



## DOMS

*with Claire Minshull*

19<sup>th</sup> May 2022

## TRANSCRIPT

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**Steven Bruce**

I have got the wonderful Claire Minshull on the line to talk to us once again, Claire, welcome. It's great to have you with us.

**Claire Minshull**

Thank goodness for that.

**Steven Bruce**

I've got one issue, and that is the fact that you're there, not here. But I'd much rather have had you in the studio.

**Claire Minshull**

Yes. Likewise, it's always a pleasure.

**Steven Bruce**

However, it is fantastic to see that in your own little home office there, you've actually got your weight training kits as well.

**Claire Minshull**

But of course.

**Steven Bruce**

Now, I suspect most people know who you are, Claire, because we heard you on the show three or four times before. You are a superb strength and conditioning trainer and expert. And just to reinforce your credibility, tell us what you were doing in the meeting immediately before the show.

**Claire Minshull**

Oh, goodness. So yeah, well, I was in a meeting with some high-level executives for a hospital in Wales. So we're running a prehabilitation programme for long waiters for knee replacement surgery. So those people that have been waiting the longest of time, so way over a year. So delivering some strength focused exercise alongside a complimentary series of psychology focused education, and mindset training to improve physical and psychological health and resilience going into surgery. So we're looking at extending that trial. So speaking very nicely to some some of the funders and giving some of the amazing outcomes that we've been seeing kind of just halfway through. So yes, that's what I was doing. Maybe that's why you couldn't hear me quite well.

**Steven Bruce**

The reason I think it's important, Claire is because it's all very well being a strength and conditioning expert like yourself, as well as being a former World Champion in Powerlifting, and all the rest of that stuff. But the point here is that you've got the evidence behind what you do to convince the NHS that this is a route worth pursuing, haven't you? And of course, your PhD was I think it was in something very complicated to do with the knee. So clearly, this is an area of great interest to you.

**Claire Minshull**

It was actually British champion but thank you for accelerating that. So yeah, I mean, I'm all about data. I'm actually a neuromuscular physiologist by I guess, if you're going to call it a trade, but people understand strength and conditioning. And I think that's fine. And absolutely, we need data, we need to evaluate things, we need to have evidence informed approach, if not based and we're generating that evidence as we're kind of intervening, particularly with this population. So we're taking fastidiously outcome measures. And also not just objective outcome measures, but the qualitative data, so people's lived experience and how that relates to the bigger picture because we can often lose some of the fuller picture of what's happening with interventions, if we just rely on numbers. And I am guilty about because I'm definitely a numbers person and quantitative data, lines of inquiry for me, but you know, with the qualitative data, we're seeing some really profound statements and changes to people's lives, which, I mean, it's absolutely beautiful to hear that people are now able to walk up the stairs when they couldn't do before and go on holiday. And, you know, so yeah, providing that evaluation for audit. And ideally, we're getting to, you know, we will be able to publish all of this as well. So, yeah, absolutely. We need the data.

**Steven Bruce**

Now, I take that on board, it's very easy to look at numbers, isn't it? But actually, quality of life is what's most important to the patients wherever the numbers might happen to be taking them. We wrestled with today's topic for a little while, didn't we, before we decided what we were going to talk about, and we're going to talk about DOMS. At least that's where we're going to start. You can do the singing I'll just do the talking. Yeah. So start us off. Is DOMS a problem? And you better tell us what DOMS is and why it happens. But is it a problem in getting patients to comply with their exercise programmes?

**Claire Minshull**

Yes, so first of all, you definitely don't want to hear me sing, else we'd lose all your viewers right now. So DOMS, delayed onset muscle soreness, so that feeling that you get, and I'm sure everybody who's listening to this has had it before, where you do some bout of novel exercise or ramp up your training or do something or do the gardening that you haven't done for months. And you wake up the next day and you know, wanting to walk downstairs backwards because you're just so sore and so that feeling of soreness that peaks a day to two days after a novel or higher intensity exercise which is principally generated by the eccentric component of work. So the lengthening of muscle whilst it's undertaking or accommodating load and actually, you know, this is something that we've considered as well within the joint approach programme as well. So it's something that if you're a habitual exerciser, you might even like that feeling because you feel like you've done some work. And if you're knowledgeable about what's happening, you understand that the tissues remodelling, it's becoming stronger etc. But in those patient populations that may be struggling to get to exercise or indeed haven't exercised but are willing, the DOMS response can often be a real difficulty or a barrier to get people to continue to adhere to exercise, they may mistakenly attribute that to actual injury. So you've hurt me, you've made me worse, through to actually I don't like this sensation. I don't want to again, so you know, you're right, I won't come back and see you again, or do those exercises.

