Welcome to the Cutting Edge Health Podcast with Jane Rogers, where we discuss science to help prevent cognitive decline.

Jane Rogers: The director of the UC Irvine Sleep and Cognition Lab and a professor of cognitive science is our guest today. Dr. Sara Mednick says the number one thing we can do to prevent dementia is to go to bed at 9:00 PM. That's early, but the earlier you get to sleep, the more slow-wave sleep you get, and that's the restorative sleep you want. She calls it the downstate, and her book is *The Power of the Downstate*. Dr. Sara Mednick, I'd like to welcome you to *Cutting Edge Health*.

Dr. Sara Mednick: Thank you so much.

Jane: I'm so glad you're here.

Sara: Oh, it's such a pleasure to be here.

Jane: There are few books that touch me as much as yours. I have read this thing, it is dog-eared, it is highlighted, because you talk about people who are doers, people who are doing too much, and that's not good for our health, that's not good for our brain health on many different levels. We have a lot to talk about. Walk me through, first of all, what you are trying to express with downstate.

Sara: Yes, that's a good question. What is the downstate? I've been running a sleep lab at the University of California for many, many years, and what I've come to understand is that we are natural rhythmic beings. Rhythms give us two states, they give us an upstate, where we have a lot of energy and we have all the resources to go, be, do, and then there's a second path of the rhythm, which is what I call the downstate, and that's all of the processes and activities we need to engage in to restore all of those resources and get us ready for the next upstate, for the next moment **[00:02:00]** that we have to expend energy and increase cortisol and increase our stress response and increase our ability to take care of things.

The more we engage in these downstate activities, the more we give ourselves rest, and really deep relaxation, the better we can be in that next moment where we need to be active.

Jane: I read that this happens quite quickly in your body. You'll have an upstate for a couple seconds and then a downstate during your sleep.

Sara: It depends. There's many different levels that we could be analyzing how do these rhythms work. You can look at all the way up from-- the smallest theory that I talk about in the book is a neuron firing. The way that our neurons in our brain, the cells in

our brain communicate with each other is through firing and rest. There are these things called refractory periods, which are the downstates of the neurons, where they actually need to regain equilibrium in terms of electrical equilibrium so that they can get back to a state of being able to fire again. There's this upstate of excitation and then a downstate of inhibition and rest.

That you can see happens as well in our breathing. When we inhale, it's a big increase in oxygen and it actually increases our sympathetic arousal, what I call rev, it revs you up, and the exhale [breathes out] is a decrease in rev and an increase in what I call restore, which is the other side of the rhythm, which is the really restorative part. You have this increase and decrease, increase and decrease every time you inhale.

Then you can also look beyond that to a whole day. You have the daytime, which is made for being extroverted and get out there and do things and create and think hard thoughts and make big decisions, and then the nighttime is that time for deep restorative work, where you need to be basically comatose and in a state **[00:04:00]** where your body can just go internal and start to repair its tissues and start to replenish its resources.

You have that reference frame of the entire day, but then as you say, even within sleep, you can have moments where you're going into what's called slow-wave sleep, and slow-wave sleep is this period of deep restoration, and it's followed by REM sleep, which is a highly active brain state. We go through these other periods, ultradian periods and not circadian, which is 24 hours, but ultradian, which is shorter than 24 hours, where we have rest, we have activity and rest, activity and rest.

Jane: How do we get into the downstate in sleep? Are there ways, like eating early, not eating right before bed, eating three hours before bedtime? What are some ways that we can enhance the opportunity for better down sleep at night?

Sara: Yes. There's downstates that you get into naturally during sleep and then there's downstates you can get into during waking as well. If I wanted to start at the beginning of the day and say, "Okay, well, how can I not only get into downstate during the day, but also ensure that when I get to bed I'll be able to get into a good downstate at night?" There's a whole bunch of things that we can be doing, including right when you wake up, you need to really spark that active, what I call the upstate, which is the opposite of the downstate. You need to spark the upstate. You need to rev yourself up by giving yourself bright morning light.

