Psychology of Stress, Health and Well-Being
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Lecture 5
Stress Health and Non-Infectious Diseases

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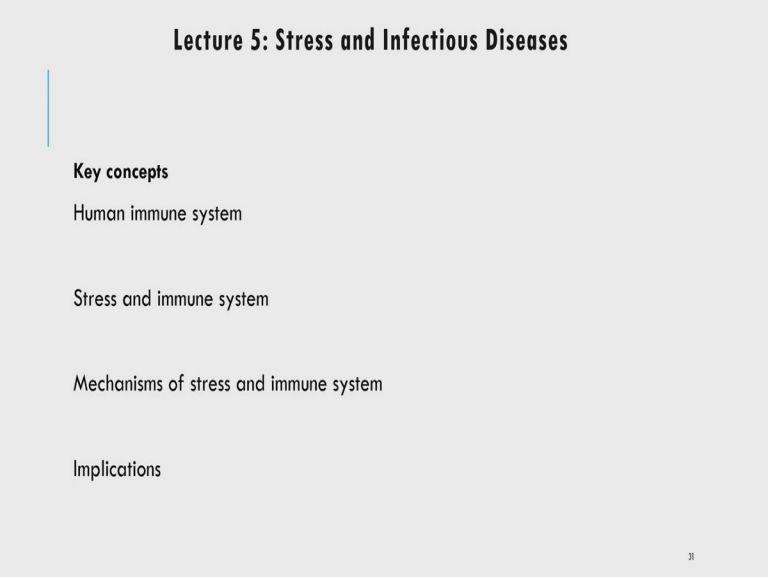

I welcome you all to the fifth lecture of this NPTEL MOOC course title Psychology of Stress Health and Well-Being. In today's lecture, we will talk about the concept of stress and infectious diseases. So, before we talk about today's lecture, let us have a brief recap of lecture number 4.

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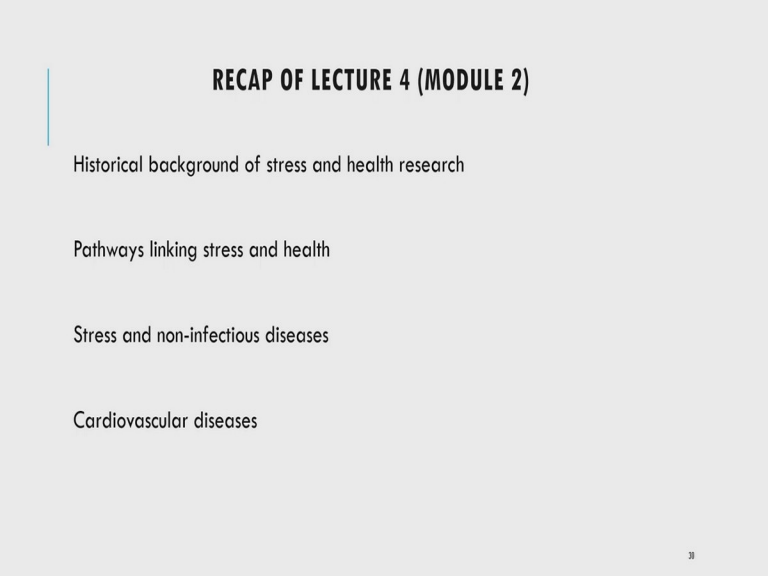

So, in the last lecture, we talked about the historical background of stress and health research. So, basically, we discussed how stress is connected to physical health particularly, and we have seen that stress can lead to various physical and mental health consequences, and we typically try to understand that this connection between stress and health can be understood from the mind-body interaction perspective where the idea is the recent researches have shown that mind and body are not separate entities rather they are kind of one unit constantly interacting with each other. So, we discussed how stress is linked to physical health in particular, and we've seen that stress can result in a variety of physical and mental health consequences. We tried to understand this connection between stress and health from the mind-body interaction perspective. We have discussed the idea that recent research has shown that mind and body are not separate entities but constantly interact with each other. And this mind-body interaction was very clearly evident when we have discussed the biological aspect of stress. It was very clear how the mental experiences of stress influence our brain and then brain in term influences various endocrine glands and secretes hormones, leading to other consequences.

In the context of this mind-body connection, we have also discussed psychosomatic diseases that are a category of diseases, where mental factors may cause or worsen physical symptoms. So, we have many diseases in such categories as heart diseases, diabetes, et cetera. Then we have discussed that there are branches of study like health psychology, psychoneuroimmunology, and mind-body medicine founded on the idea of mind-body interaction and connection.

We have also discussed pathways linking stress and health. Stress influences physical health particularly through two mechanisms; one is physiological mechanisms where stress causes various physiological changes and ultimately causes physical diseases. The other pathway is through behavioral changes, where people experience many behavioral changes under stressful circumstances, such as increasing unhealthy behaviors, decreasing healthy behaviors, changes in behavioral patterns such as sleep problems, issues with food intake, smoking, and alcohol intake, and other issues that are frequently associated with the stress and may further deteriorate physical health. So, these are primarily two mechanisms that can influence health specifically when we are undergoing stressful circumstances.

We have then discussed how stress is connected with the non-infectious diseases where diseases which happens because of some malfunctioning in certain organs of our body and in that context

we have discussed cardiovascular diseases, which are primarily connected with stressful experiences. Stress causes various wear and tear because of frequent fight and flight responses. It may cause wear and tear in the muscles of the heart and excess release of the stress hormones and cholesterol that may cause atherosclerosis, which is basically blockage of the arteries of the heart. Furthermore, certain behavioral changes such as eating unhealthy foods can lead to cardiovascular diseases, particularly heart diseases.

We have also discussed type A and B in this context. Type A people are typically highly competitive, achievement-oriented; there is a sense of time urgency; they may also have anger, especially suppressed anger and hostility. So, because of the typical characteristics of type A people they are more likely to experience stress as a result research shows they are more vulnerable for stress-related diseases such as heart disease. Type B people are just the opposite, they are very easy going and relaxed people.

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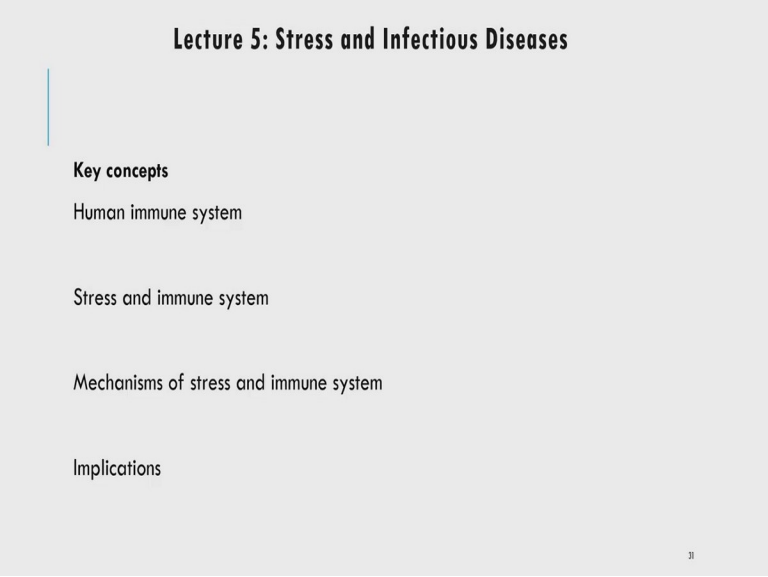

In this lecture, we will discuss the concept of the human immune system, how stress is connected to the immune system, the mechanisms of stress influencing the immune system, and the implications of this research or findings. So, we will look into all these things in today's lecture.

