Mansoor bin Zayed Al Nahyan, for those who follow football, the owner of Manchester City, because he's got a keen interest in jockeys and horseracing.

So we fed the jockeys daily for six weeks. What we did in the first instance was get all the jockeys in to assess their resting metabolic rate, and it wasn't, again, surprising to me a little bit, too far off what you would have predicted, around about 1800 kcals.

So what we needed was a decent amount of energy we could put into it, so we decided to feed them more or less for the resting metabolic rate plus a little bit, a high-protein diet to try and preserve some of the lean muscle mass, and then we made the carbohydrates basically fit the total energy intake they needed for that day. We tried to encourage them to do some structured exercise as well, which a lot of them did, and now they were eating breakfast, which was generally maybe like an omelette, then they'd ride out in the morning, so that's they're training on the horses. And we'd ask them to drink water. We'd give them a snack around about 9:30, like oats. They'd have lunch, which would generally be like a chicken-and-vegetable-soup-type meal. During the races, we'd ask them to have another snack. And then evening dinner, it'd be something like fish and vegetables, something like that.

And what we saw was that at the end of the six-week plan, the mean weight loss of the jockeys was 5 pounds. Now, 5 pounds might not seem like a lot, but a lot of these jockeys were quite light to start with and 5 pounds was what they were having to sweat off on a daily basis, so certainly we'd taken away the need the sweat. The biggest loss we saw, I think I'm right in saying, was about 14 pounds. What was really interesting as well was that we didn't give them any resistance exercise to do, but pretty much every single jockey improved the chest strength, the leg strength, and VO2 max increased as well.

The loss of weight was all fat mass, because that's the other thing to point out. When we DEXA scan these jockeys, there is a little bit of fat mass to take off them. So they preserved the lean mass and dropped body fat.

And a really important thing to mention which was not touched on so far is that the mental health improved. Now, when we did our early studies on jockeys, I think the most worrying finding that we came across was the huge incidence of mental health issues partly attributable to the fact that they're starving themselves on a daily basis. So we identified that around about 75% of jockeys you could identify of having some kind of, let's just say, not regular mental health score when we were doing our validated psychometrics. Now, to put 75% in context, the general public using the same questionnaire would come out at around about 3%, and the mean for overweight score is around about 14%. So it puts into perspective just what are the mental effects of this constant starvation, and we were really pleased to see that at the end of the study there were signs that their mental health was beginning to improve.

Danny Lennon: Yeah, I mean, that's such a huge thing, and surely from you working with these guys and getting to know them as well, not the fact that you're just allowing them to make weight easier but essentially giving them these sorts of these skills and approaches when you see that that tradeoff of actually improving their mental health and impacting their life in this greater way that maybe you'd set out to do is a huge thing.

Graeme Close: Oh yeah. You know, Danny, when I first got into this industry, it was all about papers, writing your papers, getting your grants, and that's where you got your kicks and your rewards. When you get a text message from some of the jockeys saying that you've literally transformed their lives and you're getting phone calls from their families saying, "I can't thank you enough for what you've done for this jockey," that they were unbearable to live with. I've even had a jockey's wife saying that what George was doing with the jockeys has actually saved their marriage, it's actually snapped them out of this dark hole that we didn't see any light at the end of the tunnel, so when you get messages like that, it just really gives you a pick-up to continue what you're doing.

Danny Lennon: Yeah, that's amazing. That's probably one of the things that's, like I said, not on the surface, maybe seen in some of this stuff when people look at it, but it's probably one of the most profound things to consider. One thing that I did notice in that paper when I was just looking through some of the measures of the caloric intake, and it's something I think you've mentioned to me before as well, was that when you look at before the intervention and they did a 24-hour recall of their diet, I think their estimated caloric intake came out something like 1300 calories.

Graeme Close: Yeah.

Danny Lennon: Whereas during the study they were on average, you had them on 1700 calories, which was going to be accurate because you had them on these meals provided directly by this company. Now, despite this supposed increase of 400 calories, like you said, their body weight dropped, body fat dropped, and lean body mass pretty much stayed the same. So does this tell us that the most likely reason is that the jockeys' reporting of 1300 calories at the start was just a case of significant under-reporting?