**Steven Bruce**

Years ago, didn't people used to attribute it to lactic acid buildup, which I think has now been completely disproven?

**Claire Minshull**

Yeah, so it's very, very different, the mechanisms are very different, the sensations are very different. And the time course of change and feeling of that discomfort is very different. So lactic acid, and it's the hydrogen ions. So when the lactate and hydrogen ions disassociate, it's that the hydrogen ions that cause a discomfort in the musculature, it builds a toxic environment. And you'll feel that if you're doing some high intensity work, let's say pick resistance exercise as an example. So you're kind of working really hard, do up to 10 repetitions, 12, and you're really pushing hard. And the thing that stops you is just that awful, burning feeling in your muscles, that's really different to then muscle damage. So during the exercise, you probably don't feel that, you feel the discomfort days after. And the mechanisms are different. So it's not down to lactic acid, it's not down to accumulation of hydrogen ions per se, it's something that's a little bit more structural.

**Steven Bruce**

Would you say to a patient, would you use the expression muscle damage when you're talking to a patient about this?

**Claire Minshull**

Depends on how educated they are in the world of exercise. So if they understand and are very versed with training, then they probably know of it already. If they have any awareness, then absolutely not. No way. Damage is not, it's quite a fear inducing word. They've come to you probably because they are damaged, or they feel like they're damaged, or there's something that's not quite right. So, you know, absolutely we need to mention it, and we need to manage people's expectations. But to make sure that they understand that that's normal, it will subside, it means good things.

**Steven Bruce**

It's very tempting in the clinic, isn't it? I mean, I find myself explaining to patients, you know, what we are trying to do, we're inducing micro tears in the fibres, and all those things in a patient's mind could be quite intimidating. The idea of damage, the idea of tearing and so on, but of course, without it, there's no remodelling, is there?

**Claire Minshull**

Yeah, exactly. And I think, if you can describe it in a way that I mean, you'll get a level of their understanding, but if you can provide a framework whereby if you, things get better by providing a stimulus and a stress, so you become, I don't know, when you're learning things, you need to, I guess stress your mind to incorporate different information, remember, and be able to then critically evaluate in the future. If you're thinking about adaptation and muscle to get stronger, we need to challenge it. And by challenging it, you then, that's how you become stronger. If you don't challenge it, you will go the opposite way. You don't need to accommodate the stress. So therefore, you will become potentially weaker if you're certainly in that older category. So yeah, I don't frame it within the context of damage and repair. It's more of a stimulus and an adaptation.

**Steven Bruce**

Okay. I've had a question come in from Vlad already about DOMS. And let me get this up and read it because it's a long one. He says, is there any reason a person will suffer with a very high level of DOMS? He's talking about himself. And he's not a stranger to exercise. But as of a few years, his DOMS seemed to be debilitating. For full disclosure, he has a diagnosis of Ankylosing Spondylitis and has been taking anti TNF medication for the past three or four years. It seems that chronologically the two are related. Do you know if there's a link? Perhaps he says he's imagining it. Sorry, if this is the wrong question for the broadcast. I don't think it is the wrong question, is it? Because if there are reasons why people might suffer extreme DOMS then we ought to be in a position to tell them about it.