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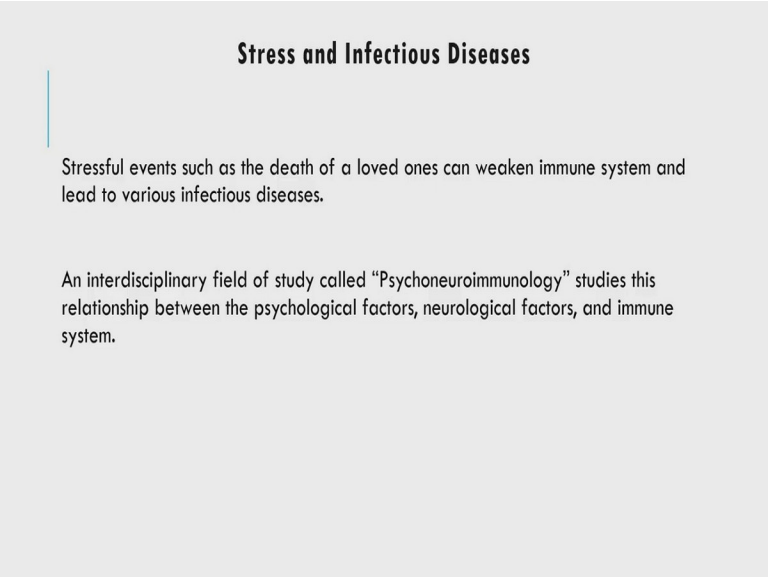

So, infectious diseases as we have already discussed in the last class is basically that category of diseases that are caused by external agents such as bacterias and viruses and they particularly influence our immune system. So, if your immune system is strong, you may be less influenced. Still, if your immune system is weak, then they are more likely to influence our body and cause diseases. These are mostly communicable diseases in the sense that this kind of disease may get transform from one person to another person because it is basically caused by external agents who can be transferred from one person to another person. So, that is why they are called infectious diseases or communicable diseases. Now, stress can influence infectious diseases by influencing our immune system. So, an interdisciplinary field of research or field of area of research called as psychoneuroimmunology, particularly looks into this relationship between psychological factors, neurological factors and immune system,. It looks into how psychological factors influence our nervous system and how the nervous system influences the immune system.

So, they try to see all these relationships. So, this area of research is very important to understand the connection between stress and immune system. Interestingly the birth of this whole area of research called psychoneuroimmunology was an accident.

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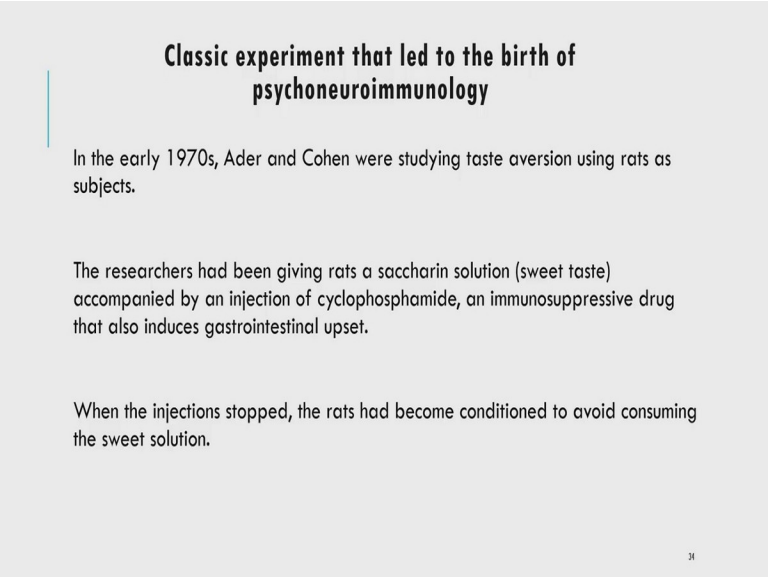

So, in the 1970s, these two individuals, Ader and Cohen, were conducting a classical conditioning experiment in which they studied taste aversion in rats. So, before we get into the details of this study, let me give you a brief introduction of classical conditioning so you can understand what it is and how it contributed to the birth of psychoneuroimmunology.

So, classical conditioning is essentially learning through associating, or, to put it another way, learning by association. A lot of learning occurs through associating two things, and by associating two things, you can learn a new response, which is referred to as a conditioned response. So, you'll understand, I'll just discuss briefly the experiment that was conducted by Ivan Pavlov, the Russian physiologist who first discovered the classical conditioning phenomenon, and he was initially doing experiments with dogs, and how he came to this conclusion was also fascinating.

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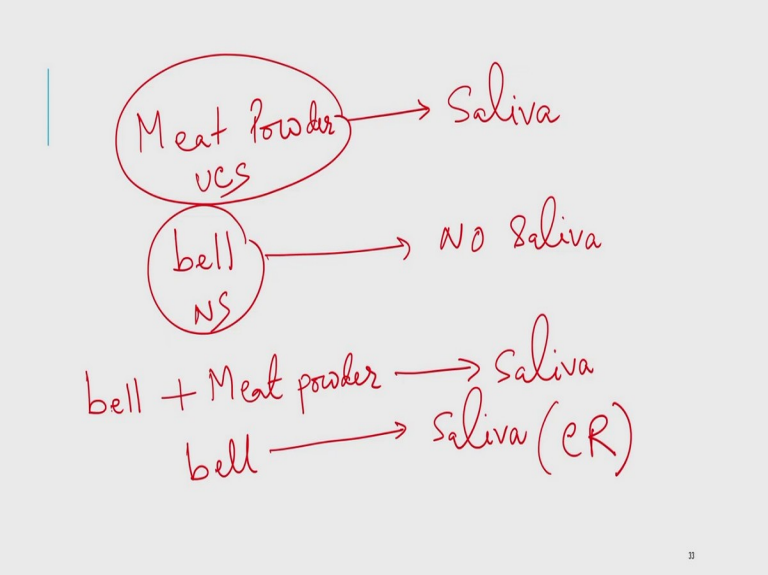

So, he was doing research with dogs on physiological aspects of dogs, and what he discovered in the experiment was that if you offer a good food, food that is for example in the sense of dogs, let us say meat powder, when a dog sees meat powder, the normal answer is saliva production in the mouth.

So, meat powder is an unconditioned stimulus, meaning that it is not conditioned, but rather a natural reaction that occurs, hence the name. Now, what Pavlov did was add a neutral stimulus, such as the sound of a bell. Since this is a neutral stimulus, if you simply create the sound of a bell in front of a dog, it will not react in any way; it is a neutral stimulus, and the dog is unconcerned about the sound of the bell.

Since no saliva is produced, this is a neutral stimulus, as it does not elicit any particular reaction. Now, what he did was he combined these two stimuli again and again to see what happened, so he produced bell plus, so he connected these two stimuli one is sound of bell and immediately after that he produced meat powder, so by saying meat powder the dog produced saliva in its mouth, and the dog was salivating.

So, after a few trials of association, they discovered that simply producing a bell or hearing a bell caused the development of saliva in the mouth of the dog, which was not the case prior to conditioning; prior to conditioning when the sound of the bell did not produce any response in terms of saliva production.

As a result, this is referred to as conditioned respond, conditioned response. As a result of classical conditioning and learning by associating two items, this is a new learned response. So, before conditioning, the sound of the bell did not induce saliva development because it did not stimulate the dog's taste buds, but when meat powder was repeatedly paired with the sound of the bell, the dog learned a new response that the sound of the bell signals the arrival of meat powder, which signals the production of saliva in the dog's mouth.

As a result, merely hearing a bell without producing meat produced the same response as meat powder, indicating that it is a new learned response that occurs as a result of the association of two stimuli. The dog learned a new response that involves producing saliva in response to a neutral stimulus. As a result, this is referred to as a conditioned or newly learned response. As a result, this is a broadening of the classical conditioning model, which occurs in human lives as well. For example, many fear reactions that we learn are kind of linked with learned through association.

So, for example, if you were involved in a car accident, there is a chance that the next time you ride in a car, you will have a fear reaction because you have learned to associate cars with accidents. As a result, many fear reactions in people's lives can be classically conditioned.

