

Ergonomics Research Techniques

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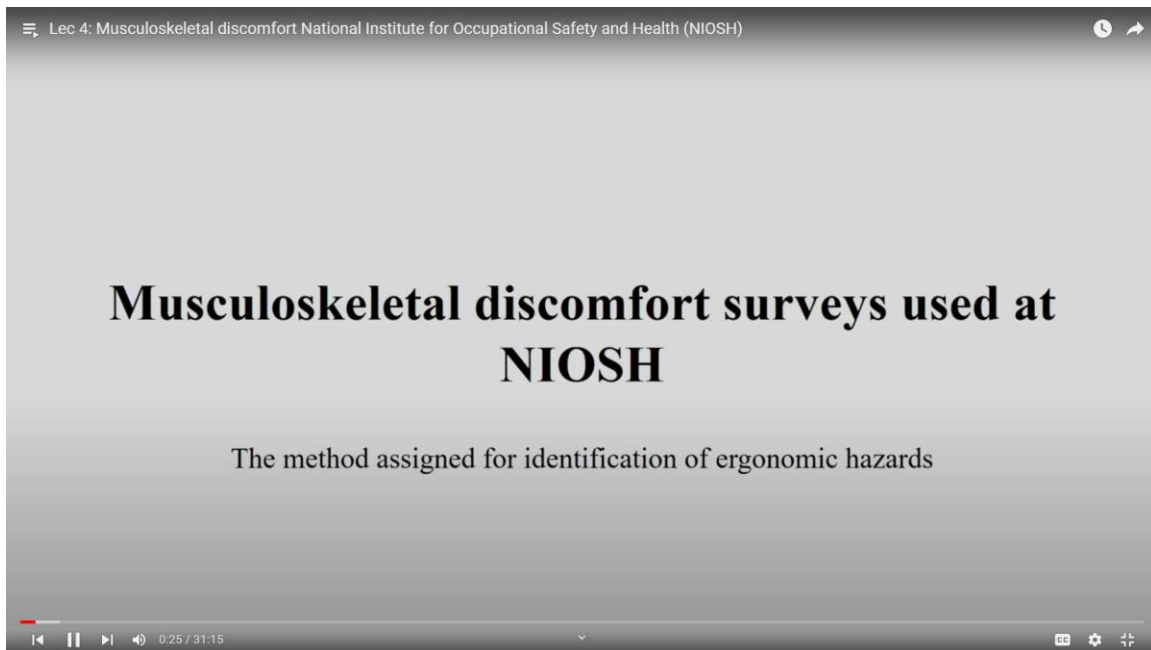
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Week – 01

Lecture - 04

Lec 4: Musculoskeletal discomfort National Institute for Occupational Safety and Health (NIOSH)



Welcome back. Today, we will talk about the musculoskeletal discomfort survey, which is introduced and mainly used by the National Institute of Occupational Safety and Health, NIOSH. Okay. So this method is very, very preliminary in nature, and it is a survey kind of thing, and people use it at the basic level to identify the prevalence data of musculoskeletal disorder or discomfort. So, this method was initially started as a questionnaire. However, right now, this remains what we use as a gold standard, as we use it for any population and occupation to identify the basic preliminary understanding of musculoskeletal disorder or discomfort.

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Introduction

- Self-report musculoskeletal discomfort survey are generally accepted as **risk factor for musculoskeletal disorder**.
- Discomfort measures are also used to **evaluate ergonomic interventions** or as a **screening tool** in the context of hazard surveillance to detect exposure to workplace physical stressors.

1:53 / 31:15

So, let us understand the procedure and the background of this particular method or tool. So, it is a self-report musculoskeletal discomfort survey, and it is generally accepted as a risk factor for musculoskeletal disorders. So, from this particular questionnaire or survey method, we try to understand the body parts or body locations that have a prevalence of musculoskeletal discomfort along with the associated causal factors. So, these discomfort measures are also used to evaluate the ergonomic interventions because they give direction or are a screening tool in the context of hazard surveillance to detect exposure to workplace physical stressors.