**Claire Minshull**

Yeah, I mean, forgive me, I don't know about the interaction there with the medication. Although there are some supplemental strategies that might try and impact that, though, in terms of susceptibility to damage, there's a few things so the higher, broadly speaking, first and foremost, the males tend to be slightly more susceptible than females, if we're taking a massive population here. And adults more susceptible than children. And what that's principally related to is the sensibility of tissue and the, you know, the stiffness if you like, so if you've got more compliance, then the stress is taken up proportionately more by that non contractile tissue, which of this is kind of some of the fields of thought. The other things that predispose higher levels of damage are higher levels of eccentric exercise. So if you're doing a resistance training programme, it's a lowering phase of that weight against gravity rather than the concentric phase or shortening. So if you're undertaking new exercise, novel exercise, you're ramping up your exercise in terms of intensity that will likely present as a stimulus and thus you get the response thereafter, you get proportionately more damage on the descending limb of the length tension curve. So that means at long muscle lengths, where if you're thinking about if it's acute micro trauma to the musculature, and there's, again, some emerging fields of thought that we might also be related to the connective tissue as well. But if you're thinking about that, you know, the actin and myosin kind of overlap, one of the hypotheses from many years ago was the popping psychrometer hypothesis. So you've got the overlap of actin and myosin, if you've got muscles that are a long length, many of the sarcomeres are in a position where they overlap is very little. Some of them are, you get pockets of damage whereby then you apply a high load and then that sarcomere pulls apart effectively. And that becomes then unusable and so that's one of the reasons why it occurs more at longer muscle lengths. So there's a variety of reasons why you might experience DOMS. And those are just just a few of them as I said, forgive me I don't know the interaction with the medication. But have a think about your training and what you're doing. And you know, if we get into it, we can discuss some strategies that might attenuate some of those uncomfortable feelings of DOMS. So there's things that you do pre new exercise that might reduce some of those uncomfortable sensations.

**Steven Bruce**

And that's definitely where we'll go with this. But there's a few questions before that if I may, Carrie's asked whether DOMS increases with age generally as opposed to affecting, not affecting children as it were.

**Claire Minshull**

Yeah, well, probably to a point. And obviously, in physiology, everything's an inverted youth, isn't it? So as we start to get older, and if we don't do much about it, we can start to lose a lot of our fast twitch capabilities and you know, the fast twitch muscle fibres and those are the ones that are more susceptible to muscle damage. So potentially as we get older beyond a certain point, then older adults might experience less muscle damage given equivalent exposure to exercise and the same exercise than potentially younger adults. So it's not a linear relationship as we get older in chronological age, the amount of muscle damage for any given bout of exercise will begin to increase, it will most likely taper given you know where you are in your conditioning status relative to your muscle fibre makeup.

**Steven Bruce**

And Jason sent in a comment related to this saying that, as he's got older, the DOMS comes on two days later, rather than one day after exercise. Is there any reason why that should happen?

**Claire Minshull**

Well, could it be that actually, the severity of DOMS is less? So had you done that same exercise exactly the same relative dose, would you have had a response that you perceived that was peaking at day one, that you're just not seeing now? In addition to that, different muscle groups have different profiles of peak soreness. So you might notice this as well, or if you haven't, think about it when you're next do some new stuff. If you dose the quadriceps and the hamstrings with exactly the same level of exercise stress, so clearly, it's got to be an equivalent dosage. You'll see...

**Steven Bruce**

When you say an equivalent stress, do you mean the same number of reps to failure? As opposed to the same weight?

**Claire Minshull**

Yes, yeah. So you can use muscle damage as a tool to perturb the neuromuscular system, to then investigate other things, which is the way in which I've used it in the past and published on in the past. So what happens when we disrupt the musculature and cause this sustained loss in performance, capacity and strength? Does it impact things like your switch on times of muscle, your proprioceptive acuity and etc. So if you're using it as a tool by which to perturb the system, then you've got kind of a dose that you give. And I explain that for a reason in that many, many years ago, one of my PhD students was looking at trying to evaluate whether or not you can perceive how much literally fuel you've got left in the tank, how long you can keep going for. So whilst you might rate you know, rating perceived exertion, how hard is something? Can we evaluate how much longer we can keep going for, which is a really interesting question. Now, in order to do that we're in for some known bout of exercise to cause a predictable level of compromise to muscle, you know, if we're doing it under fresh conditions and damage conditions. So I've done loads and loads of stuff on the hamstrings, and you get a very, you know, if you did six sets of 10 isokinetic contractions at 60 degrees per second, and, you know, it is pretty damn uncomfortable the day after two days after, so you get a peak soreness in the hamstring muscles around about two days after. And then it was really quite severe soreness that continued for several days. But when we applied that same protocol to the knee extensor group, and between populations, males and females, etc, we didn't see anywhere near the same level of compromise. And in addition to that, when

we could cause the same level of compromise in terms of loss of peak force, then their peak soreness and the peak loss of performance occurred around about up to 24 hours post, so not 48 hours post. So there's a different profile of, or can be a different profile according to different muscle groups, which is quite interesting and probably related to habitual activity and the like. But, again, that's another influential factor.