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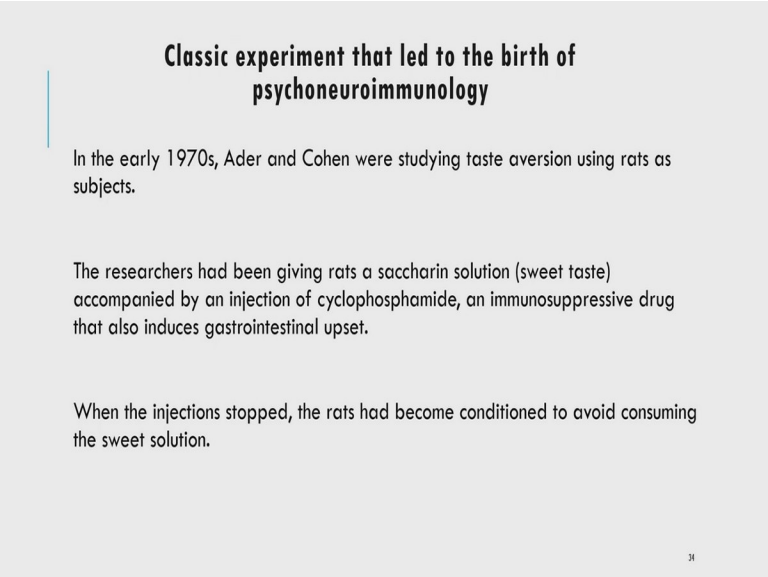
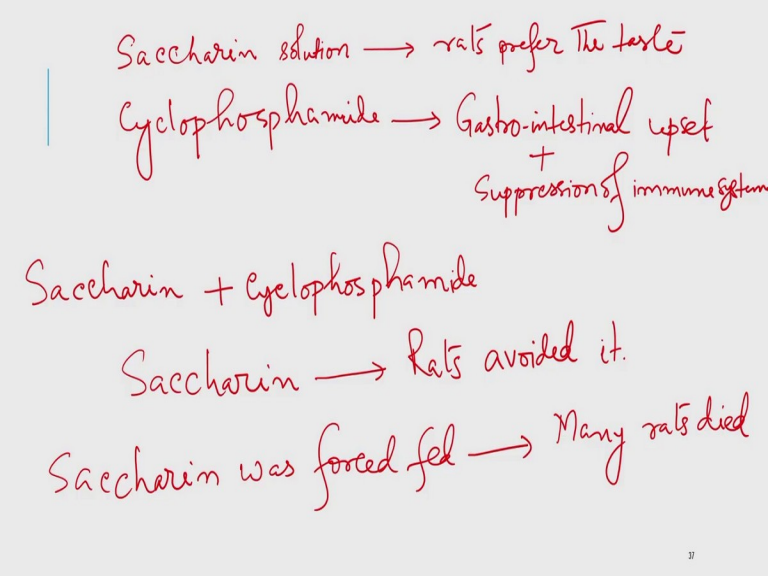


So they were doing a similar experiment with rats to see if the rats had any taste aversions. So, this was the experiment that had nothing to do with the immune system or something like that. So, the researchers gave the rats a saccharin solution. Saccharin solution is essentially a sweet sugar solution that is sweet test, and it is normally produced in such a way that if given to a rodent, it would love to drink it.

So, they were attempting to create a test aversion to saccharin, which the rats usually preferred, so I'll just draw it in a diagram and then we'll talk about it. So they gave the rats saccharin solution and then injected them with a chemical called cyclophosphamide, so they gave the rats saccharin solution and then injected them with this chemical, which had two effects: one, it caused a gastrointestinal upset, so they felt like vomiting, and the other was that it caused a drug-induced gastrointestinal upset, so they felt like vomiting, and those kinds of intestinal upset was created by this drug and there was another effect of this drug was that this drug used to suppress immune system to some extent.

But, when the rat was given this saccharin solution along with the drug injection, they learned a new response, that saccharin, which they previously preferred, was now associated with a drug that caused stomach upset, and they learned to avoid saccharin solution because of the association with a drug that caused stomach problems. So, let's see it in more detail. (Refer Slide Time: 18:05)



So, if you offer a saccharin solution to a rat, they usually enjoy the taste of it. When that was the case, this was a natural reaction. Now, another thing was a drug named cyclophosphamide, which does two things: one is gastrointestinal upset and the other is immune suppression. But when the researcher mixed these two stimuli (saccharin and drug) again and again, this was a kind of classical conditioning; initially saccharin solution rat liked it, but now when it was combined with a drug that causes stomach upset the rat learned to avoid it.

So, this is a classic conditioning or taste aversion study, and this is what they did. Interestingly, they discovered, by an accident, that when this saccharin was forced fed, that is, in order to complete their study procedure, they forced fed them using a dropper. The interesting thing was that many rats died after this force-feeding procedure, which was an unusual finding because how could a rat die just by feeding saccharin? So they hypothesised that this saccharin was conditioned not just to the gastrointestinal upset, but also the other effect of the drug, which was suppression of immune system.

So, it's likely that the rat was also classically conditioned to the drug's suppression of the immune system, and that saccharin was conditioned to the role of the drug's suppression of the immune system. As a result, many rats died when saccharin was given or forced fed, and the number of deaths was proportional to the amount of solution given; the higher the amount given, the higher the death rate. So, it was hypothesized that not only gastrointestinal upset but also immune suppression was conditioned to saccharin, and that when saccharin was given to them, force fed to them, there was a signal in the brain or nervous system of the rat, which suppressed the immune system, which was previously suppressed by that drug, so by classical conditioning, saccharin was almost acting like the drug with immune suppression effect.

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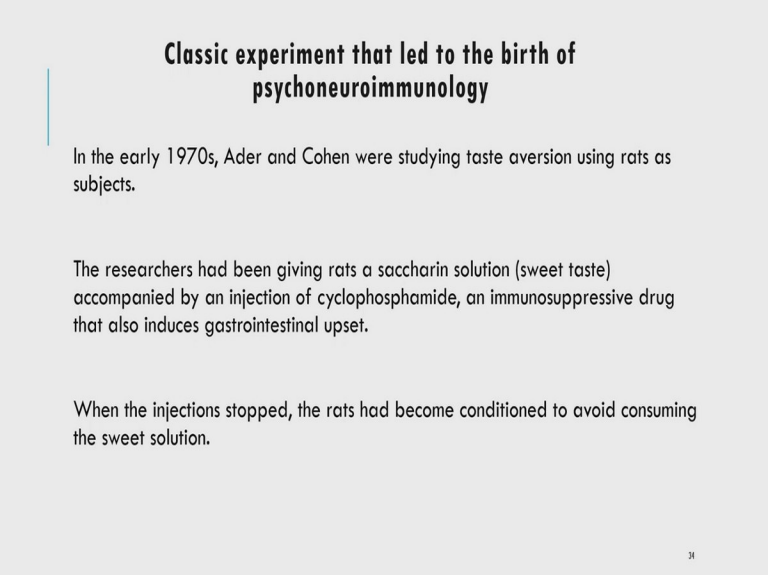

Now, you should be able to comprehend some of what is written in the slide. So, the researchers were giving rats saccharin solution, which was a sweet test, along with an injection of cyclophosphamide, which had an immunosuppressive effect as well as causing gastrointestinal upset, and when the injection was stopped, the rats began to resist eating the sweet solution. As a result, when it was stopped, the rat learned to resist it due to its connection with the drug.