So, we know in my earlier MOOCs course I introduced you to varieties of musculoskeletal disorder stressors, mainly from the occupational perspective; we have six major stressors. So from this particular survey, what we try to understand we get some indication of what the stressors are causing this type of musculoskeletal discomfort in a particular population or particular set of occupations.

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Discomfort survey method at NIOSH

- This method surveys that combined body maps and rating scales to access discomfort in multiple regions of body.
- The body maps used in NIOSH studies are very close to standardized diagrams used to distinguish various upper and lower extremity body regions-
 - Neck
 - Shoulder
 - Elbow
 - Wrists-hands
 - Upper and lower back
 - Hips/ thigh
 - Knees
 - Ankles/ feet

3:16 / 31:15

So these are the major areas and body parts that we will be looking for, or we will try to evaluate where the problem is; it may be a single body part, or it may be multiple body parts. So, these methods or this particular survey combined the body map. So, we will talk about body maps.

So it is associated with a body map; without a body map, we will not be able to use this survey and the rating scale to assess discomfort in multiple body regions. So, the body map used in NIOSH studies is very close to the standardized diagram that is used to distinguish various upper and lower extremity body regions. We will go for it; we will check what this body part or body map is all about. These are the body region, neck, shoulder, elbow, hand, and wrist. So it is completely hand and this wrist.

We will talk about this together: upper and lower back. So here, we are not discriminating between the upper back and the lower back separately. We will be talking about it as a whole trunk like, you know, upper back and lower back, hip and thigh together, knees, ankle, and feet together. So, through these divisions we will be talking about, we will try to understand the prevalence of musculoskeletal discomfort or disorder or pain in these body parts through this questionnaire. Now, how do we define the location of discomfort? So, musculoskeletal discomfort surveys collect information on the location of discomfort.

Defining the location of discomfort

- Musculoskeletal discomfort surveys collect information on the location of discomfort
 - By reference to specific body regions, or
 - By use of partial- or- whole-body diagrams designating specific regions to be assessed.
- Less commonly, body maps are shaded by respondents to identify regions of discomfort.
- The number of regions targeted varies in relation to the interests of the study.
- Two different display formats are used for identifying body parts in the NIOSH studies-
 - All of the ten upper-extremities studies, partial body diagrams provided multiple views of designated regions of interest.
 - Only a single attribute of discomfort is rated; possible to target all regions of interest in a single integrated diagram with a space for recording ratings with each designated regions.