Graeme Close: Yeah, I think that's exactly what it is. The more research I do in this field, the more I think that's... I don't think we've rewritten thermodynamics. I don't think we understand a lot. So some of the feedback we got was brilliant. I remember one particular jockey say that, "My lifestyle won't allow me to have breakfast because it's just too hard to eat. You can't eat." So I said, "Well, what would you do in the morning?" And he said "Maybe have a cup of tea with two sugars and a handful of digestive biscuits." Now, I wonder how much of that actually ended up on the food diary because this jockey didn't even see that as eating. It's only a cup of tea and some biscuits, but not realizing there's maybe 400 calories in this cup of tea and these digestive biscuits.

So yeah, I certainly suspect that, and another reason I suspect that is that we've recently done some doubly labeled water studies, which we're writing up at the moment to accurately assess energy expenditure, and what you see when you accurately assess it is that it is much higher than what the energy intake which they're reporting. And when we look at the resting metabolic rate, I hate this term metabolic damage, metabolic crisis, I'm not quite sure what it all means, but even these guys who are sporadic eaters and terrible, their resting metabolic rate isn't anywhere near as low as what you maybe expect it to be someone starving themselves. So all we studied together makes me think that it's just more ammunition that food diaries are, I wouldn't say useless, but they're not... from even no use for assessing energy intake the more I do it. Where they may be useful is for patterns of eating and to get a feel of what athletes are doing. But I actually think to try and get an accurate total energy intake now off a food diary or any method I think is virtually impossible.

Danny Lennon: I mean, even if you think of people who are relatively clued in around eating or healthy eating, whatever, their ability to maybe accurately assess certain portion sizes or just how much they had if they're trying to recall

something, never mind someone who doesn't have maybe a background of working with nutrition. So it kind of, like you said, goes out the window.

Graeme Close: Yeah. We just got very similar data, Danny off rugby players in this rugby trial we've just done with doubly labeled water. I picked purposely maybe eight of the most dedicated, disciplined people going because I didn't have a lot of money to do doubly labeled water, so I wanted players who I knew would be consistent in everything that they do. And again, their energy expenditure was coming back almost a thousand kilocalories more than their energy intake, yet it was all weight-neutral. So again, these were people who were trying their very best and doing everything they could to try and give me an accurate food diary. So I just think it's really hard to do.

Danny Lennon: Yeah. I think you made a really good point as well when you talked about that even in this group of people where for basically year-round they're in this semi-starvation mode and this really kind of strange eating pattern, even with that, we don't see a massive depression of metabolic rate or at least as much as someone may think when they refer to things like you said, like metabolic damage or like, "My metabolism is broken. It's impossible for me to lose body fat." So to see that if it's not playing out in the extremes of what a jockey is doing, then it's a pretty good indicator that it's not the case for most general folks just trying to lose some body fat.

Graeme Close: Yeah, without doubt.

Danny Lennon: Yeah.

Graeme Close: Just maybe to a couple of hundred kilocalories, but it's certainly...there was one jockey who there must have been an issue or she mustn't have been telling us something because she was telling us she was only eating 200 or 300 kilocalories a day and her metabolic rate was maybe 100 or 200 less than what you would have predicted off the Cunningham equation. So if what she was telling me is true, which I had no reason to doubt at that time and she told me that it's been going on for weeks, that's the type of person if there is such a thing as starvation mode you'd have expected to see it, and I have not seen it yet.

Danny Lennon: One thing when we talk about how you look through this intervention, how you actually try to set up the diet, and I think this relates back to one of the earlier case studies that you published as well that I remember reading where you decreased a jockey's body fat percentage which, like we said, allowed them to make weight without as much emphasis on

dehydration, and despite having him decrease calorie intake I don't think his lean body mass dropped massively. I think it was a slight maybe decrease if at all significant with most of that weight loss coming from fat mass, which is awesome considering that these guys are already lean by normal standards or relatively small-framed and not eating huge amounts of foods. When I looked at the dietary intervention, two things stuck out because they tied into recent conversations I had with Kevin Tipton and Caoileann Murphy on protein intake during a calorie deficit, and that was that not only did you increase their protein intake I think in that case that it was something like from 0.7 grams per kilo up to 2.4 grams per kilo and then increased the meal frequency from like two to six meals.

