Welcome to the first podcast in the series human performance and health the aim of the series is to enable like minded people to bridge the gap between hard science and its application. So what I mean by that is generally how do we use the data in the literature that's out there how do we use that to improve on our understanding but more importantly how we use it in the real world.

Today's talk or chat is on muscle muscle hypertrophy muscle protein synthesis and protein requirements and what's needed to what's needed to help and developed help develop and maintain muscle mass firstly introductions I'm going by I'm joined by Nick Burd from the University of Illinois and he'll give an introduction to himself in a second.

I'm Dr Rich Mackenzie, I'm an associate professor in London working in areas of obesity type 2 diabetes and insulin resistance. Just bringing in Nick, Dr Nick Burd

Yes hi Richard firstly thanks for having me, at University of Illinois I'm currently assistant professor within the Department of Kinesiology and Community health. I also have appointments in nutritional science and lead the nutrition exercise and Performance research group at Illinois laboratory. Our laboratory mainly focuses on exercise nutrition and metabolism looking at their interactions. Sometimes we also read them through a single lens

Great thanks mate that was probably rather modest introduction and having known you for a few years, so I remember when I first met working together correct me if I'm wrong in New Zealand I was working and you were mainly just sitting around not doing so much and when we lived together I saw you eat one thing that wasn't cottage cheese in the whole of the two weeks and that was that was mussels that I think I cooked in some white wine sauce. I think on your biography that you've got over 63 publications and many book chapters and count and countless conference abstracts. This is is all in the area of protein synthesis, exercise and health and general metabolism.

That's correct Richard thank you, work is not a single effort it it's a group effort so that's not all on me I've been fortunate enough to work with some of the best people in the field who exactly contributed to my success but thank you, I did a little bit. Everything that we do in our fields we rely on others.

You're currently one of the main guys in the field of protein synthesis and exercise. Before we go into some questions that I've got for you around this area, Nick I just wanted to give a brief overview of why I thought it was important to make this podcast series available to external individuals rather than just undergraduate students and postgraduate students at Roehampton.

Over the last couple of years I'm sure you'll agree there's been a massive massive increase in the interest in health wellbeing and fitness industry and without there's been an exponential growth in the number of so called so-called experts in their fields of exercise and health with many stories but some of the key ones that I thought were pretty bad are - carbohydrates are bad for you, sugar causes cancer, nowadays that fat is now ok there's no question mark?

One of the things I wanted to try and explore when making this podcast is protein can seemingly do no wrong and you can eat as much as you want I really supplement your diet with protein whether that be food or supplement patients to avoid things like carbohydrates know I know from my own work - glucose metabolism and obesity alienating one macronutrient or over consuming another macronutrient special populations notwithstanding is never really a good idea so hopefully we'll get to explore that a bit later on. But firstly I wondered if you can just kick us off by a giving a broad overview of protein and what it is in the context of health and exercise

Yeah yeah sure so protein we can think of outside in two ways whether it's dietary protein or the food that we eat eating on a day-to-day basis or a total protein mass that's in the body. I like to study both aspects so I study how does the food we actually interact with our bodies on that level on one level and when I think about protein in general metabolism what I'm talking about is thinking about is how is the body renewing its total protein pool so rather tha set the whole body level or the muscle levels usually considered as about 12 to 14 kilos protein in a 70 kilo individual we know that renewing this total protein mass is important for optimal function important for optimal metabolic health. So a lot of times in our laboratory we try to understand or identify how

we can remodel that total protein mass and you know two of the most effective stimulation are exercise and nutritional manipulations and you kind of alluded to earlier but protein can do no more wrong - you can eat more and more and more and now we generally recognising that protein requirements to maximise the remodeling of your total protein massis likely elevated against what's commonly recommended.

But when we start to see protein loads we are often required to totally remodel the total body protein mass we have to start to reconsider how we can make better use of protein in the die. It becomes a bit problematic when we start prescribing big protein loads to individuals in particular, when they see protein amounts per meal expressed that roughly 30 to 40 grams of protein per meal is required to optimise whole body remodeling that's good information. It's not that it's going to be unhealthy, it's just going to be challenging as far as from your day to day life.