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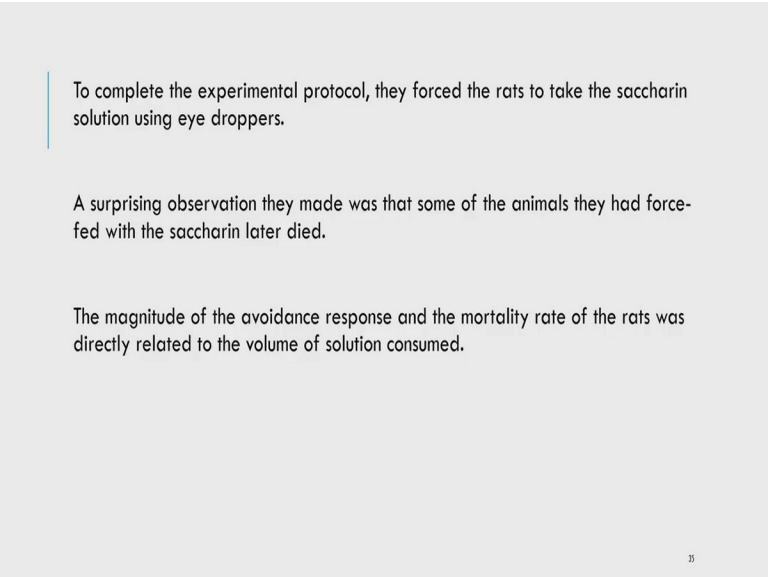

To complete the experimental protocol, the researcher used eye drops to compel the rat to drink the saccharin solution. Unexpectedly, they discovered or observed that some of the rats who were force-fed died solely from the saccharin solution.

They also discovered that the size of the avoidance response and the rat's mortality rate is proportional to the amount of solution ingested. As a result, as the amount of the solution used to force feed them increased, so did their avoidance response and the mortality rate.

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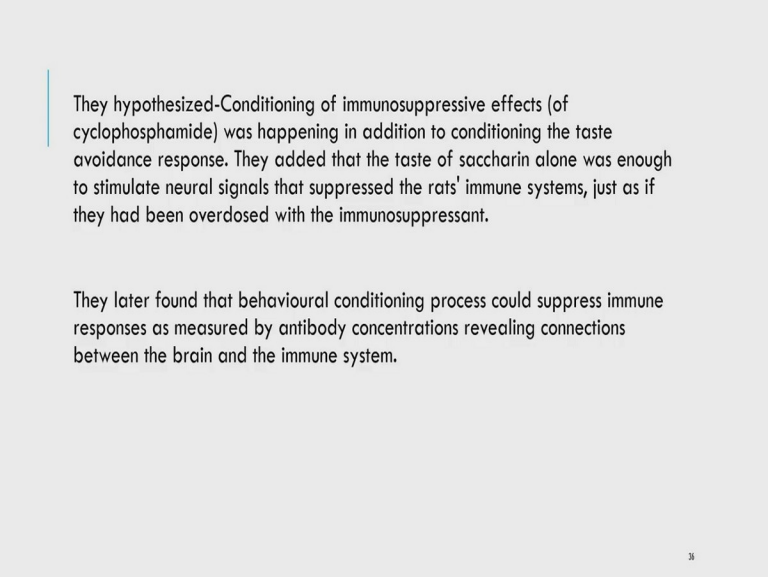

As a result, they proposed that immunosuppressive effect conditioning occurred in addition to taste avoidance response conditioning. As a result, there was a kind of conditioning effect. So they added that only the taste of saccharin was enough to activate neuronal signals that suppressed the rat's immune system, as if saccharin was acting as if they had been given a high dose of immunosuppressive drugs. Later it was discovered that behavioural conditioning can suppress immune response as measured by antibody concentrations, revealing links between the brain and immune system. They also discovered that psychological factors, especially negative emotions and stress, can signal the brain to suppress immune response, revealing connections between the brain and immune system. W e will now see some of these findings.

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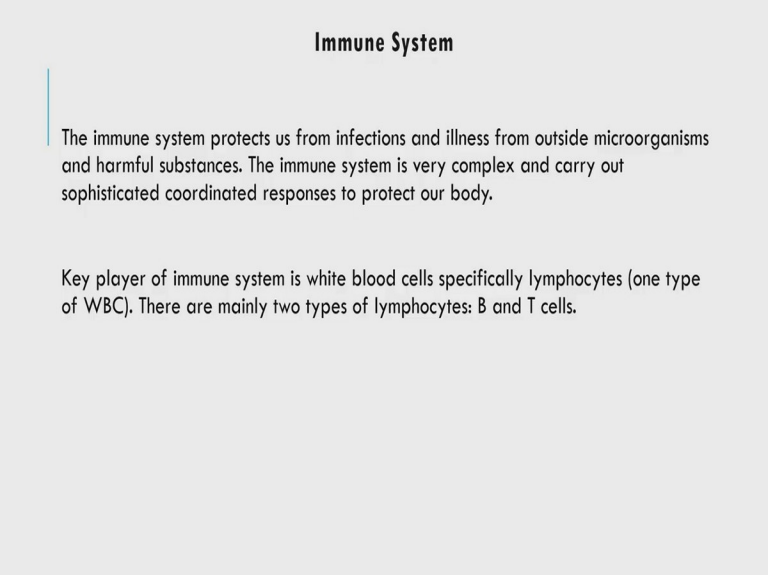

But, before we get into how stress affects the immune system, let's have a look at what the immune system is all about. As a result, the immune system essentially protects us from infections and illness caused by external microorganisms. As a result, it is a form of body defence mechanism. So, it protects our bodies from microorganisms and harmful substances that enter our bodies, and the immune system is extremely complex, especially in the human body, and it is a highly organised system.

White blood cells, are important players in the immune system. So, white blood cells, also known as lymphocytes, are mainly responsible for the immune system of the body. Lymphocytes are one form of white blood cell that plays a key role in our immune systems. So, there are specifically two types of lymphocytes: B cells and T cells, both of which serve the immune system in defending our bodies from foreign invaders. So, let me just illustrate for a moment.

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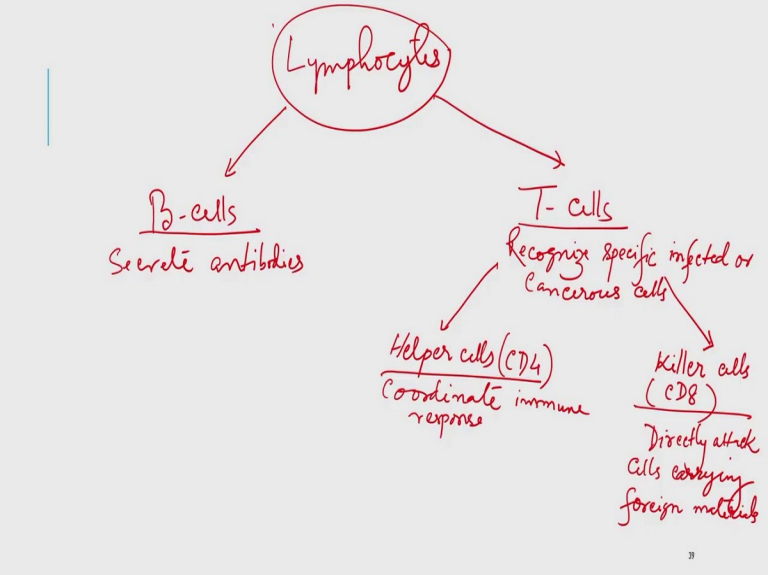

So, we have white blood cells, or lymphocytes, which have two distinct cells: B cells and T cells. B cells secrete antibodies, whereas T cells recognise specific infected or cancerous cells. B cells create antibodies in response to antigens or external agents, and antibodies are basically produced in the body. T cells are more specialised when it comes to identifying infected and cancerous cells, as well as fighting them. T cells are divided into two categories: helper T cells and killer T cells. Helper T cells are also known as CD4 cells, whereas killer T cells are known as CD8 cells. As a result, helper T cells basically organise immune responses, while killer T cells target cells carrying foreign materials directly.

So, these are the major immune system cells that are responsible for immune functions, primarily the lymphocyte component of white blood cells, and they have two types of cells: B cells, which secrete antibodies in response to external agents to fight with, and T cells, which recognise specific cells such as cancerous cells or infected cells. And T cells are divided into two types: helper T cells, which organise immune responses from various parts of the body by sending messages and coordinates, and killer cells, which target infected cells carrying foreign harmful material directly.