Graeme Close: Yeah. Yeah.

Danny Lennon: Presumably, this was done with the idea of maximizing the anabolic response as much as possible in order to maintain that muscle during the deficit as opposed to just losing body weight flat out.

Graeme Close: Yeah, it was done for a few reasons. That's obviously one of them, but there's not a lot of muscle mass to start with. So the fact that, as I said, it was a huge isometric contraction throughout, we probably wanted to preserve that muscle mass as much as we could. The second reason is the satiety side of things, that we know with the protein more than the carbohydrates, and the third reason is that I just find that it's a bit easier to stick to because you're not taking away the foods that they actually enjoy eating. So a lot of the foods that you're maybe asking them to restrict are probably ones that if you were going to a five-star restaurant and you have to pick your order of foods in order of preference, it's often the stuff that you'd pick at the end. So, ideally, I'm not one who believes that all you need to do to lose weight is drop the carbohydrate. I don't think it's as simple as that as I've said a few times. I'd still believe that you need to have some kind of energy deficit. I just find it easy in athletes to create that energy deficit with carbohydrate at times, particularly if the sport isn't a high-intensity, intermittent-style sport.

Danny Lennon: Sure, sure. And that actually raises a point that I wanted to bring up because obviously then, if we're maybe looking at someone, what a "optimal protein intake" might be, so let's assume that number of 2.4 grams per kilo, and then maybe we set a reasonable fat intake that's not going to be too low, and then we have the remainder generally coming from carbohydrate, then we have this kind of maybe this conflicting thing, particularly in jockeys because we have to monitor caloric intake and keep

it relatively low because they're maintaining body weight. Where does that tie in then with allowing them to stick within that caloric range but then also hit a...or how would you even go about setting up, say, certain macronutrient targets for them? Because I think with especially endurance training and then obviously field sports, we have research that kind of hints at where, say, carbohydrate levels should be and where protein intake should be. Whereas with jockeys, we have very little data. So how would you go about working out what might be a good target in terms of macronutrients for each of those?

Graeme Close: Okay, there are a few things that we did, but you're exactly right the way you described it. We kind of made a decision initially on the protein, which was around about the 2.5 grams per kg mark, as you say, a reasonable fat intake because of all the other good things that you need with the fats and we set that around about a gram per kg. That then left us with dependence on whether they were willing to do any additional exercise, and this is a key factor in this. We did want them to do additional exercise. That then left us with around about 3 grams per kg body mass of carbohydrate. What's really interesting is a common misconception by jockeys that if you do any exercise apart from horse riding, you put muscle mass on, and because of that it'll be even harder to make weight. So if you ask a jockey to do any type of running, their initial reaction was always, "I can't do that. I'll get muscle-bound." And I'm thinking, "Have you ever seen Mo Farah?"

Danny Lennon: [Laughs]

Graeme Close: This isn't a guy you'd exactly aspire to have a body shape like you just saw him in the gym. So these misconceptions are just constantly coming up in that world.

The other thing that we did is we tried to assess the energy expenditure during a typical ride. Now, this was quite hard to do because in the jockey-riding world you're not allowed to put heart rate monitors on them; you're not really allowed to put much on them for a variety of reasons. So it's hard to assess energy expenditure. What we did was we created a simulated ride on a jockey exerciser. So it basically looks like...is a mechanical horse. And we did some simulated rides in the laboratory using, again, top-class jockeys. So the world's best jockeys around to test it. And from that was able to work out a typical two-mile race was only really getting through around about 15 kilocalories, something like that. So it isn't as energy-expending as you would have thought it basically because

I've said you've got this little isometric contraction for a couple of minutes and then 30 seconds of a Wingate. Again, if we add 2 or 3 grams per kilogram of carbohydrate in them, that would probably more than enough...when you actually start thinking of the energy systems, a lot of it would have been the ATP-PC with a Wingate-style test. So they should be able to handle their activity quite easily on lower carbohydrate intakes. And that's something that we worked very closely now with the dietitians and nutrition team with the British Horseracing Authority to maybe really look at some of the guidelines and the current guidelines written by, like I said, this really great team that we've got there of dietitians has now begun to incorporate some of our research and he's now actually beginning to suggest these lower carbohydrate intakes for these athletes.