Right we know that protein is expensive, you can make the argument that the sustainability might be an issue trying to sustain the world's population on those protein load might become a problem down the road it's only a whole other discussion but we often have a lot of opinions of them so essentially proteins important for optimal functioning health to maximise remodeling and we need to view based on the sum of the current data that's higher than what's currently recommended. So I think our laboratory next manoeuvre is how can we make better use of protein in the diet and trying to understand can we somehow use those amino acids in circulation to a greater extent.

I don't know if we want to jump right into this kind of stuff but we're starting to learn that protein in the diet might behave a little bit differently when it's sitting in its natural food matrix right so a lot of the data generated on isolated protein meals is very important data but guess what, we just don't sit down and eat isolated protein sources so we're starting to pick up some of this stuff.

I've got that probably coming up in a bit so let's make a note of that and park that for when we look at food types later. I completely agree with you we don't just generally eat micronutrients we sit down and eat meals so we are consuming protein with fat or certain percentage of carbohydrate that's likely to change how we observe and digest and handle that particular protein in this example and I think that's what you were getting to in terms of better use of the protein in the diet so lots to think of it

Thank you Nick I wanted to just touch on why you think protein ingestion is such a current topic not just for you but also in the general public

Yes, again we're starting to learn you know the old nitrogen balance data loading techniques that we utilised for protein requirements here in the US - the protein RDA, we're starting to learn that may be not optimal, we need to redefine these dietary protein requirements recognising the protein in the diet could be beneficial if consumed in amounts greater than what's currently recommended.

If we go back to the same sustainability point as a lot of people don't have access to high quality food protein, so it's a global health problem - we currently see the world population growing right and we're going to be putting more stress on our resources. Sopolicymakers are recognising it's an important health world problem protein in the modern world. So trying to define these requirements how can we improve the protein in the diet - basically there's a lot to learn and it's very relevant now based on those points

Absolutely it's a very fair point and will not go away soon - the interest you hear out there is trying to maximise skeletal muscle adaptations whilst exercising and what's athletic performance is really important than protein certainly filters into that. I'm not saying I don't have an interest in sports nutrition stuff but that's a really small end and if you really open that lens and take a picture, it becomes really apparent how important protein is in the modern world. I guess you've got quite a vested interest in the field not only because it's your research interests but from when I first met you a few years ago in New Zealand you are solely of the opinion that high protein diet to help symptoms help facilitate or maximize protein synthesis to give you muscle mass with something you were really interested in.

So sometimes you know we see high protein diet and the lay public gets confused where you look at them macronutrient dissertations range you say high protein that's pretty vague but generally what we consider a high protein diet is about 30% of your total kcals coming in coming in dietary protein so that's probably where we need to be talk. You might talk to some of the individuals involved in that strength training community and they might get closer to 64 - 70% of caloric intake which I don't even know how to refer to that let's be honest. So putting a definition on a high protein diet sometimes it problematic to the lay public and even 30% of your total kcals should be coming from dietary protein that's not really relevant for them.

For individuals embedded in nutrition that does make sense so when we say high protein I'm generally thinking of that range not something that super high or however you want to refer to it.

So what you're suggesting for maintenance of health so unless you are an athlete or an elite athlete correct me if I'm wrong if I'm putting words into your mouth, if you're not an elite athlete that's a huge amount of protein turnover you're an expert so I stuck around the topic little bit. When we talking about muscle mass that's a product of protein synthesis and I heard and I think it may have been Van Lume along the years he said that if you look at your arm you might think that it's there all the time but actually over the course of two to three weeks is completely replaced itself so that's how rapid digestion all breakdown of proteins and replenishment of proteins so yes that's professor used that example quite a bit.

I was fortunate enough to work with him for a few years during my postgrad so I've heard that example being used - your body's in a constant state of protein turnover you're constantly breaking down muscle proteins for total body proteinso it's a very dynamic process, we need to exercise and eat food in order to facilitate that remodelling. What he saying is literally look at your own arm - within 30 days that total protein pool with in your arm has basically renewed itself. Now to take that one step further you can say you have a new arm and turns out that protein pool within that match within that arm mass is a good analogy. It kind of highlights a dynamic of protein metabolism as well. I've never really thought about that area in the same way how rapid and dynamic it is but just go back to one point because I think I got a bit carried away and excited I can do that sometimes; so unless you are an elite athlete - 30% of your calorie intake - of course there's people that would agree and disagree, not gospel but you're someone who knows a bit about the area - so 30% is going to be enough to facilitate health and growth and muscle mass. An elite athlete working in an area where protein dynamic is a lot higher than the average person who attends the gym 3 or 4 times a week lifting weights.