### **Steven Bruce**

Yeah, I guess one of the muscle groups that we're all prone to rehabbing most is the quadriceps, isn't it? It's a very common one. And I guess if someone has physically damaged their biceps, then you might well give them a biceps rehab programme, but the quadriceps affects the knee and people with bad knees come to see us quite a lot. And as you have ably explained on previous shows, actually strengthening can be very, very helpful with knee problems. And so that being one of the groups, which does tend to give a bit of grief when you've overdone the exercise, I'm thinking that some patients might be put off the exercise. We actually had a comment from Robin earlier on, a few minutes ago, saying that he's a habitual exerciser and he ramped it up yesterday and he has DOMS today and he doesn't like it. Of course Robin is a bit of a wuss and the only answer for him is get his barefoot shoes on and start doing it properly. But, I'm going through a few questions here as well. Myori has asked again about the differences between lactic acid buildup and DOMS. Now you did explain that. So I mean, I think I wonder if she's saying, you know, what's the difference in the sensation to the patient? Or how would they feel about it?

### **Claire Minshull**

So I like to describe the two things as, so if you think about the lactic acid and that buildup of the acidotic environment, that's muscle fatigue. It's acute and...

### **Steven Bruce**

And it's immediate, isn't it? Yeah.

### **Claire Minshull**

It's acute, it's immediate, and it recovers really quickly. The muscle damage, exercise induced muscle damage is, it continues to get worse in terms of the loss in performance capability, following cessation of exercise to a point now that will be determined on the extent and how much you've done, how intense it was, etc, how much eccentric loading a dosage it was, but you know, the profile of change is very different. So whereas you get an acute impairment to muscle strength, if we're defining fatigue as a loss in muscle strength, you'll get an acute loss of muscle strength performance during that buildup where the hydrogen ions etc interfere with the fueling of muscle contraction. But that will recover really quite quickly. And within maybe two, three minutes, you might see a restoration of muscle strength performance. With muscle damage, you might not see a massive change in strength performance after cessation of this type of exercise that induced damage, acutely. There might be maybe, I don't know, arbitrarily 10% change, next day, it might be 20, 25%. And that soreness, you will not feel the soreness whilst you're doing the exercise. You'll feel it the days after. So it's the very, very different mechanisms, very different profile of performance, enhanced performance loss and adaptation as well. That's why it's really important. You know, the damaging process is important for the adaptation. Whereas in a fatigue



environment, you're not getting an improvement in muscle strength. It's an acute compromising muscle performance that you then recover very quickly from.

**Steven Bruce**

Regarding overcoming DOMS, and we're going to get to your theories on how we minimise the risk in a minute, Christina's asked if there's any merit in the idea behind hot and cold therapy for, I'm presuming she means for DOMS, she didn't specify.

**Claire Minshull**

Oh, we can get into a lot of strategies here. So when you come in from a patient perspective, for me it's finding that balance of what's going to enable them to adapt and what's going to, that they're still going to keep coming back. So if you want to, and again, also just there's a lot of caveats here. DOMS is one thing and loss in performance is another and you can potentially influence one and not the other. So let me give you the example, if we can reduce DOMS, but muscle performance is compromised substantively, then you're not getting that cueing, that cueing of discomfort when you engage in maybe it's, if we're talking maybe higher-level performance and you go into unpredictable situations with a lot of joint perturbations expected. If you haven't got that cueing, then actually are we doing the individuals a disservice by reducing DOMS because their performance characteristics are impaired and potentially their stability or the ability to stabilise the joints dynamic grading if we got loss of strength and rate force development, electromechanical delay, proprioceptive acuity, if that's all compromised, but you don't feel it, there's a question there. But in terms of hot and cold therapy to reduce DOMS, you might get a little bit of downregulation of that uncomfortable feeling. It depends on how you do it. And if we're looking at those big systematic reviews and meta-analyses, cryotherapy, and cryotherapy can mean a lot, so whether you put a bag of frozen peas on your leg through to super cold chambers where you're like in a really low minus temperatures. And then you intermediary, you've got ice bathing. So it's difficult to answer that question. They're unbalanced and might be a little bit of a reduction acutely in sensation of DOMS with inverted commas to cryotherapy, but it depends how you apply it. Also, we need to be quite careful as well, depending on how we're applying it, because by rapidly cooling the musculature, it can influence the calcium dynamics in the contractile muscle or the contracting muscle. So it might, in some circumstances, make the recovery impaired and or make them more susceptible to future damage. So, you know, whether or not you'd be in those situations where you are applying a lot of very cold to immersion for prolonged periods, it's, I don't know, in terms of heat, it might feel a little bit nice, but there's no real evidence to say that that again, it mitigates effects of...