Danny Lennon: That kind of raises another point. I was going to talk about supplementation, these guys, because when we think of just that general term "athlete," one of the I suppose supplement recommendations that's nearly given across the board in most cases to people is to supplement it with, say, creatine...

Graeme Close: Yeah.

Danny Lennon: ...and I'm just wondering, in this case, would that be almost contraindicated because of the...maybe even if it's slight, but just a slight increase in body weight by pulling more water into a cell, or do they even need that because, like you said, like the main outcome is going to be the horse and they just need enough to get through the race as opposed to the slight benefit creatine may give? Would it be even any use to them during a race?

Graeme Close: Yeah, well, creatine is something I've not gone near for a few reasons with these jockeys. One of them is, as you said, the potential for that little bit of weight gain, even if it is only quite small. One to two pounds for these guys is huge, so yeah, it would be contraindicative. The other thing is, and really I don't want to pull up the creatine safety card here, but what I don't know and I've not seen any research on somebody taking creatine who is in a constant state of chronic dehydration. So I just think it's probably not worth putting that into the system for both of them reasons, really.

Danny Lennon: Yeah, that's a really good point. I did want to put it back to some of the health aspects on this. We've already mentioned things like their mood and maybe something to tie in there, say, just general cognitive function if things like mood are getting affected. So in terms of the typical practices

they would have employed like the caloric restriction we talked about, sporadic meals, low nutrient quality, low protein in the diet, dehydration, what sort of compromises to their health were you able to find when you looked at different...or what metrics were you able to look at in terms of general health markers?

Graeme Close: Yeah. I think my most well-known one, and this was found before we did the...I should point out that **probably** the pioneers of jockey health research originally were from Ireland by a group in DCU and they fell short about bone health. And that's probably the biggest issue with the jockeys and something we've confirmed with our UK-based jockeys, is that if you actually think about the tissues in the human body, there's almost a hierarchy who gets preference when diet isn't great. We start with the brain, the vital organs, but right down at the bottom of that list appears to be bone. So when these diets are particularly poor, one of the first things you notice is that a lot of the jockeys are presenting with bone mineral densities typical of what you would see in much older people, many with osteopenia, some actually presenting with osteoporosis. So the bone health of these guys isn't great in any way, shape or form, and when you consider that a typical jump jockey would probably fall off the horse one in every 14 – 16 races, and some maybe have six [races] a day, so maybe every two or three days they're coming off a horse going at high speed with bone quality suggesting osteoporosis, you initially see that's not a great thing.

Danny Lennon: When we talk about bone health, I mean, one of the nutrients you did mention to me which I want to bring up in more detail in a moment was vitamin D, which is well-known at this stage for having a role in bone health, and so presumably if that's low, that's tying in there. But now we also have a population of guys who are generally in a hypocaloric state and low calories virtually across the board year-round. And then you add in the factor of they don't want to do, say, resistance training like you mentioned, which we know is great for bone density. So all these factors seem to be stacking on top of themselves, that all leads to this kind of bone health issue.

Graeme Close: Yeah, but the great news is though, from what you said, you're exactly right, but then when we measured them was the lowest of any athletic group I've ever looked at. I use an expert endocrinologist who does my vitamin D analysis for me, and in his words, the only he's seen concentrations so low were in malnourished Gambian children.

Danny Lennon: Wow.

Graeme Close: So the vitamin D, some of them were almost undetectable levels of vitamin D. Now, the whole vitamin D story's maybe been exaggerated in some ways and maybe that's a topic for another podcast one day, but what we do know is when they're down at the levels that some of these jockeys were presenting with, there would be some bone consequences. What we also know is that a lot of jockeys would avoid dairy-type products, again because of the calorific intake there, so the calcium would be low as well. So not only they've got low vitamin D but actually got low calcium levels as well, plus they've got low energy intake. As you said, they are not doing exercise, particularly any weight-burn exercise, so we're not really getting an osteogenic stimulus. So you put all that together, it's not really surprising.