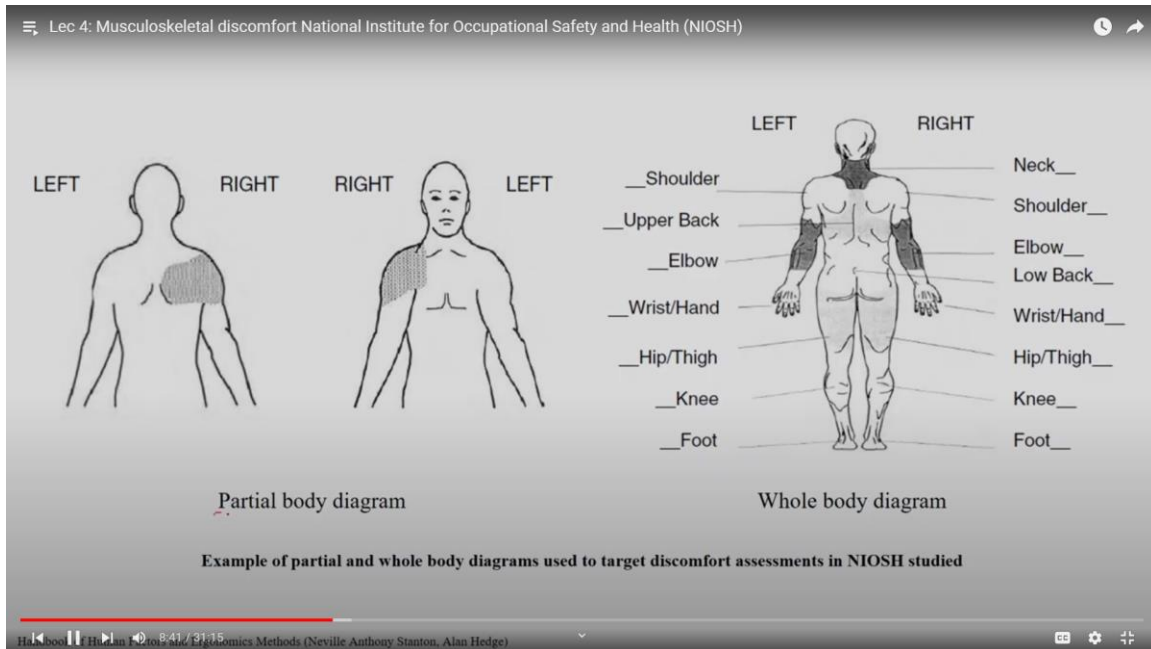
What? By reference to specific body regions, either we refer to that body region, so by reference to a specific body region or use a partial or whole body diagram designating the specific regions to be assessed. Either we mention this part is painting, this part is painting, or something like that, okay. So, in a whole musculoskeletal system, we refer to the specific body region or use the partial or whole body diagram, which has a designation like in a body map of specific regions to be assessed. So we can suppose we are talking about some place where we are expecting only the upper body to have discomfort or pain or body aches or something. So maybe we can have a figure where only upper body regions are depicted or designated okay.

Less commonly, body maps are, you know, shaded by respondents to identify the regions or discomfort. So what do we do? We ask those body regions to give a shade, okay? Sometimes, we ask them to tick also. The number of body regions targeted varies according to the study's interests. So it is not mandatory that the same body map is being used for one study, and for the other study, we will get a similar pattern of responses. In some cases, we may only be interested in understanding the neck region.

So, we will be asking questions about only the neck. Whereas in the other study, in some other cases, maybe we do not know where the problem lies or how we assess it or all those things. So, in that case, we will simply ask you to please tell us the subject we are going to ask them, the respondent, we are going to ask them that you specify where the problem is. So, both cases have the same body map; however, the responses are different. Two different display formats are used to identify body parts in the NIOSH study.

First, all of the ten upper extremities studies, including partial body diagrams, provide

multiple views of designated regions of interest. So, multiple views, maybe from the front side, side view, and top of all these things, is possible, or only a single attribute of discomfort is rated. It is possible to target all regions of interest in a single integrated diagram with a space for recording ratings with each designated region. So, maybe we can also collect data in that way. So, we can collect data in both ways.



Now let us see what it looks like this is a partial body diagram. Maybe we can say from the front side and from the back side, we are talking about the shoulder region, neck shoulder region. So we can use this type of diagram together, or if we are not sure the study objective says it is like we are not sure where the target area is, then maybe we can use this type of diagram where it shows the whole body. Here, it is a very important thing for this diagram: the picture is from the backside, not from your front size. So you are talking about the lower back or upper back, not the chest. So it is very important for us to know when we are talking about musculoskeletal disorder or discomfort, the body map that we are going to refer to is from the backside.

The picture is from the backside of the human. Again, for both types of things here, it is only the shoulder and elbow neck regions. In some cases, our target is the elbow. Maybe we can do that kind of shading depending on our requirements. Depending on the study, we can have any figure. So, in both cases, it is possible for us to use it.