Light is a very important stimulator for your circadian rhythm, this internal clock that tells you when it's upstate, when it's downstate. Bright light, or when it's winter time and if you're in a place where you don't get bright light, then using a bright light box can be very helpful for stimulating that initial information for your day. We don't get that

information by regular light bulbs. We don't get that information by just sitting indoors with light streaming through our window, we actually really need to go outside **[00:06:00]** or be in front of a light box that really is sending you the right amount of lux.

The other thing you want to do is make sure that when you are thinking about your upstate day, how can you cram as much of the most energy-dependent activities, the stuff that really drains your batteries, the stuff that really makes you think hard or makes you work out your cardiovascular system, also with eating, pump up your metabolism, use your brain by heavy thinking, try to cram a lot of that stuff to the earlier part of the day.

When you start your upstate, that's when you have the most amount of glycogen, the sugar in the brain to make you think, the glycogen in the muscles to give you energy for your muscles, your insulin levels are at their height or being able to really take the food that you're eating and turn it into energy. All of that stuff is at its height during the first part of the day. You really want to try to get as much of those active activities happening in the early morning up to midday, because after midday, your brain starts to slowly go into downstate mode, so your body starts decreasing insulin production.

This is why eating later and later in the day, the food is not as efficiently used because you don't have as high insulin, and so your body can't turn that food into energy and it just gets turned into fat. Your brain is also being occupied and working all day long and it starts to go into its own downstate by the evening, and so this is why it's great to push all the really intensive thinking to earlier in the day and then a little bit more of the pleasurable or less emotionally intense thinking to the evening.

That's also true for your cardiovascular system, that it's primed and ready to go in the morning and it's good to let your cardiovascular system go into a downstate in the afternoon and evening because that also sets you up to be in a very relaxed state for when you want to go to **[00:08:00]** sleep, and sleep is the natural downstate. That's where you go into slow-wave sleep, which is the most restorative, repairing, clears out your brain from toxins. It produces proteins.

There's a lot of really deep restoration that goes on a slow wave sleep, and that's the first part of the night that you're going to get that slow-wave sleep. It's important to really create that rhythm of a lot of activity in the morning and the afternoon and then start to tamper it down so that then you can go into this deeply relaxed state and fall into deep slow-wave sleep.

Jane: What if someone's, as you call them, a dozer? They ramp up and they ramp up all day long and get stuck in that ramped up upstate mode. Are there things that you recommend someone can do during the day to help foster a downstate time?

Sara: Yes. If you think about children, babies, who need naps, they need rest in the middle of the day, and when they don't get rest, they actually get more hyperactive and it's harder to put them to bed at night. That's a interesting thing, where you think, "Well, they must be so tired, then they're going to fall right asleep," but a lot of time you get the opposite, you get this hyperactive, out-of-control child and it's really hard to get them to bed at night. Well, it's the same thing. We're not actually programmed to be dozering all day long constantly.

I have a ton of research that shows that if you try to do the same thing over and over during the day, your performance actually gets worse and worse and worse, so you need to take breaks. The question that you asked is, what kind of breaks can you take? Well, one of the best go-tos is just deep breathing. All of your restorative mode starts with the deepening of your breath, the intentional deepening of your breath, because what that is sending, it's a signal to your brain to say, "All right, enough with the stress, enough with **[00:10:00]** reacting and panic breathing and shallow breathing. I've got control of the situation. I can slow my breathing down, I can control my breathing."

No matter what circumstances you're in, having that slow, deep breathing while you're driving in the car, while you're making dinner, while you're in a meeting, while you're opening up your email-- There's something called email apnea, that the second people open up their email, they stop breathing, and that's an immediate stress response. Really trying to regulate your breathing more often during the day is one of the key elements to having a more balanced, autonomic nervous systems throughout the day.