You know Richard you could almost remove that disclaimer when we talking about sports nutrition and guidelines – as scientists, we can certainly prescribe global recommendations but the individuals who are truly working with these athletes on a day-to-day basis they know it's not how that works so it's very personalised

I kind of have to use our framework it's just that it's not at all recommendations because performance nutrition is very individualised to the athlete so rather resistance or endurance athlete your protein requirements are probably different based on some of the work we've been generating. But even if an elite athlete you know probably there's no evidence to suggest that these really high protein loads and some of the earliest work suggests that I just look at both sides of but there is evidence out there to suggest that trained individual makes better use the protein meaning that better able to shift a protein that they're eating their diet into the total body protein stores a little more effectively than someone who's untrained.

So again a possibility exists that these individuals are better at utilising so they could probably get away with a little less or the same amount as some of these other individuals. This is 30% of total intake pretty relevant to these individuals as well you know and it comes back to the point protein important for remodeling repair but for an athlete what sort of most important micronutrients of course is carbohydrate intake - they must have glycogen stores.

Now I'm getting into your world so you've got to be hesitant you don't want to upset too much of the total intake with protein because then you're going to start a setting somebody's really bad balance

of macronutrients for these individuals and their nutrient intake for total nutrient intake is so high that generally hitting their protein needs as well because they have such a high intake of energy

And you know we haven't talked about this but you know that exercise exercise increases amino acid sensitivity of your muscle and an acute bout of exercise is quite effective immediately in the sense so you're actually again able to use the substrates in circulation better if you exercise then if you don't certainly don't walk away with this that I'm highly supportive of super high protein intake in athletes and that's I'm talking about 60 grams of protein in a meal that's not necessary for anyone all you're going to up-do is up for regulate a lot of prolytic activity

We're making oourselves a little less efficient in using the proteins in your body but we still learning. A lot of our work is currently in the resistance exercise realm and when we look at the endurance exercise individuals it is a completely different beast. Completely different metabolism so there's a lot of work to be done in the Endurance exercise world

Now you're getting into my field again because I consider myself an endurance so I look forward to reading some of that work. I thought a lot about before of how sensitivity to the substrate of amino acid is improved with exercise but correct potential lifestyle and part of a healthy lifestyle is that regulating substrate uptake within muscle. I quite like that so if we have time it would be quite nice to go into some of the mechanisms around building your proteins and how we get amino acids into the muscle.

But we may have to do that next time so I just wanted to come back and ask you a couple of questions

I've heard a few things over the years and you get ideas and you've kind of alluded to it - 30% of your calorific intake from amino acid vs 60% and I've heard I think it was your old supervisor Phillips he was a great guy in the field with a lot of experience; suggest that no more than 1.2 grams per kilogram of body mass is required for healthy lifestyle and for even for heavy resistance type exercises. Then there were others it's just that even 2/3/4 grams would be prescribed as required for those elite athletes. So what I think I've got from your answer is actually those types of people are exercising very hard on for long periods of time probably need the same as someone who's probably exercising more in a more amateur moderate level because they're more efficient at turning that protein over into amino acids and using it to build new muscle mass.

Based on the evidence we know obviously I could be wrong, utilising the current state of knowledge based on those two things combined yes endurance trained individuals has better whole body nitrogen retention which is to put it in more simple words and little more efficient at turning over their retaining protein for total protein mass. Combined with the knowledge we know - exercise does enhance the amino acid sensitivity to the food you're eating and this can be sustained for two days afterwards - 1 to 2 days afterwards.

There's a lot of evidence to suggest athletes and I think that but if you look at the protein RDA which I think it's 0.8 grams per kg per day of protein is too low they need to be closer to some of recommended athletic amounts - 1.2 or is high is 1.7 meaning that the sedentary individuals could probably benefit from eating a little more protein from a health perspective and benefit from exercise as well of course. We promote protein in a healthy diet and promoting exercise eating more protein but also maximising the protein coming into the system with some activity because we know it has great benefits for your muscles but also total health and well-being.

If you look at other communities such as the body building community - I don't study those individuals at high level but they go through competition season where they were required to get to a lower amount of body fat so they might increase my protein intake as we know protein is very satiating that's going to help cure hunger curb hunger so I don't know if they're utilising that. But if they eat more protein - physics going to build a bit of muscle. You can oxidize quite a bit of it actually it's not they are getting the beneficial effect during that is energy restricted phases so that makes a lot of sense and things I've thought about in my own field protein increase to a healthy level.