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- Most discomfort surveys use descriptors-

Assessing the nature of discomfort

| | |
|---------|------------|
| Pain | Bother |
| Problem | Discomfort |

10:20 / 31:15

Now, how do we talk about musculoskeletal disorders, or how do we understand them? How do we enquire about it? So, there are four main terminologies. Rather, we will talk about six more terminologies that we are trying to understand or describe in this particular survey. First is pain is there any pain? Is there any pain in your neck? Is there any discomfort in your elbow or wrist? So pain, botherness, discomfort and problem.

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Assessing the nature of discomfort

- Then the conditions are rated using various severity indicators.
- The survey asks about the presence and severity of a “problem” in a specific location.
- It also asks the respondent to qualify the problem in terms of the types of symptoms experienced-
 - Burning
 - Stiffness
 - Tingling

11:25 / 31:15

So, these are the four major terminologies that we are going to use to describe the discomfort survey. Then, what I would like to tell you about this particular survey is that it not only identifies the problematic area but also tries to give you an understanding of the severity of that identified problem. Now, how do we do that? We use a variety of scales to

understand the severity. Suppose a person who is working on a computer or maybe in his or her workdays reports that he or she is having some neck problem or neck trouble. Now, the second person of, like, you know, maybe the other colleague, is also saying yes, the problem persists, as you know, they have neck issues.

Now, the concern is we only know they have a problem, but if we cannot discriminate the severity of the problem, then we may not be able to go further in research or in the analysis of how these severe problems are coming. So if you have a severity understanding of that particular problem along with the duration of exposure, the personal risk factors, the work habits, and all, then definitely you can try to do a lot of statistical analysis like correlation, association, and all those things and try to get an understanding that what is the causal factor to have such kind of discomfort or disorder or problem. So, this NIOSH discomfort survey also gives an understanding of the severity of the problem. The survey also asks about the presence and severity of a problem in a specific location. It also asks the respondent to qualify.

So, severity, in terms of a particular scale, maybe you are trying to give some kind of quantification. Also, it tries to qualify the varieties of problems. Maybe it is a problem. What is the problem? Is it a burning sensation? Is it some kind of stiffness or tingling? But all these three are problems. All these three can be categorized as musculoskeletal disorders and musculoskeletal discomfort. However, through this particular questionnaire, we can also try to understand the type of problem.

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- The survey begins with a single question that screens for the presence of one or more of six symptoms in each body region-

Assessing the nature of discomfort

| | |
|-----------|----------|
| Pain | Aching |
| Stiffness | Burning |
| Numbness | Tingling |

14:35 / 31:15

So, symptoms categorization. Mainly, we look for burning, stiffness, and tingling. Now, this survey talks about pain and aching. As you know, when we start with the questions, we will discuss stiffness, burning, numbness, and tingling. So, the survey begins with a

single question. So we should start somewhere, right?

So, it starts with a single question that screens for the presence of one or more among these six. It can be one symptom, or it can be two or three, or all six symptoms. Six symptoms are very rare; it is not really. Then it is like in a very, very severe case.

We may not get such cases. Maybe one or two. So, among all these symptoms in each body region. So you have a body map, and you have six symptoms. You ask where these problems are. Maybe you are getting an answer.

Next, you have pain. Whereas in the elbow, you have tingling. Both are musculoskeletal disorders or discomfort indications, but the symptoms are different. Types of musculoskeletal disorders are different. So, from here, you get an understanding of the possible varieties of problems, what the causal factors may be for all those things, and what kind of severity they have in this particular case. So, this looks like a very simple tool. However, it is very, very important, and it gives a very detailed screening of your population if you are talking about musculoskeletal disorders if your research is oriented on the topic of musculoskeletal disorders.

The screenshot shows a video player interface for a lecture titled "Lec 4: Musculoskeletal discomfort National Institute for Occupational Safety and Health (NIOSH)". The slide content includes a bullet point: "An affirmative response is then followed by a rating of this 'problem' using as many as three severity-". Below this, there are three input fields labeled "Duration", "Frequency", and "Intensity". The video player controls at the bottom show a progress bar at 16:23 / 31:15.