Then there's a lot of other restorative mode activities that you could get into, such as 10 minutes of meditation any time during the day, maybe in the morning, once in the evening, maybe once in the middle of the day, doing yoga, going out into nature. I think that this is something that we really have lost in our industrial world, is being in touch with the natural world. First of all, do you take deeper breaths when you're in nature? You commune in a way with something that's larger than you, so you get out of your own head space and you actually are breathing in phytochemicals from trees and plants that are healthy and immune boosting.

Taking time to dozer in nature. Go, be, do out there, but do it in a way where you're connecting with something larger than yourself. Another great way is sex, having more sex because sex is a really great way to stimulate your autonomic nervous system and it's exercise, but then as also the calm down after the orgasm is this really big ushering you into a downstate state.

Jane: Good advice. Very good advice. Now you're also a big proponent of napping. Napping does a lot, doesn't it? It does a lot for you cognitively.

Sara: My first book was called *Take a Nap!* **[00:12:00]** *Change Your Life*. It's based on my research from my dissertation, actually. I wrote it right after graduate school because we were the first group to actually show the dozering idea of doing the same thing over and over and over again. We first showed, well, we can't maintain our performance that way because we just get worse and worse and worse.

What we then showed was that you can't motivate people by paying them more money and say, "Hey, your performance is decreasing. I'm going to give you an extra 50 bucks and try to keep it as high as possible." Nothing we did allowed people to get back to their baseline except for taking a nap. There's something very energy-depleting about being awake and cognitively focusing on something. What naps do are they restore those resources that you use up when you're sleeping, but they also help you learn.

During sleep, naps, or nighttime sleep, your brain is taking the information that it learned during the day and it's consolidating it. It's making it into a long-term memory, it's integrating it with everything else that you know, and so when you wake up, you've now processed that new memory, you've now processed that recent experience so that you're faster at playing piano, or better at thinking through a problem, or you maybe have less of a real deep emotional reaction or something because you've been able to process the emotions better.

Jane: As far as the timing for naps, I've read that you need to get your nap done before 3:00 PM because if you nap later than that, it starts to rob your sleep the following night. Is that right?

Sara: Yes. It depends on how long the nap is. As I said, that first part of the night is called slow-wave sleep, and that's really the really important part for really downstate recovery, and your need for slow-wave sleep increases across the day. The moment you wake up, your need for slow-wave sleep is very low, but as you stay awake and as you're active, your brain and body **[00:14:00]** needs slow-wave sleep, so you have this increasing pressure to get back to bed to get slow-wave sleep.

That means that if you take naps during the day, your naps in the morning will have very low slow-wave sleep. In the middle of the day, they'll have a medium amount of slow-wave sleep. If you nap in the evening, your naps will have a lot of slow-wave sleep, and then that can take the pressure out from when you want to get to sleep at night. That's the mechanism for why it's good to have your naps and/or around three o'clock if you're going to be napping so that you don't rob yourself of that sleep pressure that gets you to sleep at night.

Jane: I use an Oura Ring to track my sleep so I know exactly to the minute, supposedly, how much deep sleep I'm getting and how much REM sleep I'm getting in the early morning. Do you feel devices like that are helpful?

Sara: We actually use the Oura Ring in my lab to remotely measure peoples' sleep in research studies. The thing is that they give you a number. It's not the same as what I would get if I was bringing you into a lab and I had polysomnography and I had electrodes on your brain and I was measuring your heart rate, and I could measure all these things from medical grade devices.

I think the Oura Ring, the reason why it is as good as it is is because they actually have done a lot of work to validate their algorithm to the medical grade polysomnography. They're doing as best as they can with the information that they have to get a sense of how many minutes are you in each sleep stage. I have found, I think in general, the information that you get from the aura that's good is how much you're sleeping. I think that that's probably pretty accurate.

There seems to be a lot of differences in terms of different skin color. It can really change how well the Oura Ring works because it goes through your skin. I am not totally convinced that that is the greatest measure right now. We are still in infancy in terms of getting good-at-home user-friendly **[00:16:00]** options. The Oura Ring does have a lot of benefits, and I do think it's a great device to use. I think that we still have a lot of work we need to do in order to get better devices.