Increased protein ingestion can make us feel more satisfied from an evolutionary perspective that would support that and appetite regulation and also the exercise can increase the sensitivity amino acids to muscle by up to I know I think you said the day after and I know from my work for insulin sensitivity can be improved up to 72 hours afterwards in muscle so it's parallels from slightly different fields and we could probably talk for hours about the right amount of protein; but from my limited knowledge compared to yours we can kind of agree that 30% or 1.2 - 1.7 grand total mass or 1.2 - 1.7 of total body mass would be optimal and won't cause any damage.

I come back to the word damage in the second because it's quite important in may be eating and overeating protein and how we can maybe dispersal myths about that. So let's say my next door neighbour for example does a little bit of exercise 3 or 4 times a week every 3 or 4 weeks he has a massive box of protein supplementation I won't give the brands away but massive box of stuff and he powders it into a bottle and drinks it and he goes off and does some exercise, does it after the exercise. Assuming that the body only needs a certain amount of protein he is maybe spending a hundred bucks on this stuff - what's happening to those excess amino acids once they enter his body being digested he can't use in for protein synthesis because it's already got enough maybe from his natural diet but for arguments sake let's say seventy percent is left and used what's going to happen to that some of those amino acids?

Yes some of those amino acids will be used to remodel total protein mass but the rest is simply oxidised so we've got to get rid of the ammonia so we're eliminating it from the body so we're wasting it - basically we just passing it through our body and it comes out in waste.

Yes that's right exactly right we don't want too much nitrogen or ammonia messing around in our system so the body will get rid of it and that we get rid of it so healthy individual it's not a high protein in taking some of these healthy individuals and when I'm talking I mean super high there's no evidence to its detrimental to a healthy kidney or for bone health or any of that stuff just simply wasted so expensive habit. You know the protein products they're great, handy and useful but when I used to do the strength training an alternative way is to just buy powdered milk from any grocery store. If you're worried about the convenience facts instead of buying expensive protein powders you can get to skimmed milk powder.

I think that's probably the most useful thing you learnt from your PhD experience is how to save a bit of money when you're buying something that does the same thing for a lot less it's also a practical thing so the guy next door I may have played him down a little but him what he's doing but there is a practical element and say for example I made a meal the other day which need to be prepared and it gives you a recipe to follow with ingredients at the park with herbs etc really good but in it and thinking about our chat today it said how much protein is in the meal and then I divide that by my body weight and it was nowhere near enough to 1.2 grams to the required amount. Supplementation in that form could have a handy convenience aspect to it - protein supplements are useful there's a place for them especially in clinical nutrition as a supplement but certainly shouldn't be a basis for your diet as a replacement for well balanced meals.

I know you've done a little bit of work and I'm going to keep coming that phrase so is there a food type thing we could be talking chicken fish egg whatever and there may not be an answer?

If using supplements for convenience but most of your dietary protein intake should be coming from nutrient in protein based foods these are unquestionably the most beneficial so once we start looking at meat they are protein dense so especially like a lean sort of meat they are mainly very protein dense. Some might contain some other nifty fod components that might be beneficial food components that might be beneficial such as Super egg. It's a very interesting food source in the sense that it's quite nutrient dense lots of vitamins minerals fat a lot of the individual's and I'm not going to pick on the bodybuilding and strength conditioning community.

No I won't pick on them, they're big guys and I am a fast runner but it only takes one ! During certain faces of competition phases in health and fitness magazines they always promote eliminating the yolk from the egg which doesn't make a lot of sense to me and that there's a ton of nutrients and a lot of protein as well. About 45% of total protein is in the egg yolk so don't

eliminate egg yolk. Some of the work that we presented in Experiment Biology was quite a simple study. We compare the total nutrients of egg white and the total nutrients in terms of whole egg. Nutrients were matched for protein content and what we found was that when some young healthy individuals consume whole egg that's match for protein to an egg white, there is a greater potential more remodeling or a greater stimulation of protein synthesis from a whole egg. I think this is very important data for us - not really to help you decide your breakfast choices but that they're quite high. 30 to 40 grams of protein in a meal which for a number of reasons is sometimes hard to obtain, nature is giving us a better way to make better use of protein in food for eating in its natural food matrix. So identifying what components make better use of the dietary such as amino acids I think there's something there and why is protein so important in the diet in the world?