Now, we can improve the vitamin D quite easily with supplementation. We can improve the energy intake. We can improve the calcium, again, by getting the diet better. What becomes hard is, and I've spoken with Craig Sale about this—he's my go-to when it comes to bone health, at Nottingham Trent University—is the exercise that they would need to do to actually get an osteogenic stimulus is quite close to the fracture index, so what you really don't want to do is try and get the bone health better purely by exercise because you do run the risk of stress fracture even worse with these. Again, speaking with Craig, what we know about the exercise is that probably the best osteogenic stimulus is a random change of direction, the type of things that we see in football, because I even talked to him about should these guys be doing maybe some low-intensity skipping to get an osteogenic stimulus, maybe something a little bit more random, maybe even getting them to play some five-a-side football. But again, the worry there is to help them you need them close to that fracture index.

Danny Lennon: Yeah, and I suppose then the other worry for those guys if they have to do these other activities, there's obviously some inherent risk of just random accidents and injury, and like you said, if they're injured and they can't ride, they can't make money.

Graeme Close: [Chuckles] That's exactly the problem and in many ways that's why it's almost been the status quo for years that, “Look, I know it's not great, but at least I can make weight, I can get on my horse and I can earn a living,” and that's what we're trying to change.

Danny Lennon: Cool. And just this whole vitamin D thing is personally a big interest to me because my own MSC was actually on vitamin D research with Professor Kevin Cashman in UCC...

Graeme Close: Oh yes.

Danny Lennon: ...and I'm thinking one of the studies you found that perhaps like a quarter, even a fifth of the jockeys had adequate levels of 25-hydroxy D.

Graeme Close: Yeah.

Danny Lennon: And were you able to determine just from talking to them or is there any kind of hypothesis why this particular population does have such low levels or why it was so poor compared to any other people you looked at? Was it generally just because they're eating so little food that they can't get enough in nutrient-wise or was there any other thing going on?

Graeme Close: Yeah. Well, certainly that is a big contributing factor. The other thing to bear in mind is we know most of the vitamin D that we're going to get particularly in the summer is going to come from sunlight exposure, and you'd immediately begin to think that, well, these guys are outside, so we're going to get sunlight exposure. But you think about a jockey on a horse, they're actually covered head to toe. There's a helmet on, there's riding goggles, they've got the silks on which covers the neck, and obviously the breeches and boots. So every time they're outside, they're completely covered head to toe. So they're not getting any sunlight, plus their diet's particularly poor. There's just a whole host of factors which means that there's just going to be no vitamin D synthesis whatsoever with these athletes.

Danny Lennon: Just on a couple of other health markers before I start to wrap up. One that I think that you looked at in one of the studies was around maybe liver function, if I remember correctly.

Graeme Close: Yes.

Danny Lennon: But it's one that kind of stood out to me because I've actually been talking to a friend of mine who has interviewed a few jockeys recently, I think like Mick Fitzgerald, a few other guys that are now retired, and one of the things that they'd been anecdotally telling her is certain types of health issues that they've had related to things like kidney function and liver function. Was that one of the things that actually bore out when you looked at the data?

Graeme Close: Do you know, it was really surprising to me, when we looked at liver function tests and kidney and things like that, that it wasn't as bad as I would have suspected. So, as I always do, I speak with someone who's far more intelligent than me, which isn't really that hard. I'm a rugby-playing Wiganer so it's not that hard to somebody much more intelligent. So I spoke with a few friends I've got who are nephrologists. So what we often do when looking at kidney function is we might look at creatinine and things like that and then calculate an estimated GFR. The problem with that is what you're picking up there is a failed kidney, not a failing, so at the age that we're getting a lot of them the probability is we're not going to pick anything up there. So what I think we probably need to do from speaking with these nephrologists that I've consulted with is we need to reanalyze our data and come up with better markers, and that might involve some ultrasounds looking for early stone formation to actually begin to see. And then the other thing which I'm very aware of that all the groups are now doing, which is great, is we need to get the retired jockeys in, so the guys who have gone through this their whole entire life, and see how they're doing.