Jane: For me, I know it's not completely accurate like if I would be in your lab, but it's heightened my awareness that I need to keep my bedtime steady every night. If I go to bed late, you immediately see it in your deep sleep. You've cut out this whole portion of your deep sleep opportunity, your downstate opportunity. Even though it's not completely accurate, it's raised my awareness that, "Hey, sleep's important and here's why."

Sara: Actually, the slow-wave sleep factor is probably the most accurate. The lighter sleep is where it doesn't do as well because slow-wave sleep is such a clear signal. It's very strong signal where your heart rate slows down enormously and you don't move very much. There's just a very big signal that the Oura Ring is picking up. Most of the time, that downstate sleep is detected by the Oura. It's more the light sleep, the stage 1, stage 2, and REM sleep that are not as accurate.

Jane: Yes. I've noticed that one of the things on the ring tracks heart rate variability, and I know in your book that something that you're really studying. Could you explain heart rate variability and parasympathetic and sympathetic modes?

Sara: Yes. HRV, it's a term that people throw around a lot, and I think it's really interesting to understand what it means. The idea is that all of our subsystems; our heart, our brain, our metabolism, all of these systems have a rhythm. When we're at our best is when we're aligning these rhythms so that all of the upstates happen at the same time and all the downstairs happen at the same time because then you really get this

resonance and a much more powerful signal in your heart rate, in your metabolism, in your brain activity. That concept is the **[00:18:00]** general concept of what HRV is.

You have your heart rate, which, of course, it's a beat to beat interval, but it also has a rhythms. It goes **[unintelligible 00:18:09]** Your heart rate actually speeds up and slows down. That has its own rhythm. Another rhythm is your respiration, your breathing. Usually, we breathe around 10 to 15 breaths a minute in regular conversation, which is actually very fast, and it's much faster-- It's a faster rhythm than our heart rate, which is fast, fast, fast, slow, slow, fast, fast, fast, slow, slow.

Heart rate variability, what that is is basically bringing your heart rate and your breathing rate into alignment with each other so that the speeding up of the heart rate is matched with the deep inhale. Your heart rate gets to gobble up all the oxygen out of your lungs, and then when it's gathered up enough oxygen, your lungs are also empty of oxygen and the heart rate slows down because that makes it a more efficient system. The way that you do that is you slow down your breathing.

You slow down the breathing. You get your breathing to be about six breaths a minute, which is a five-second inhale, five-second exhale, and what you find is your heart rate variability becomes much larger. You have this really big boost in heart rate variability because you've brought your lungs and your heart into alignment with each other. How that affects your body is that this deep breathing, this slowing of the breath is controlled by this very restorative system called the parasympathetic nervous system, which is the rest and digest system of your body.

When you bring your heart and lungs into alignment with each other with this slow, deep breathing, you're increasing HRV, which means that you're increasing your **[00:20:00]** parasympathetic activity. That is the most restorative system you can engage for getting into the down state. People who practice HRV, when they practice getting their HRV higher and higher, what they're doing is they're bringing more alignment between their heart and their lungs, but they're also showing really big increases in frontal lobe capacity in terms of executive function because the white matter in your brain actually increases and you show a lot more calm, a lot more emotional control, a lot more emotional stability as well. There's a lot of downstream benefits to increasing that parasympathetic activity by this breath control work.

Jane: Is there a method or way to help train your body to breathe more slowly? I'm really trying hard to do the five seconds in and even a longer exhale sometimes, but you have to be thinking about it. My body doesn't naturally want to do that. How can I train my body to do that?

Sara: Yes. Just taking the time to do a slow meditation of five-second inhale, five-second exhale for about 10 seconds a day, that's just you being on your own, but

there's also this HRV biofeedback, where you can download an app and use a device that allows you to track how well your breathing and your heart rate are aligned with each other. The system that I often recommend and we've used in my lab is called HeartMath, heart and then math. They have an app that is not that expensive. Allows you to practice your HRV training with visual stimulus that allows you to see feedback like, "How well am I breathing?"

Jane: I love HeartMath.