We really don't know that much about it you have to start somewhere and this comes back to the protein RDA for policymakers - they made your point is that you needed a starting point and then right that was a starting point sometimes it might be played off - as an all in protein requirement after starting point now start to optimise and that sort of how I view some of the isolated protein sources. They provided valid framework so now we can start moving into how does mixed macro nutrient interactions happen and we've done some of that work already but we didn't see anything exciting as far as taking an isolated protein source and combining it with another isolated source such as a carbohydrate source so you didn't see the effect of adding in all that extra energy through a carbohydrate. Another study we did something similar we took protein and fats sources but we didn't see much benefit of adding in extra isolated fats to isolated protein source.

But going back to the egg which we learnt that results were still within its normal food matrix so a lot to learn not only how isolated protein sources are interacting but also have food within its natural matrix is interacting so stay tuned !

The Superegg in Experimental Biology was a really interesting thought-provoking kind of concept. We really don't quite know yet if you look at the work that Kevin Tipton did during his time at Galveston some years ago now he said whole milk and anabolic potential in whole milk vs skimmed milk and even had a nice energetic control in that particular study so it wasn't just the energy that was facilitating greater muscle anabolic advances.

So whole milk still was closer to how it was naturally produced by the animal. It could be something there I could be wrong, but based on a few lines of evidence we need to explore it greater and high level but there might be something to it and it's important for me because this might mean we are getting some help for obtaining foods within a nutrient protein dense matrix and maybe we can try to bring down some of these protein requirements to try to help out the stress on the protein resources. It’s expensive to produce protein and with the population growing and requirements are higher it's a perfect storm - we have to figure out a way to help how to better utilise a protein in diet and make it more efficient.

If it helps I can volunteer myself & my son because my wife decided only he can only drink whole milk and that's what I need to consume because the grocery budget is outstripping everything and whole milk is energy dense and given that I'm an endurance runner I need that energy.

I just have a quick question about the time of day - is there a need for time of day of consumption and within that question, for example with weightlifting does it need to be consumed immediately within the time of weightlifting?

Yes that's a big question obviously we do know now that that dietary protein requirements on a daily basis - usually people like to backload their protein in calories in big protein meal for dinner. Is that the most efficient way to utilise a protein?

No. it's better to try to spread it out throughout the day 4 - 5 times a day to break up those protein requirements across the day - the distribution of protein appears to be really important in relation to exercise. The theory of the window of anabolic opportunity - after an acute bout of resistance exercise now when we're thinking about the interaction of exercise and nutrition in particular resistance exercise on muscle protein synthesis we know that you get the best synergy when you

have a maximal exercise induced response. So if we if we look at help muscle protein synthesis and remodeling in stimulation during post exercise recovery we know it's pretty robust in a measurement period for example 0 to 4 and then 0 to 5 hours after the exercise. It kind of wanes over time but it still kind of can go upwards from to 24 or 48 hours in some instances depending on how much you put on the muscle. So now we know there's an interactive effects of course you want to eat protein when you have the highest exercise muscle and use protein response

There is this window of anabolic opportunity but does it shut quite rapidly?

No it doesn't show that if you eat a meal somewhere within 2 to 3 hours after an exercise bout - I wouldn't say that's equally as beneficial as having a protein shake sitting on the floor after you finished your exercise but from a practical perspective if you are a super busy athlete then forget to eat - it depends who you working with. You might try to underline the importance of post exercise nutrition maybe to a greater extent just to make sure they try to get some food into the system but from a practical or real perspective you do have quite a window quite a prolonged window. That makes a lot of sense particularly from a practical point of view some people try to ingest a huge amount of protein which has less benefit then I might but if the coach or whoever's working with them know they've had some protein and they haven't forgotten about it. That's a common thing with athlete that they forget to eat - it depends on the travel schedule. Post-exercise recovery is not a 10 minute window - it's much longer in nature so you certainly have time to go home from the gym take a shower then you could still have a nutritious meal then and it'll still be beneficial.

I would imagine you'd be hard-pressed to find much different statistical analysis for eating a meal 10 minutes after exercise without exercise bout compared to 2 to 3 hours afterwards.