Now, an affirmative, once that is done, then we go for more detailing. So, an affirmative response is then followed by a rating on this particular problem. One is duration, from when and how long these problems are. So, we try to understand duration. Frequency, how frequently these problems occur, and then severity or intensity.

So, we mostly use a variety of scales. Now, these scale definitions or scale utilizations are not fixed. Based on your research interest, you can use a five-point scale; you can use yes,

no, sorry, not yes, no, five, five-point rating scale, seven-point rating scale, or maybe a simple visual analog scale. It absolutely depends on what your research interest is.

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| Discomfort duration | Discomfort frequency | Discomfort intensity |
|------------------------------|-------------------------------|-------------------------|
| Less than 1 hour | Almost never (every 6 months) | No pain |
| 1 to 24 hours | Rarely (every 2 to 3 months) | Mild |
| 25 hours to 1 week | Sometimes (once a month) | Moderate |
| More than 1 to 2 week | Frequently (once a week) | Severe |
| More than 2 weeks to 1 month | Almost always (daily) | Worst pain ever in life |
| More than 1 to 2 months | - | - |
| More than 3 months | | |

Discomfort rating scales for "pain" commonly used in NIOSH studies (Handbook of Human Factors and Ergonomics Methods (Neville Anthony Stanton, Alan Hedge))

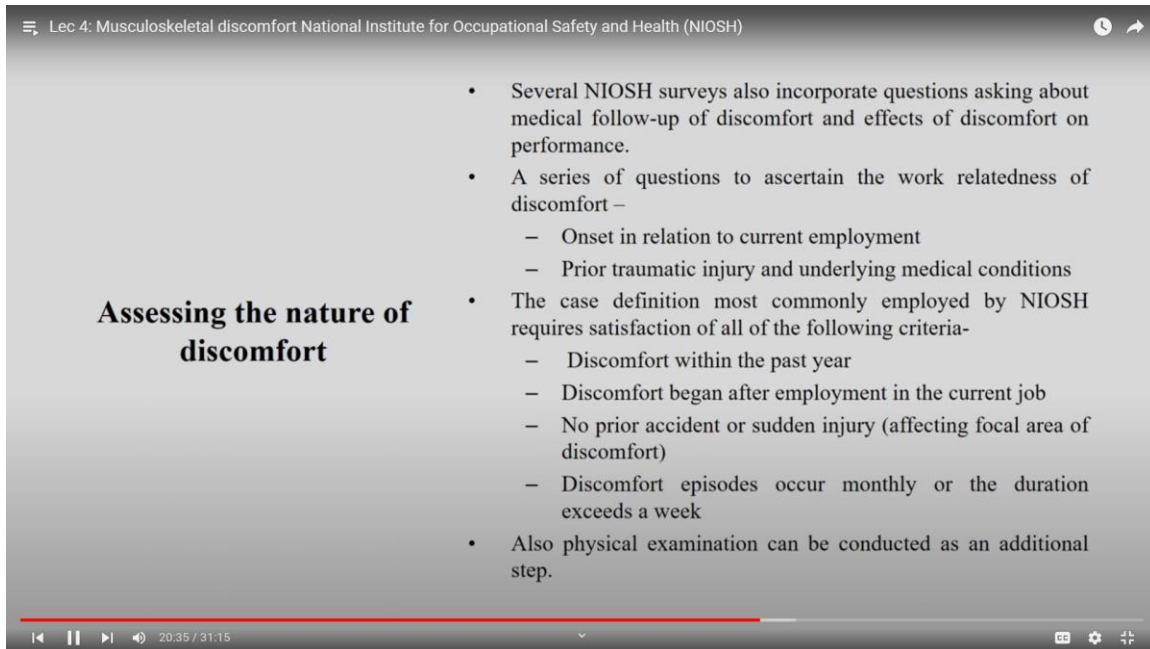
So, I will just give some examples. So here, this is normally being used. So you can use this and have your own scale. When we are talking about discomfort duration, how long are these discomforts? So maybe we can talk about a seven-point scale, where it is less than one hour, one to 24 hours, more than 24 hours to one day to one week, one week to two weeks, maybe two more than two weeks to a month or more than one or like one or two months or more than two months or year. So that you can categorize the duration of discomfort.