Danny Lennon: Yeah, for sure. That'll be really interesting to see where that goes just for those reasons you said. Just one thing on vitamin D before I forget. I think you just mentioned there a minute ago in one of the answers that potentially the high doses that are talked about or even maybe high blood levels if someone's measuring 25-hydroxy D, in certain cases that high vitamin either intake or status maybe isn't a case of "the higher we get it the better" and there could be harmful effects. Now, I don't want to open a whole can of worms at this stage of the podcast, but can you maybe go into a bit of why or what lines of thinking you're starting to go on as to why there may be some harm of going too high?

Graeme Close: Okay, well, the first thing, everyone's jumped on this bandwagon that people have got low vitamin D, okay, and I don't think that is pretty much debatable anymore. If you blood test people, including athletes, there's a fair percentage will come up with lower-than-what-you-would-expect vitamin D. There's now a huge debate on what is optimal vitamin D status. So people talk about 50 nanomoles per liter being sufficient, but there's a whole school of thought that you need to go double that over a 100, really, to get to an optimal vitamin D status. But if we actually sit back and start thinking about some cause-and-effect-type scenarios—and I'll give you one example.

We've done hundreds of DEXA scans on black athletes and what we found with the black athletes is their bone density often is like granite. It's absolutely unbelievable. It's often off the scale. But then you measure the vitamin D, because we know that dark-skinned individuals aren't able to synthesize vitamin D the same way as lighter-skinned individuals, the vitamin D concentrations are really low. So immediately you've got to start thinking, "Well, vitamin D in bone, it can't be as simple as what some people are actually saying." What we're beginning to think now is that we need to start looking a lot more than just looking at 25(OH)D. There's an emerging literature about there are maybe differences in vitamin D in protein, and we've got collaborators over in Qatar doing this type of work and what we see is that maybe we need to start looking at available vitamin D, so looking at the vitamin D to vitamin D binding protein ratios. Then, as we know, vitamin D isn't like any other vitamin. It should actually be classed as a prohormone, so its effects working through the vitamin D receptor, which is found in almost every tissue. And again, my collaborator in Qatar, Richard Allison, beginning to get some emerging data showing that there may be polymorphisms of the vitamin D receptor so that people, different individuals, need a different amount of vitamin D for it to have its hormonal effects.

So just stopping at 25(OH)D and trying to come up with a magical number, I think we've just oversimplified it. And what I also think is that what is a magical number for one system might be very different for another. So when it comes to skeletal muscle function, our work would tend to suggest that low vitamin D may affect muscle function if you're down at really clinical deficiencies. Whereas if someone's sufficient and you try and raise them to this optimal state, we have not any evidence that muscle function improves; however, Mike Gleeson has shown some correlative data that a higher amount of 25(OH)D in a student population in Loughborough reduces the chance of getting upper respiratory tract infection. So he's got the number of around about 75 nanomoles per liter. So I just think it's a lot more complicated than saying, "Let's give some vitamin D."

And the final thing I'll add to that is, and we're just about to submit this paper, but when we've given really high doses of vitamin D, and Daniel Owens, my former PhD student now postdoc in Paris who'll be the lead author in this when it comes out, when we give really high vitamin D, and as you expect, 25(OH)D goes through the roof, initially 1,25, the active metabolite dose, well, then it begins to fall, and the reason it begins to fall

is that we've measured 24, 25(OH)D, which is a breakdown product, so it would appear that the body is trying to reduce the amount of 25(OH)D and the consequence of that is 1,25 drops. And what we know is that when we remove supplementation, there is a bit of a lag with uptake sometimes to get back to normal, which might actually render them, individuals, worse off than when we started for a period of time. And that's some work that's currently ongoing and that something that hopefully we'll have more information on in the next year or two.