I just wanted to finish off and for those that are listening I will be listening in the future I'll pop some of the next papers that's so you want to if you want to read some more about what next been doing Nick's been doing I wanted to talk about what's related to the topic today related to some questions that I've had from people that I work with that are protein intake ingestion because what they want to do is lose fat mass and increase muscle mass. I noticed that you did some work that was published in the American Journal of Clinical Nutrition I think it was this year 2017 where you looked at the anabolic sensitivity post feeding in the individuals that were overweight obese or healthy adults.

Could you talk this through the rationale of why conducted the study and what the main findings of the study were ?

The unique aspect of that study was that we used a food source - lean pork - again moving away from the isolated protein sources we know when you consume whey protein for instance dietary amino acids in circulation peak at 30 to 60 minutes so you get quite a large rise in amino acid availability. But it wanes quite quickly, the post amino acid profile is completely different, so when you eat lean meat per say it doesn't peak until 2 hours later.

It was important for us to see healthy food that you actually sit down to eat might get into the circulation and impacting subsequent anabolic response that's important in itself individuals with different body compositions per se but different amounts of fact is that food more or less effective. Basically is the protein in the diet that they are consuming having a different impact based on the amounts?

We take care in that study to use sedentary individuals who are not following a healthy lifestyle with consistent exercise so we wanted to provide the initial framework for sedentary adults who would sit down and eat a protein load that might be recommended you to e.g. 36 grams of food protein how does this impact myofibrillar contractile remodelling? We originally hypothesise as noted in a paper that we thought it would provide a strong signal to the muscle as far as the amount of amino acids in circulation. It basically listed a good response across all participants with different amounts of fat – in a commentary to our hypothesis what we noted that when either an

overweight individual or an individual who is obese- when they eat that means they're not able to remodel the muscle to the same extent as someone who is not carrying around as much fat.

This is quite a surprising finding because we fed them quite a big protein load and I thought we could at least get the muscle to respond so we couldn't so that was the basis my next manoeuvre is so sitting around eating protein is not effective so use exercise help these individuals - and will the exercise then be able to kickstart a muscle to utilise that substrate that's going to be available?

I'm hoping that combined exercise with that study using the exercise as an adjunct strategy to get their muscles to respond but wedid a good framework for future manoeuvres but again it's not uncommon for people not to exercise so there's individuals and not remodeling no matter which then leads to poorer metabolic health and we certainly noted in these individuals that a lot of these individuals will be coming insulin resistant. Of course I'm not saying it was all because of the muscles not responding to remodeling but it certainly contributing total body impairments in metabolism.

Why is this important so people with larger amounts of fat mass do not remodel muscles as effectively as someone who is of a healthy weight with less fat mass?

Actually we know that the muscle is a good thing for excessive nutrients and so if that stops responding to insulin and it's not remodelling, you've got a double whammy because you're losing muscle mass or not replacing and the muscle you have is now resistant to the hormones that it needs to help the body remain in the homeostatic state. This can lead to type 2 diabetes, secondary complications heart attacks loss of sight loss of limbs all those horrible things a lot of the things that people who go on and change will suffer from.

An interesting part about obesity model is that these individuals have a lot of lean mass so this is a great example of protein synthesis but sometimes people view protein synthesis under the view of hypertrophic remodelling. But protein synthesis is also non-hypertrophic remodeling so these individuals have a lot of mass- just not muscle mass it's not turning over, they have to make it better quality.

It's really interesting exercise, probably the right manoeuvre but again in science we have to be very systematic so we probably could have done that study right away but I wanted to understand how does nutrition alone impact. Our study is also unique in the sense that hopefully we start seeing a shift in the field and general in the protein metabolism world we study men and women so that was a mixed gender study.

A lot of our work is studying both men and women we need to study both sexes on a high level not just the men a lot of work has focused on this because it's easier for us to control so you're right in saying that we do need to get away from that and at my university we're planning some work by ourselves and we looking at involving both male and female.

I think that's probably enough information from my tiny brain for one day

Thanks it's about my nap time!

For anyone interested in learning a bit more about this topic please just hold tight for relevant information and papers that we've discussed links will be placed on the accompanying website which will be up in the next couple of days and for those that would like to know a little bit more about your Reiss can you briefly let them know where they can find you yes absolutely I have an online presence my research group has a web page that publishes regularly and you can also get access to this via my university of Illinois faculty page which might be easier I do have a Twitter account not highly active but do occasionally to eat and that's @Nicholasburd

Thanks very much Nick it's been an absolute pleasure