So, how long have you been having this problem? You said yes, you have shoulder pain. Now, from when you have this shoulder pain, you should have some kind of description. So maybe you can use this description. However, if your study objectives are not going to help you and are not in the direction of the duration of exposure, maybe you can have a simple answer: Yes, you have a problem.

It is absolutely based on your research objective. You should not always use this based on your idea or your research objective. Similarly, for the frequency, maybe very rarely, it is actually going to cross-check that prevalence data. Is it point prevalence, weekly prevalence, or annual prevalence? What type of prevalence is it? So, understand that this type of data is actually going to help you. So almost never, very rarely, sometimes frequently, and almost always.

So you can understand the frequency of discomfort. The intensity is like we can divide it into no pain, mild pain, moderate pain, severe pain, and worst pain. That way, you can

have, or you can have a 1, 2, 3, 4, 5 point scale where no demarcation, or maybe extreme left is 0 is no discomfort, and extreme right is extreme discomfort or maximum possible discomfort, and you ask them to rate it in 5 scale that is also possible. So it is absolutely up to you how you use it. When we talk about this NIOSH survey, several NIOSH surveys also incorporate questions about medical follow-up.



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Assessing the nature of discomfort

- Several NIOSH surveys also incorporate questions asking about medical follow-up of discomfort and effects of discomfort on performance.
- A series of questions to ascertain the work relatedness of discomfort –
 - Onset in relation to current employment
 - Prior traumatic injury and underlying medical conditions
- The case definition most commonly employed by NIOSH requires satisfaction of all of the following criteria-
 - Discomfort within the past year
 - Discomfort began after employment in the current job
 - No prior accident or sudden injury (affecting focal area of discomfort)
 - Discomfort episodes occur monthly or the duration exceeds a week
- Also physical examination can be conducted as an additional step.

20:35 / 31:15

We do check; we try to understand how severe it is. So, do you take medication for it? If you have neck pain, do you take medicine for it or not? So we try to sometimes understand that. And effects of discomfort on the performance. So, such questions are also included in this particular survey. Now, it is your choice that you would like to incorporate in your study or not. A series of questions to ascertain the work-relatedness of this type of discomfort, like onset in relation to current employment.

So suppose somebody is working in a particular job for a year. Now you can, and right now, the person is having neck pain. So you can ask if this pain started after you joined this particular job or if it was before that also. So maybe you can have some kind of indication, whereas it is not a confirmatory part. Today, you cannot confirm that he or she is having the problem only because of this job.

Now for that, you need to go into more detail. But you can have some kind of indication or prior trauma. So it may happen you had an injury, maybe an accident, or some bigger trauma, and that may get aggravated because of your job. So, you really need to identify where the problem started. Because a weak muscle group or weak musculoskeletal system will respond very easily or will get more affected by occupational hazards or those stressors. So if your muscles are weak, if your musculoskeletal system is weak it is more prone to develop such kind of symptoms.

So if you have an injury beforehand, then your frequency, intensity, all these things will get aggravated. So, this type of information will also be from this particular survey. The case definition most commonly employed by NIOSH requires the satisfaction of all the following criteria. The first discomfort within the past year means the last year. What is the kind of discomfort? The discomfort began after employment in this current job, with no prior accident or sudden injury, and discomfort episodes occur monthly, or duration exceeds a week.