**Steven Bruce**

No, I didn't think there was much as for heat or cold therapy out there at all. But clearly, you've got some there for cryotherapy. And I certainly wasn't aware that the possibility that might impair muscle future performance. One question here from Nita coming in earlier, she says she sees this DOMS effect more in older patients. Do you think it is aggravated by muscle wastage, sarcopenia?

**Claire Minshull**

I think it's more related to the fact that it's lack of familiarity with exercise and habituation. So, which again, possibly is exacerbated by that loss in performance overall, it would be interesting to note what the differences between those habitual exercises and those individuals that are, I guess it sedentary, but it's



an important part of the remodelling process. So is it that those individuals are, and how are you judging, you see it more in older populations than younger populations? What's the metrics by which you're able to assess that? Is it that you give relatively similar doses of exercises to different patient profiles, and you see relatively different profiles of soreness responses? And then have you taken into account their exercise history as well? So, and I don't even necessarily mean, are they out running, lifting weights? How much are they doing in their activities of daily living? So even thinking like, how many times you stand up and sit down? That's one of the theories posited that the quadriceps are such a, you know, they're a local motor muscle, you're doing a lot of lower grade in eccentric work with the quadricep muscles as you stand up, sit down, go downstairs, think about all that you do in your normal daily activities. Is that basal level of activity less in your older populations? And if so, that, also influences why people are becoming, as you would say, generally more sore than the younger comparators. But there's something you know, there's things we can do about it if it's a barrier.

### **Steven Bruce**

Shall we talk about that, we do to minimise the effect. Sorry, it's quite hard. I think I'm possibly interrupting you because you're so out of sync on my screen thanks to Microsoft Teams that I'm never quite sure when you finish talking, because you stop on the screen, but then sometimes the audio carries on.

### **Claire Minshull**

Okay, I'm seeing myself on the screen and I'm about 30 seconds but well, no 10 seconds behind myself, which is about normal for me anyway.

### **Steven Bruce**

Yeah, well, you did say you got a nasty concussion from being knocked off your bike about a year ago or something, didn't you. But should we talk about what we can do to minimise the impact of DOMS?

### **Claire Minshull**

Okay, where do you want to start? Well, I think there are a multitude of strategies that have been investigated for a multitude of reasons, actually, if we hold that down to kind of a clinic environment and a patient environment. And if DOMS is something that would absolutely get in the way of people coming back, or under engaging in things that's going to enhance their recovery, then clearly we need to look at that. So depending where you're at in terms of what patients you see, there are loads of research themes on supplemental strategies, there's things prior to exercise, there's things that you can do post exercise, but I think really the most pragmatic thing that you can do, and the things that are easier to implement is prior exercise. So something called the repeated bout effect whereby a dose of eccentric exercise because it's an eccentric exercise that brings about this soreness, this muscle damage if you like. And so the repeated bout effect refers to, you give somebody a dose of eccentric exercise of a standard description if you're doing this experimentally. And then you will see symptoms of DOMS, you'll see symptoms of loss of strength, the things that I said before, if it's intense enough. Then, if you were to repeat exactly the same exercise, so exactly the same reps, sets, intensity. You know, as I say, a week, two weeks later, the consequences to performance and the experience of DOMS and inflammation and you know, loss of range of motion will be attenuated. So it's an inoculation effect against a future bout. Now, you know, initial studies in this area were, let's do a heavy bout of eccentric exercise. And then let's do exactly the same heavy bout with eccentric exercise a couple of weeks, three months, maybe even