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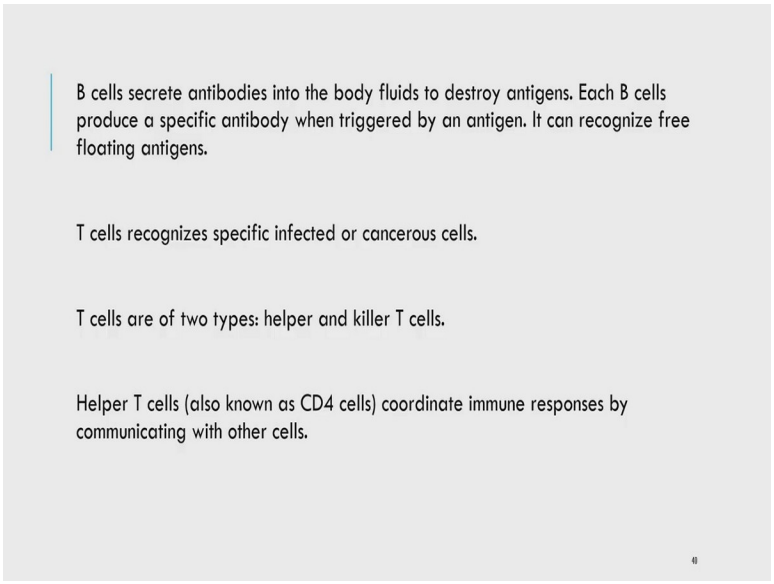

As we previously discussed, B cells secrete antibodies into the body fluids to kill antigens. Each B cell produces a particular antibody in response to an antigen, allowing it to identify free-floating antigen. T cells identify particular infected or cancerous cells, and there are two types of T cells: helper T cells and killer T cells. Helper T cells, also known as CD4 cells, organise immune responses by interacting with other cells, and they do so for the purpose of coordinating anywhere, whatever resource is needed.

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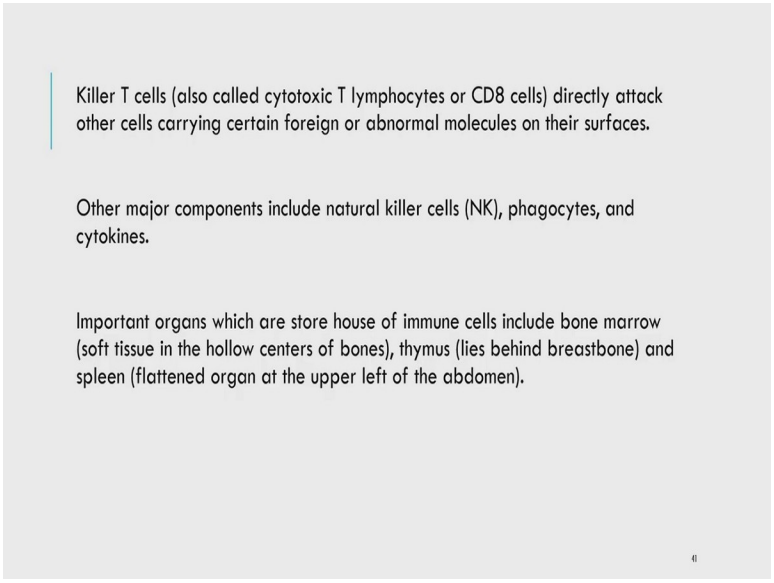

Killer T cells, also known as cytotoxic T lymphocytes or CD8 cells, destroy other cells specifically if they have any foreign or irregular molecules on their surfaces. Natural killer cells,

phagocytes, and cytokines are other major components of the immune system. We won't go into detail about these, but they are important components.

Bone marrow (soft tissues inside bones), where the bulk of the immune cells are concentrated, thymus, another organ that lies behind the breastbone, and spleen, which is a flattened organ at the upper left of the abdomen, are important organs where these are the storehouse of immune cells. Thus, bone marrow, thymus, and spleen are the organs in our bodies where immune cells are mainly concentrated.

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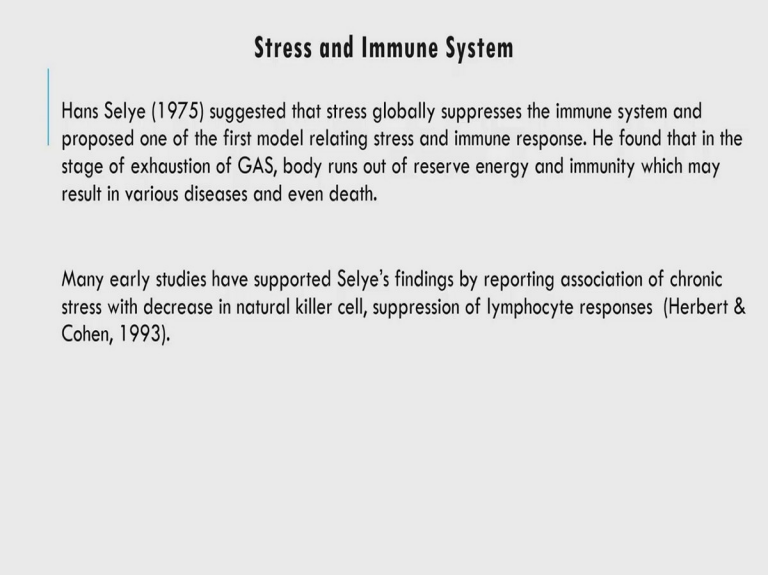

Now we'll discuss some of the research results on stress and the immune system. So, as we've seen in the discussion of general adaptation syndrome, Hans Selye proposed that stress actually globally suppresses our immune system, globally meaning all functions of the immune system, and he found that in the stage of exhaustion, which is the third stage of general adaptation syndrome the body runs out of the reserve energy and immunity is deteriorated. So, in the 1970s, Hans Selye discussed how stress affects the immune system, especially when chronic stress is present and the immune system deteriorates into the third stage of exhaustion. So, several early studies supported Selye's findings, reporting an association of chronic stress with a decrease in several immune cells such as natural killer cells and suppression of lymphocyte response, implying that stress suppressed different immune functions or cells.

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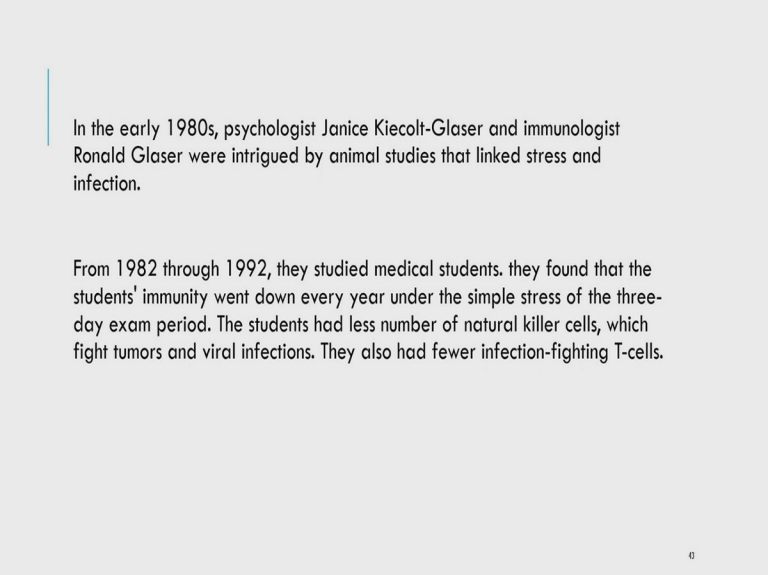

Janice Kiecolt-Glaser, a psychologist, and Ronald Glaser, an immunologist, conducted another type of study in the early 1980s that quite clearly reflects how stress can influence our immune system. They were doing research with animals initially and they got intrigued by those researches that link stress with infection that how infection increases under stress.