So, in such cases, only you take it for more detail. So here, when we try to understand who is going to be part of my study, like who is going to be the subject of my study, in that case, we create the inclusion and exclusion criteria. So, if we talk about the musculoskeletal discomfort survey from NIOSH, we will take only those healthy human beings who do not have any prior injury. If you have a prior injury, you are already in a vulnerable zone. So you will not be able to give proper information, and we will not be able to get proper data or validate data.

So that cases we will not take. Maybe specifically when we are talking about pregnant women. So, for them, the typical responses are different. Like they are more vulnerable to musculoskeletal disorders. So, for a common survey or for a particular workplace, if we try to, maybe we will exclude them from the original study. Maybe we can have separate studies for them, but we will not include those subjects in your study.

Also, if the person is under some complicated medication or some kind of medication that may have an extra impact on the musculoskeletal system, in that case, we also need to exclude those subjects. So before we start any such survey, we should select the inclusion and exclusion criteria for the subjects to take part in the NIOSH musculoskeletal discomfort survey. So that is very important. A physical examination can also be conducted as an additional step. Because if there is already some physical disability or physical discomfort, they may not be the same as the other person.

So, in that case, we can have a separate study for them, but not for the target or as a target population. So, we can have this type of prerequisite to start the musculoskeletal discomfort survey.

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Quality of NIOSH discomfort survey methods

- Discomfort survey need to be practical to use-
 - Quick and easy to administer in a variety of populations and workplace
 - Readily analyzed
- They also need to demonstrate acceptable psychometric properties
 - Reliability
 - Validity

26:51 / 31:15

So what kind of quality will we get? So, discomfort surveys need to be practical to use. So this is quick and easy to administer, very easy if you have some basic understanding of ergonomics and musculoskeletal disorders or discomfort; you can easily use this particular tool with a variety of populations, which is a very important thing, with a variety of populations. So maybe a literate person can participate, and an illiterate person can also participate.

A person from a low socioeconomic background also can participate. People from very high socioeconomic backgrounds also can participate. Children can participate, the elderly can participate, adults also can participate, males can participate, and females can participate.

So the range is very high. It is very easy. You can use this particular method in any case. Now, here, one important thing is it is readily analyzed. Why? Because it only gives the. Is it present or not? If it is present, to what degree? So you can make a very easy calculation. So musculoskeletal disorder, the thing is it is not, we may not have it on the spot.

It takes time to develop. So, if you are saying yes, today you have neck pain. Definitely the causal factor is not immediate. It must have started many years. It takes time to settle this particular problem to set. So, from this particular type of survey, whatever data we are getting can easily be converted into percentages, and it is very easy for us to understand and analyze the data. They also need to demonstrate acceptable psychometric properties, reliability, and validity.

Summary & Implications

- Surveys of musculoskeletal discomfort vary widely along many dimensions:
 - The time frame for assessment
 - Assessment of qualitative aspects (intensity and temporal characteristics)
 - Scaling methods employed (from binary yes/ no choice to Borg scale)
 - The derivation of summary indices of discomfort
- NIOSH survey is sensitive to wide range of physical stressors across many occupations

It is tested for this type of survey, and it has been proven that it is very easy, as it is a very reliable and validated method for any occupation, for any age group, for any socioeconomic background, and for any case. So you can use it. Now, if we try to summarize it, we would like to see this particular survey of musculoskeletal discomfort vary widely among many dimensions, the time frame for assessment when it is being assessed, assessment of qualitative aspects like intensity, temporal characteristics, and all, scaling methods employed from a binary scale, yes or no, the spelling is wrong, yes, it is yes, Yes or no choice of you can have box scale along with it, the derivation of summary indicates the discomfort because once you summarize it, it gives an understanding about your discomfort and NIOSH survey is sensitive to wide range of physical stressors across many occupations. So this is very important.

So you can; it is like you can use it from the A to Z category. So it is very, very easy. So that is all for the NIOSH musculoskeletal survey. We will take another discomfort survey, the DMQ Dutch musculoskeletal questionnaire, in the next class. Thank you.