Sara: "How well is my heart and lungs aligning with each other?"

Jane: It gives you such good feedback. You know right away, "Oops, I'm messing up." Good suggestion. This audience is really specifically concerned about preventing cognitive decline. Sleep **[00:22:00]** is important for that part. Variability is important for that. What are your thoughts on why it's imperative that we get a handle on this so that our brains will stay healthy.

Sara: Sleep is important in two different timeframes. One is on the daily basis. The other one is on a long term basis, which is that prevention of these memory pathologies. On a day-to-day basis, what happens is when you are just being you out there upstating during your day, dozering, your brain is using a lot of chemicals, is using a lot of neurotransmitters, is doing a lot of neurotransmission, and it creates these little proteins from neurotransmissions that then accumulate in your brain. These proteins are just byproducts and they're not actually helpful. What slow-wave sleep is doing on a nightly basis is cleaning out the brain from these toxic proteins.

When you have really good slow-wave sleep, you see these waves of flushing, that are flushing these chemicals through the cerebral spinal fluid and out of your brain. That's really important. This is why the idea of catching up on sleep on the weekend, it doesn't actually work that way because the buildup of these proteins happens on a daily basis. If you try to push your sleep to just sleep on the weekend, what you're doing is you have just a greater accumulation of these proteins that can't be caught up on the weekend. A lot of the time catching up on weekend sleep means that you're sleeping in in the morning, which is actually not when you're going to get your slow-wave sleep anyway.

That idea of this short-term banking your sleep till later doesn't work. The reason why it also doesn't work is that these proteins, if they're not flushed out, build into the plaques and tangles that **[00:24:00]** become part of Alzheimer's and dementia. This is why there's very important research coming out now showing that the sleep that you're getting, the amount of slow sleep that you get in your 40s and 50s can predict the onset of dementia and Alzheimer's in your 60s and 70s and 80s.

Some people are like, "Oh my God, you're making me to have so much anxiety about my sleep, that it's going to create this problem with me in the future," but I think knowledge is power, right? If you know that how I'm sleeping in my 40s and 50s and 60s is impacting my future brain health in my 70s and 80s, take care of whatever sleep disorder that you have. Go see a sleep doctor, make sure you're going to sleep early. Don't spend the night watching, like I did last night, too much Netflix, and so you didn't actually get to sleep early. It's a constant awareness of the fact that every night we can do as much as we can for feeling good in the next day, but also for our future.

Jane: One of the things I saw in your book was talking about fecal transplants on page 44.

Sara: I talk about fecal transplants a lot in the book.

[laughter]

Jane: Why'd you talk about that? You're a sleep doc. Why did you talk about the fecal transplants?

Sara: Because I have the humor of a four year old, I think, number one. Number two, I find that this idea that our guts are a second brain, that they are as important to our emotional health, to our physical health, as the information that's happening in our brains, and that we can show this via this fecal transplant research, where you get an animal and you completely dysregulate their circadian rhythms where they're jet lagged and their flight system is totally off and their circadian rhythms are totally off and they start to get sick because of this circadian dysregulation.

You can **[00:26:00]** then take a completely healthy animal who doesn't have any circadian dysregulation and you can take the poop of the unhealthy animal and put it in the body of a healthy animal and you can make that have gut problems because of the gut problems that were happening by the circadian dysregulation. It really shows the impact of our circadian rhythms on our guts and our guts on the rest of our bodies.

There's a very important loop between how we're sleeping, how well we're regulating our circadian rhythms, and how healthy our guts are. The gut is directly related to how our brains are processing. There's a lot of research showing that poor gut health is related to increased rates of mental illness and depression. What are we doing to really understand that relationship? I guess the reason why I put that in the book is because I find that we don't think enough about our gut health and how sensitive our guts are to how we're treating ourselves,

Jane: Especially in America. You probably have had prescribed to you multiple courses of antibiotics in your life for different things, since you were probably a little kid, I know I

have, and that just decimate the gut, to the point that, Sara, my gut's a mess. I've had antibiotics nearly every year since I was four and five. I made the decision to get a fecal transplant.