Danny Lennon: Yeah, that's just so fascinating, all that stuff and the potential hypotheses, and so much stuff was just going off my head as you said. I mean, particularly a lot of the stuff that I would have looked at during my MSE when we were looking at, say, dose responses and you start to see individual data points. So number 1, you have this different dose response of how someone's going to react to a certain intake, but then, even like you mention, if the active metabolite is going to be 1,25 dihydroxy D and we're only looking at what 25 hydroxy D status is, then potentially that could be high and seen like good, but if for whatever reason there's something going on weird where we have low active form of 1,25 dihydroxy D is low because it's not able to get converted or something weird going on, you can still have these higher levels of 25 hydroxy D. So there are so many things that could be there like you said. That's why I wanted to bring it up because just all that stuff is so fascinating to me.

Graeme Close: Yeah, and so at John Moores University we're really fortunately that we...we've got a great bunch. The team of me, James Morton got some really talented students who ask the right questions and it fits with our...we've got this little mantra of "cells to communities and back", where we try and do the molecular work, we try and look at the cell biology, try and take it back out into the real world and bring it back, and that's just one example where by actually asking the right questions I think we're going to be able to take this a lot further than just jumping in with a blanket vitamin D supplementation policy without really asking the fundamental questions that you should ask before you start doing things like this.

Danny Lennon: When you mention that, to think about it as a prohormone more accurately, that starts to really tie in to what you said of that just getting from deficient up to an adequate level of vitamin D in circulation is going to have profound benefits, but just slightly increasing within still what a normal range even, if we know what that is...

Graeme Close: Yeah. [Chuckles]

Danny Lennon: ...isn't going to have something, and we know that intuitively already looking at, say, other hormones. You've got a guy with deficient testosterone up to an adequate amount and you get all these profound benefits, but then slightly increasing someone's testosterone through some sort of dietary manipulation if they're still within normal range and if you're just going from normal to slightly higher on that scale, there's not really going to be a whole lot going on practically with, say, body composition or whatever.

Graeme Close: Yeah, it's a great way to look at it, Danny. Yeah, absolutely, couldn't agree with more.

Danny Lennon: Cool. So we'll start wrapping up. Maybe the last thing I'll finish on is when we looked in at what you're trying to do from this point onwards with the research, what are the next couple of things that you want to look at both in this population or maybe outside in other work you're doing? What are the next big research questions you want to try and address?

Graeme Close: Well, the first one is probably the continuation of what I just said there with the vitamin D. So from a vitamin D perspective, really want to try and tease out this more, what are the different individual requirements of vitamin D, really try and pull out if there polymorphisms of the vitamin D receptor, what does this mean, and as I say, I a lot more work on vitamin D binding protein, and hopefully we'll try and then get a better consensus on what is sufficient, optimal and toxic. So I've got a lot more to go with vitamin D and that's something that we're working on. Hopefully, I've got some people in the lab do some work.

From a jockey perspective, the focus has changed a little bit from the basic research that we've been doing looking at the health markers and everything like that, and now what I've got is my PhD student, Daniel Martin. His PhD is trying to work out how do we translate this message. So as you said in the 2015 George Wilson paper, I think we give a blueprint as to how the jockeys can make weight better. The issue now is, how do we actually get this message across in a group of athletes who are reluctant to listen to advice from the dietitians and the nutrition team? So that's where the jockey work is going at the moment, how do we actually implement the advice? And we're looking at all different ways to get the message across, so it's almost moving into the psychology of behavior

change but really from an ethnographic perspective and really focusing in on this unique group of athletes.

Danny Lennon: Yeah, I really love that idea of having seen an intervention that we know can have some benefit but taking it maybe to that next step that's often perhaps lacking in a lot of research of, well, how do we actually make this practically work for people and actually make some real changes within practice? Especially within a group of athletes that have always conventionally done something or have had stuff pass down, which we see across the board in a number of different sports, people doing stuff because that's just the way it was.

Graeme Close: Yes.

Danny Lennon: Which I think is a really interesting way to look at it. So that's great that you're doing that. Where can people track you down online and where can they find more about your work online if they want to do that?