six months later and the more severe and intense it is, the longer that protective effect lasts for. Now, in patient populations, we aren't going to do, because we're trying to avoid that DOMS response. So this is where kind of the more recent streams of literature that are really interesting and have a, from my view, a real clinical utility. And that is, we can do submaximal levels of eccentric contractions. And by that, I mean, maybe even around 10 to 20% of one rep max. So thinking about the maximal strength that a muscle can generate. 10 to 20% of that done in a lengthening modality. Now doing sets of that can provide a protective effect of then a subsequent bout of quite high intensity eccentric exercise. So think about you seeing a patient and you are wanting to introduce some muscle resistance work. How can you mitigate the effects of that? Well, one strategy is, if you, let's say you're going to see them. And importantly, this does not last for a long time, this protective effect, but it's long enough, I think, again, for a clinical application, so it might last for up to possibly a week. So if you've seen somebody on a Monday, and you've seen them the next Monday, or you've seen somebody on a Monday, you've seen them on the Friday, you could go about doing this in the first session with a view to then being reassured that in that second session, when you're going to ramp it up a little bit, then you're not going to see the same level of unpleasantness that that individual is going to experience from a DOMS response.

### **Steven Bruce**

Is there a minimum time between the sets, let's say, sorry, I'm interrupting you again I think, sorry about that. If you're in the gym and you do the lower intensity set now, could you then do the higher intensity set after 20 minutes? And would the effect still be there?

### **Claire Minshull**

So it doesn't really present after a day, it might be maximised after two days. And it might, again, depending what you do, you might have lost it by two weeks. So you've got like a sweet spot there. And it's similar as well. So not doing eccentric work, actually isometric work as well. So maximal contractions, isometric contractions, which, again, the consequences of this initial bout will not be enough to generate that soreness and compromise capability. So a bout of maximal isometric work, again can have a similar influence on mitigating that DOMS response such that again, it's a short lift inoculation, but clinically, it can have utility.

### **Steven Bruce**

Just putting that into practice. So how would you prescribe a maximal isometric exercise for let's say the quadriceps? What would you tell them to do?

### **Claire Minshull**

Yeah, what did they have around them? Do they go to the gym, do they, you know, they're at home. So if you're doing, let's say, let's pick a home environment. And you could have a, let's say a dining room chair, so not a chair on wheels. So they've got a maybe then a couple of cushions on the chair. So they're just raising that leg off the ground a little bit. And then what you want them to be doing is pushing maybe in a 90, 80-degree position against potentially a wall. So if you've got a gym ball, you can put that on the shin, if you haven't got a gym ball, you could, you know, the wall's robust enough, you can push it with your foot, or get a series of, form an interface between the wall and your shin, only use that if you're strong enough, wrap the other leg on top, so using the hamstrings to pull down and push up against anything where you can, you know, push against something that's immovable.

**Steven Bruce**

I was just about to say, where's the max? Are they gonna do that for as long as they can possibly stand it?

**Claire Minshull**

No, because if we were able to measure force output, that will decline over time after about five to eight seconds, to maybe 10 seconds or to push. So you'd want people to ramp up to get to maximal within a two second period, push as hard as they possibly can. And we'll hold that for maybe, you know, five-ish seconds, so the contraction is in total, then with a relaxation, it's less than 10 seconds. If they were to hold it continually for 30 seconds, you'll get that that lactic acid feeling, that fatigue will happen and force output will decline so it's better to do sets where you are able to push maximally, have a 30 second rest between each repetition and then go again.

**Steven Bruce**

Okay, some of the questions that have been coming in. Salome Olivia has asked what nutritional or other supplements might help with DOMS, if any.