Sara: Oh, you did?

Jane: Yes. I'm going to be going next month.

Sara: That's so exciting.

Jane: I'm nervous. To the Taymount Clinic, which is about a 40-mile, I didn't know they don't measure it in miles, north of London.

Sara: Oh, wow.

Jane: It's a 10-day procedure, and my gut has been diagnosed with irritable bowel syndrome, IBS. I know in our country here in the US, we can only use it for C. diff, but over in the UK, they can use it for other problems too. That's why I'm going over there. Should I be asking these donors-- I get 10 different donors over 10 **[00:28:00]** days. Should I be asking them how their circadian rhythm is fairing?

Sara: Well, I think that the question is have they just banked the stool samples over many, many years? Are they getting them fresh in that moment? Because in that moment, then you really could say, "I'd like to know about the circadian health of these people." They are saying these people have healthy poop, and that's great. "They have healthy guts and here's their poop," but how much are doctors at all considering chronotherapy in terms of medical treatment? I think that that's severely underappreciated influence on our medical system.

There's so much research to show that our organs are turned on during sometimes in the day and turned off during other times in the day, they have up-states and downstate that make them more susceptible to metal treatments to have less pain, decrease suffering if we took note of what time we're giving medicine and what time we're giving operations. I think that the idea of these fecal transplant, for sure you should be getting them from people who are regular sleepers who have very strong, normal circadian rhythms.

Jane: Oh, thank you. That was not a question I was going to ask, so thank you very much.

Sara: Yes. That's a really good question.

Jane: Thinking about circadian rhythm, what you're seeing in people with full-blown Alzheimer's is a really messed up circadian rhythm. That may be because of a gut issue that could lead to that?

Sara: I think that there is not enough research into the gut-brain connection with these aging pathologies. I think that we don't know enough. Definitely, people who eat more fiber show lower rates of depression Alzheimer's. **[00:30:00]** They live more healthier lives. People who have a greater degree of super healthy diets, with a lot more fiber are the ones who are living past a hundred. There does seem to be a very strong relationship between our eating style and our mental health and our psychological health later in life. How that is related to our guts is a big question, I think is a really exciting new area of research.

Jane: Before we close, I have two more questions. What are you doing in your lab now, in your sleep lab at UC Irvine that's really exciting you when looking at the future?

Sara: The big project that we have-- There's two big projects that I'm really excited about. One is I have a grant to look at women across their menstrual cycle. We're getting blood levels of sex hormones and then having people come in multiple times during their menstrual cycle and measuring their sleep and their cognition and their autonomic nervous system. We're doing this in young women, midlife women around menopause, and older adults, post-menopause. I'm really excited by this idea of looking into the effect of sex hormones on all of these restorative systems that we have.

The other area of research that we're doing now too is we are using functional magnetic resonance imaging so we can look at brain activity during sleep. We have people sleeping in the scanner and we're able to look at how their brains process memories during sleep while they're getting their brain scan, so that's another fun area of research.

Jane: Very exciting.

Sara: Yes. Thanks.

Jane: Tell me about your own life. What do you do to make sure that you're getting what you need for your brain?

Sara: Yes. For me, I think a lot of it is regulating when do I exercise in the morning and to also when do I stop doing things **[00:32:00]** too? Like I stop eating, hopefully, around 8:00 PM and then I try not to eat at all after that to really give my metabolic system a rest. My wife is a real night owl. Sometimes when I'm with **[inaudible 00:32:12]** I stay up later than I want to, but what I try to do is get to sleep by like 10:00, 10:30 at night because then it really maximizes my opportunity for downstate, slow-wave sleep.

Then I also engage in meditation, take a 10-minute break and suddenly feel like, "Wow, I really was able to break from that stressful experience I was doing," and then I spend a lot of time in nature.

Jane: Great advice.

Sara: Yes. Thanks.

Jane: Dr. Sarah Mednick, thank you today for your time. It's just been delightful, this conversation. Thank you.

Sara: It's been a pleasure.

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