Graeme Close: So we've got the local John Moores University website so that people can come and go to the sports science homepage and they'll find the sport nutrition team on there. Personally, people can find me on Twitter, at close\_nutrition, where I spend too much time tweeting, but it's generally when I'm traveling. So I do actually do some research on some consultancies and I do a lot of tweeting on trains. And the LJMU sport nutrition team now has a Twitter handle. And just to mention before I go, the LJMU sport nutrition team, we currently have PhDs funded by the Melbourne Rebels, Team Sky, British Horseracing Authority, the Rugby Football League, the Super League, the AIS, Premier League football, British Ski and Snowboard. So our team at JMU, the sport nutrition team, they will be banging out tweets and information from all of them projects in all them different sports, so that's probably a decent handle to follow.

Danny Lennon: Awesome. And I'll link up to all that stuff in the show notes for people, so please do go and check all of that stuff out. Graeme, we'll end this show on the final question that we always end on, and it can be outside of today's topic or theme. It's just simply, if you could advise people to do one thing each day that would improve their life in some aspect, what would that one thing be?

Graeme Close: Wow, it's a great question and if colleagues and James Morton are listening to this, they're going to not believe what I'm about to say. So I was always very dismissive of reflective practice and I was always like, "This is nonsense and I can't believe people are making a career of it."

And then one day I realized that, so most nights me and James phone each other, James Morton, and criticize the hell out of what we've both done that day and we're probably the most critical of ourselves than anyone else we know, really, and sometimes it turns into us giving each other a bit of support because we can get a little bit negative. But I do think reflecting on how you work and trying to get better is absolutely essential; otherwise, you just do the same stuff on a different day. So whether that is any formal reflective practice where you're writing it down or just the way it works for me, finding a colleague that you respect and having regular conversations and just keeping check on where you're going, I think it's really important.

Danny Lennon:

Yeah, I love that answer because it's something that certainly I don't think I do enough of either and I don't think too many people do enough of. But any time that I do set aside some time to be able to think back on things, because we just have this constant influx of information all the time I'm always doing stuff, so it's very rare we have just time to do nothing and just think, and I think even, like you say, a small period of time where you can think about what you've done and kind of pros and cons for different decisions I think is huge. So I'm really glad you gave that answer.

And that's all for the show. Graeme, I just want to say thank you so much. This was honestly one of my absolute favorite conversations to have in all the time doing this show. Just fascinated by this whole area and I just really enjoyed this whole conversation and I do appreciate your time as well, so thanks so much for coming on.

There we go. What an absolute fascinating area of research as well as a fascinating insight into the application of sports nutrition at the highest levels of elite sport.

Like I said just a moment ago to Graeme, that was one of my absolute favorite conversations to have. Remember to hit up Graeme over on Twitter at his handle [close\\_nutrition](#). Let him know how much you took from this episode and if you enjoyed it, and make sure you're following him because, like he said, he does tweet fairly regularly with a lot of good information. So if you're interested in sports nutrition at all, make sure you are following him.

In the show notes, I'm going to link up to all those papers that Graeme mentioned today as well as a link to sign up for the transcripts to the show if you want to do that. There's also an official support page for the podcast

over on the Patreon platform where you can support the show for like \$1. Thanks to everyone who has and continues to support the show. It means so, so much. And for anyone else that's interested in getting involved, just go to [Patreon.com/sigmanutrition](https://patreon.com/sigmanutrition) and you will see what the deal is there. Other than that, again, everyone who continues to review the show on iTunes, who just continues to download the show and to spread it around on social media, all that stuff makes a tremendous difference, so please keep doing that. Thank you so much for doing so. It really does make a big difference and it is noticed. So thank you.

If you want to message me, then, like I said, anywhere on social media. I'm pretty good for getting back to people. Snapchat right now is somewhere where you can probably message me direct or just follow around if I do end up putting up something of some sort of interest, which I can't promise. My Snapchat name is `lennondanny`, just all the one word. You can find me there. Instagram, it's `dannylennon_sigmanutrition`, and then on Twitter it's just `nutritiondanny`. So either of those places or, again, on Facebook—I'm pretty active on Facebook—so any of those places, make sure we're connected and we can stay in touch.

And that brings this week's episode to a close. Don't miss next week's episode though because I'm going to be chatting with IPF World Champion and World Record Holder in the 83-kilo class, Brett Gibbs, head of this year's world championships which are going down in Texas next month. So I cannot wait for that conversation and that will be here next week, and I will talk to you then. Thank you so much for listening.