So, they did a lot of research in that area, and from 1982 to 1992, or ten years, they studied medical students and discovered that, under the simple stress of the three-day exam period, students' immunity went down every year. They also discovered that, during the period of their exam, especially the three-day exam period, immune systems of most of the students went down. Natural killer cells, which combat tumours and viral infections, were found to be in lower numbers in students. They also had fewer infection-fighting T cells. When people are stressed, particularly during exam time, their stress levels spike, and they discovered that many immune cell functions are inhibited as a result.

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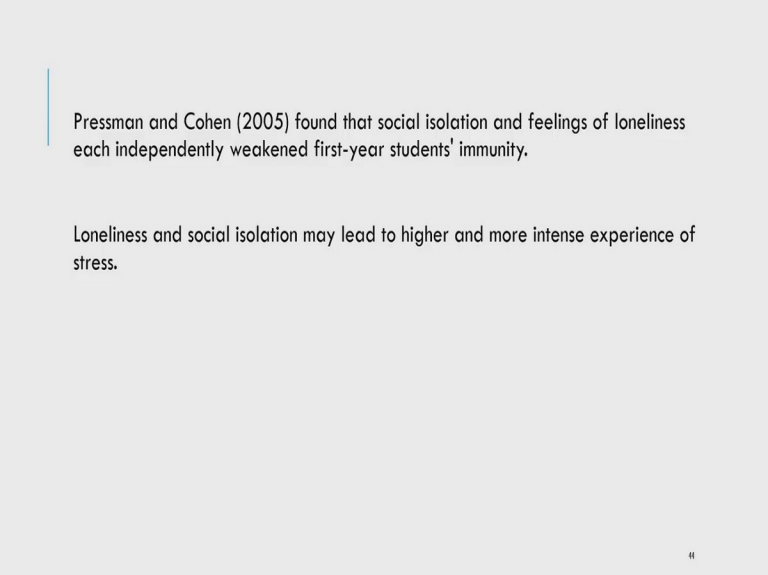

Another research published in 2005 by Pressman and Cohen found that social isolation and loneliness both weaken first-year students' immunity. So, first year students generally experience social isolation as they may not have too many friends and may experience social isolation and feelings of loneliness which can actually weakened their immune system. We also know that social support is really important in terms of stress reduction, so it is an important coping strategy that we will address in the upcoming lectures when we discuss coping strategies. As a result, loneliness and social isolation are often linked to higher levels of stress and a greater number of stressful situations. So, in this study, the researchers checked students' social networks, and they also took their saliva samples for measuring levels of stress hormones, especially cortisol, which can be measured from the saliva sample. They discovered that having a small network and loneliness both weakened immunity and also the immune response. And it was perhaps the most obvious thing for first-year students because, when they first arrived, their social networks and social support systems were probably limited, so all of this increased their stress and, as a result, their immune system decreased.

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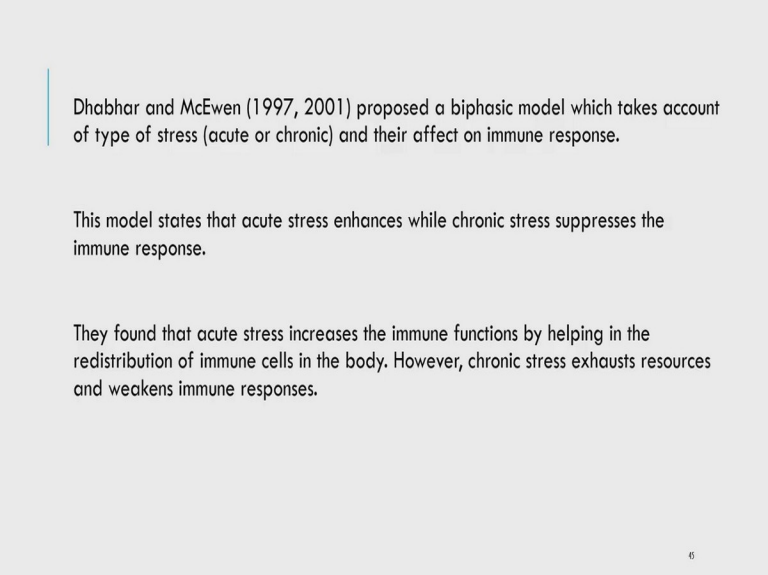

Now, several studies have been conducted, and a lot of research was opened in the 1980s and 1990s, especially after Glaser and Glaser and Hans Selye's findings. Dhabhar and McEwen proposed a model based on findings from various researches, the model called biphasic model, which takes into account different types of stress and how different types of stress affect different types of influences immune response.

So, according to this model, acute stress enhances the immune system while chronic stress suppresses it. So, according to this biphasic model, acute stress is short-term stress, such as when you see a danger or a threat and experience the fight or flight response, so in that phase, the immune system actually increases in the body, which is done by redistribution of immune cells, the body gets ready and redistributes immune cells throughout the body and enhances the immune system.

However, when stress is persistent for an extended period of time, such as weeks or months, such stress is the primary cause of immune system suppression. As a result, chronic stress depletes resources and compromises the immune system.

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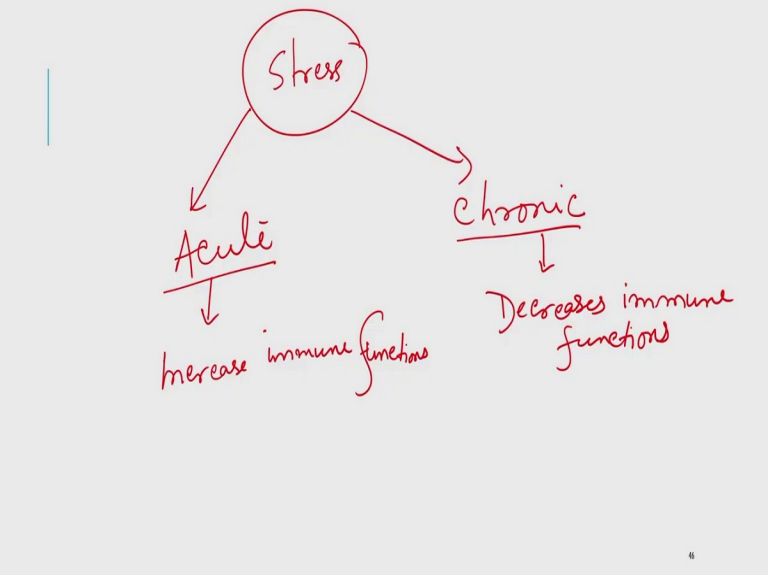

So, if you only look at it, we've talked about it before, and we can divide stress into acute and chronic stress. So acute stress seems to increase immune functions, while chronic stress seems to decrease immune function. This was a kind of general finding they discovered that depending on the type of stress, immune functions can have a different effect.

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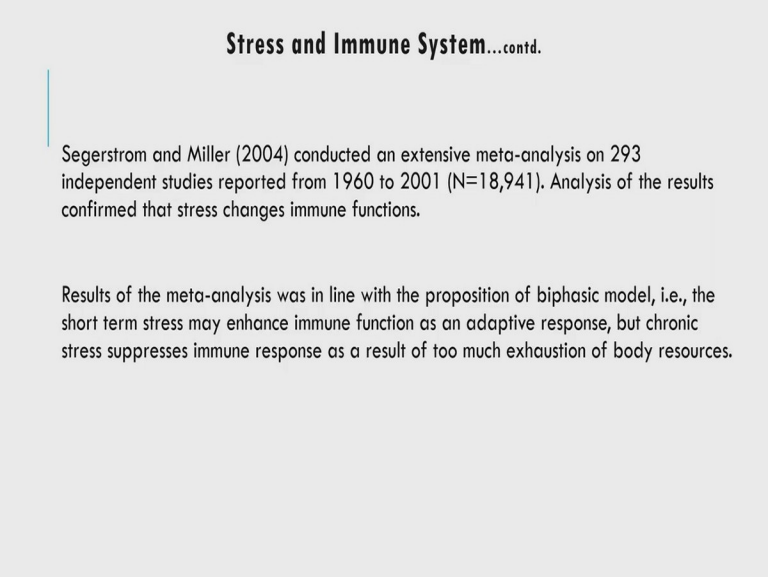

Furthermore, in 2004, two researchers, Segerstrom and Miller, conducted a comprehensive meta-analysis. So, a meta-analysis is simply an analysis of studies that have already been conducted, so it is an analysis of the analysis, which is why it is called a meta-analysis. So, there are approximately 293 independent empirical studies that have identified a connection between stress, health and the immune system, and they were conducted between 1960 and 2001.