**Claire Minshull**

This is a can of worms. Right. So supplemental strategies, there's all manner if you go to PubMed, and you kind of flock into what may attenuate and again, don't think that DOMS and muscle damage are exactly the same thing. DOMS is an indirect marker of muscle damage. If you take away DOMS, it doesn't necessarily mean that you're improving the recovery profile of muscle as well. So supplemental strategies are loads around at the minute on curcumin, i.e. turmeric. And that may have an impact, there's a lot of research kind of looking into that however, you need to eat a lot. So it probably won't come from just your regular curries. We're talking maybe up to 1500 milligrammes as a supplement, and you know, what's available from turmeric is not a one for one ratio, I don't even know exactly, you might even want to be five to 8%. So it's quite a lot. And there's nutritional strategies, all bar potentially one are supplemental, so you need to take something of a high concentration. There were a few years ago on vitamin C and E. We did a bit on that. However, again, we're looking at the systematic reviews and meta-analyses probably doesn't, again, high doses. Probably that doesn't convey an effect systematically should I say, so you might see some, you might not, there's not enough evidence to show that it does. And actually, we saw the opposite. It actually increased susceptibility. Tart cherry juice, again beetroots you know, all these kind of super concentrated nutritional or parts of nutritional supplements may again, convey a protective effect, but it's not like you can just have that regularly in your diet. Something that you might be able to do is this fantastic drink called milk. Milk has got quite amazing properties. But from a muscle damage perspective again, not consistently, but you if you take maybe half a litre of semiskimmed milk after having done a high intensity bout of exercise, it may attenuate the DOMS response. Possibly, not so sure about the recovery profile of force and reinforced development, and it may well help with that as well. But again, it's not something out there that, you know, it's across the board, but most people, or many people who are not vegan, drink milk. It's also very good for hydration as well. And it's also very good for protein synthesis. So, you know, that's something that I wouldn't be averse to just saying, try if you wanted to try some.

**Steven Bruce**

Why is it called me demiskimmed? I can't stand that bloody stuff.

**Claire Minshull**

It's just, and this is where I'm going to defer to my nutritional colleagues, but it's to do with the fat profile. And I think getting through the stomach. So it might even be skimmed milk works better. So the protein, if we're looking at protein synthesis, and potentially hydration, I think even skimmed milk is actually better because of that.

**Steven Bruce**

Okay, that'll be an interesting one to pursue, but it's not for today. And it's going to take a long time to convince me to drink skimmed milk, because it's just chalk flavoured water in my opinion, but the water is good. I got a couple more questions here. Fleur has asked if a patient is doing strengthening exercises, but they're not getting DOMS does that mean they need to lift heavier weights?

**Claire Minshull**

I'm going to ask you what strengthening means? And how heavy are people lifting? And in what positions are they lifting? So ultimately, no, but just question whether or not, if you want them to get stronger, it has to be high intensity. So if it's dynamic repetitions, you really need to be failing around about five repetitions, maybe six, you're struggling with that six, seven rep repetition, you just can't do it. That will give you the optimal benefit for muscle adaptation for strength.

**Steven Bruce**

That's a much better indicator for DOMS, the fact that you're failing at five or six reps is a really good indicator. Yeah. And Fleur should look at the recordings we've had with you before because you've talked at length about this. And it came as quite a surprise to a lot of us, I think, to learn that the number of reps was so small for strength building.

**Claire Minshull**

Yeah, and you will get some strength adaptation. If you're doing slightly lighter loads for a number of repetitions. But going to failure is the absolute criterion, you must do that. So if they're lifting 10, with which three sets of 10 is a selector, isn't it, which it isn't, but fail at 10 and you'll get some strength benefits if you want even more, lift heavier. If you do an isometric work, and you probably will get DOMS with that. If you doing isometric work, then you probably won't get DOMS but you still can get strength benefits. And depending where you are in that range, if you're doing short muscle lengths, sorry, long muscle lengths, then you can get actually adaptation through range as well. So isometric can be really useful. So bottom line, no, but question what you do in terms of what this person is doing in terms of actual loading.

**Steven Bruce**

Claire, I've got a dozen questions I haven't had time to ask. And I've only just realised that we are out of time. And I'd love to run on. But I know that people have patients at two o'clock, and you've got things to do. So we're gonna have to wind it up there. We've had 365 people watching this. So what we also need to do is make sure they're aware of the various facilities and resources that you provide for people, which

I will do in my follow up email. But thank you so much. And I'm so sorry that I insulted you by promoting you to a world powerlifting champion at the beginning. But the fact that you are merely, merely a British powerlifting champion, then yeah, but it's been a great chat, as it always is. I'm looking forward to getting you in the studio with your partner back in December. So we can talk about some more of the psychosocial aspects of what we're doing, aren't we, which is going to be fascinating stuff. I'm really, really looking forward to it. Good luck with the hospital business. I hope that goes through because it sounds as though this is evidence-based medicine, which might actually be quite good evidence based medicine as opposed to a lot of the stuff that seems to get through the NHS net.

**Claire Minshull**

Oh, thank you very much. Yeah, we've got a lot of interesting conversations around the country at that minute. So I'm really, really hopeful but you know we've seen some fantastic results so thank you.