So, these were the studies they gathered, and they analysed all of them to see what direction the findings were heading in. The findings of the meta-analysis supported the biphasic model's hypothesis that short-term stress, or acute stress, can actually enhance immune function as an adaptive response, while chronic stress suppresses immune function due to excessive exhaustion of body resources. As a result, the findings were consistent with the proposed biphasic model.

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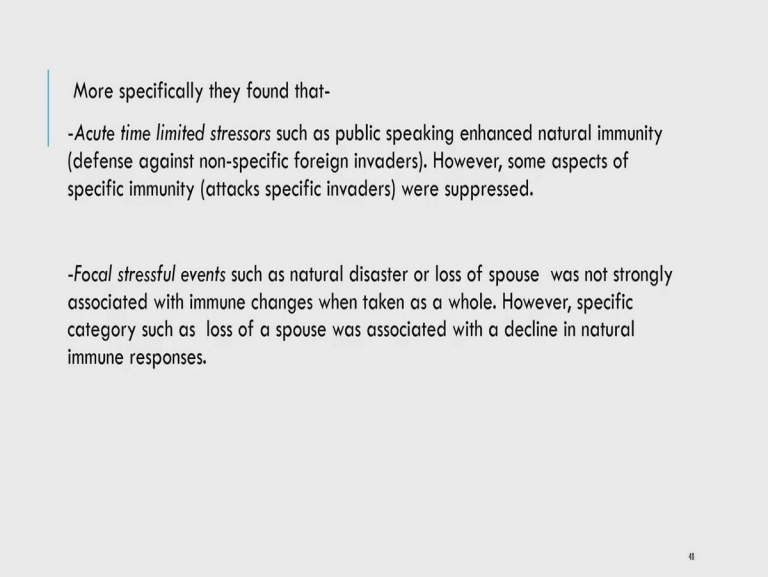

However, they found that acute time-limited stressors, such as public speaking enhance natural immunity, which is the defence against nonspecific foreign invaders. So general immunity was enhanced by such activities, but certain aspects of specific immunity that attack specific invaders were suppressed. As a result, while general natural immunity was boosted, some specific immunity was suppressed by acute time-limited stressors like public speaking. They also discovered that while focal stressful events such as natural disasters or the loss of a spouse were not strongly associated with immune changes when considered as a whole, specific categories such as the loss of a spouse was associated with decline in natural immune response. Overall, there was not a strong link, but it was linked to a decrease in natural immune response with specific events such as natural disasters.

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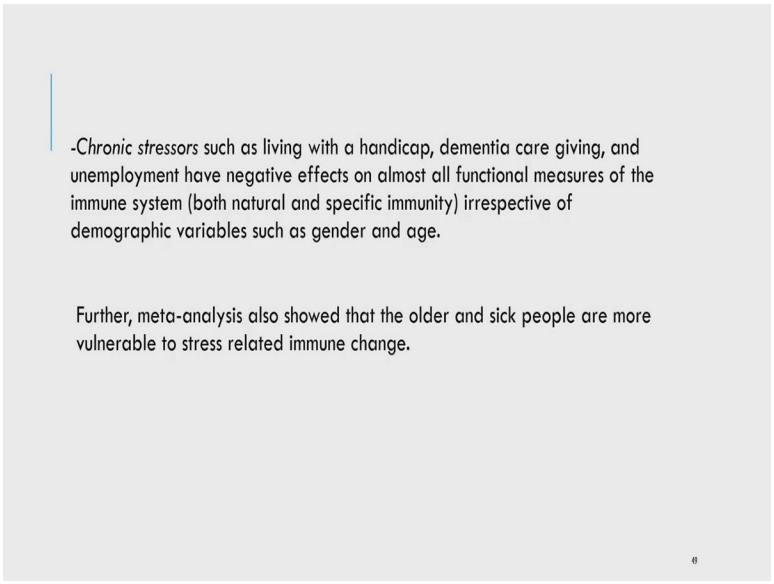

And it has been discovered that chronic stressors such as living with a handicap, dementia caregiving, and unemployment have negative effects on almost all measures of immune functions, both natural and specific immunity, irrespective of demographic variables such as age, gender, and so on. So chronic stress is the category that is most damaging to our immune system. This meta-analysis also revealed that people who are older or sicker are more susceptible to stress-related immune changes. And, since the immune systems of older and sick people are already weakened, they are not performing at their best; any more changes or declines in that system can be disastrous in terms of health.

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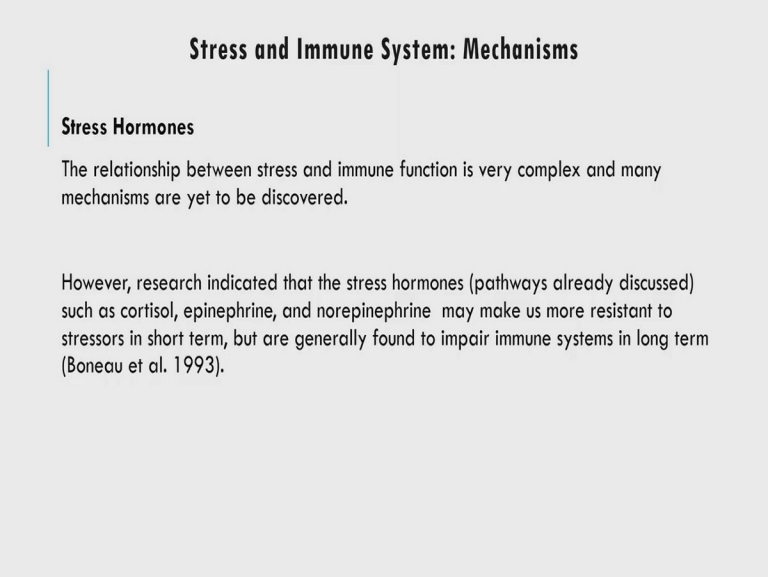

So, research has shown all of these results, and it is clear that stress has an effect on our immune system. The question now is: what are the mechanisms by which stressful situations or experiences affect our immune system? So, one obvious finding is that stress hormones are the connecting mechanism between stress and immune function. The relationship between stress and immune function is obviously very complex, and we really don't know much about it, but what we do know suggests that there is an effect.

And several mechanisms are still unknown, but research has shown that stress hormones and the pathways we've already discussed in detail, such as cortisol, epinephrine or adrenaline, and norepinephrine or noradrenaline, can make us more resistant to stressors in the short term, such as acute stress, and can enhance immune function to protect the body, but they can also impair immune function in the long term especially chronic stress.

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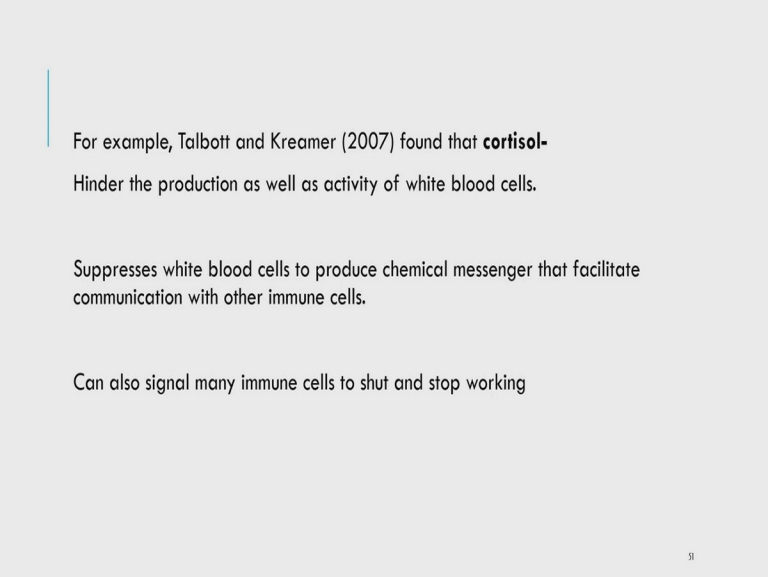

For example, Talbatt and Kreamer in 2007 discovered that cortisol inhibits the production as well as the activity of white blood cells, preventing all immune function cells from working properly, and cortisol, as you might remember, is released in response to chronic stress. Cortisol then suppresses white blood cells. Furthermore, it also inhibits immune functions by suppressing communication between immune cells. Cortisol may also signal several immune cells to shut down and stop functioning. As a result, it has the ability to shut down as well as reduce their production and function. These are some of the signs that stress hormones could be linked to immune function suppression.

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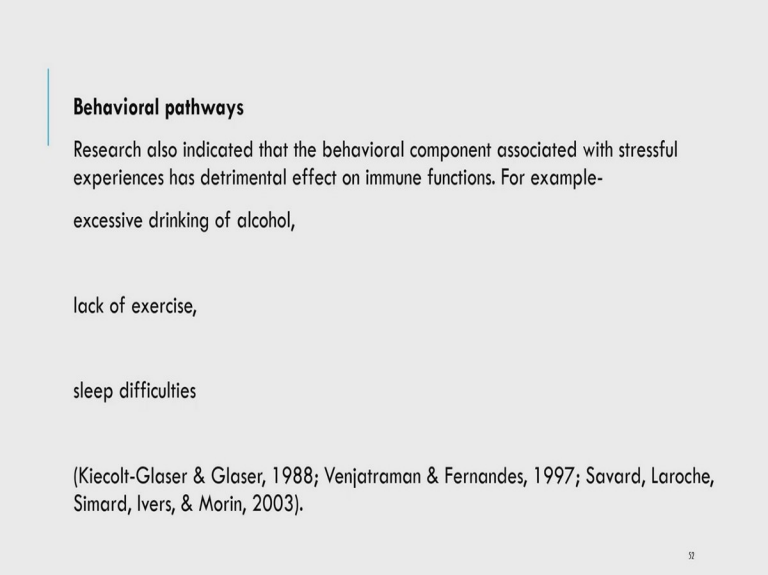

Apart from these hormones, there are behavioural pathways. Research has shown that a behavioural component that is always associated with a stressful experience may have detrimental effect on immune functions, especially behavioural aspects of stress such as excessive alcohol consumption, lack of exercise, inactivity, and sleep difficulties. As a result, stress can either directly reduce or inhibit immune function by releasing stress hormones or indirectly by causing behavioural changes that have a negative impact on immune function.

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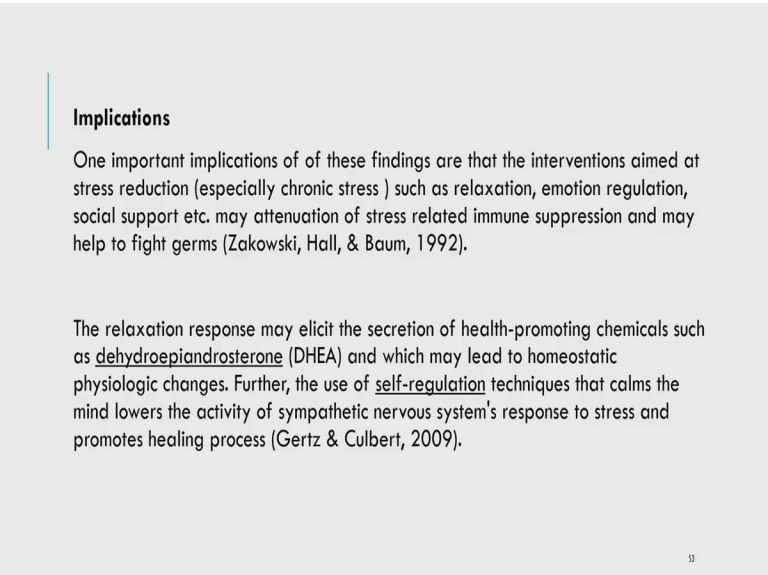

So, what are the implications of these results from research? So, one thing is clear: stressful situations lower immune immune function, so if that's the case, one implication of this finding is

that if you do anything or use an intervention that lowers stress or relaxes us, or any intervention that increases the relaxation response, since relaxation is the polar opposite of stress, and if stress lowers immune function, then increasing the relaxation response should increase immune function.

In fact, several studies have begun to point out research in this direction. One significant implication is that interventions aimed at stress reduction, especially chronic stress, such as relaxation, emotion-regulation, social support, and so on, could actually increase immune function in terms of fighting germs.

And some research suggests that the relaxation response can actually elicit or induce the secretion of some health-promoting chemicals, such as DHEA (dehydroepiandrosterone). So the relaxation response secretes such beneficial chemicals, and that the use of self-regulation techniques that calms the mind lowers the activity of the sympathetic nervous system response to stress and promotes healing process. . So, the relaxation response seems to have a positive effect on our immune system.

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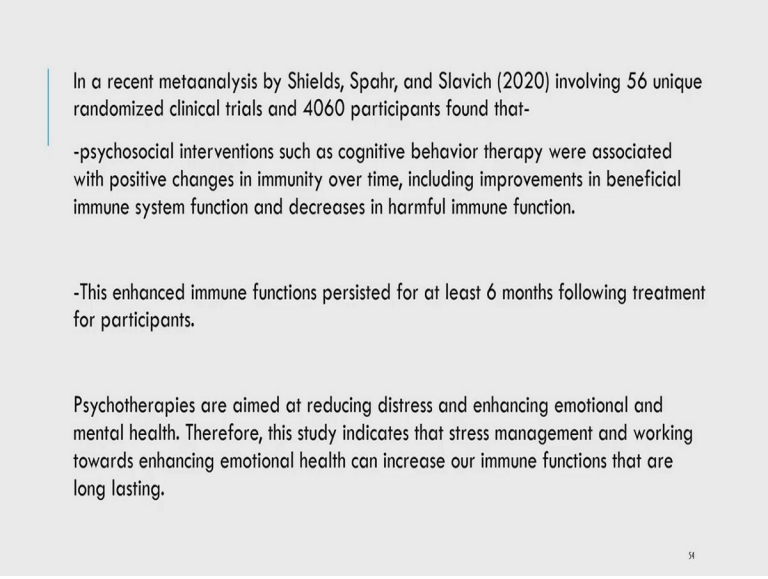

For example, just this year, a meta analysis was conducted on 56 studies or randomised trials of over 4000 participants, and they discovered that psychosocial interventions including cognitive behaviour therapy were correlated with significant changes in the immune system over time, including improvements in beneficial immune system functions.

So, it seems that, at the very least, any intervention to relieve stress and improve our mental and emotional wellbeing will potentially improve immune function, as shown by a meta-analysis and numerous studies. And this boost to the immune system isn't temporary; it lasted at least 6 months after the patients received the treatments. As a result, it has a long-term impact.

So, in general, psychotherapies that are aimed at minimizing stress and improving our emotional and behavioural wellbeing, and such interventions not only benefit our mental and emotional health, but they also benefit our physical health by increasing our immune functions. As a result of these findings, we may conclude that stress management and working to improve our mental health can improve our immune functions, which could be long-lasting.

So, these are some of the most significant findings and their effects in the sense of stress and immune functions, as well as stress and infectious diseases. So, as you can see, stress has a major impact on our physical wellbeing, as well as our mental health (which we will discuss in the next lecture). As a result, it has far-reaching consequences for both infectious and non-infectious diseases. We must recognize the significance of our mental experiences, especially negative emotions and stress, and we will learn more about how to deal with these issues in the coping strategies sections of the upcoming classes. So that concludes today's lesson. Thank you so much.