Ergonomics Research Techniques

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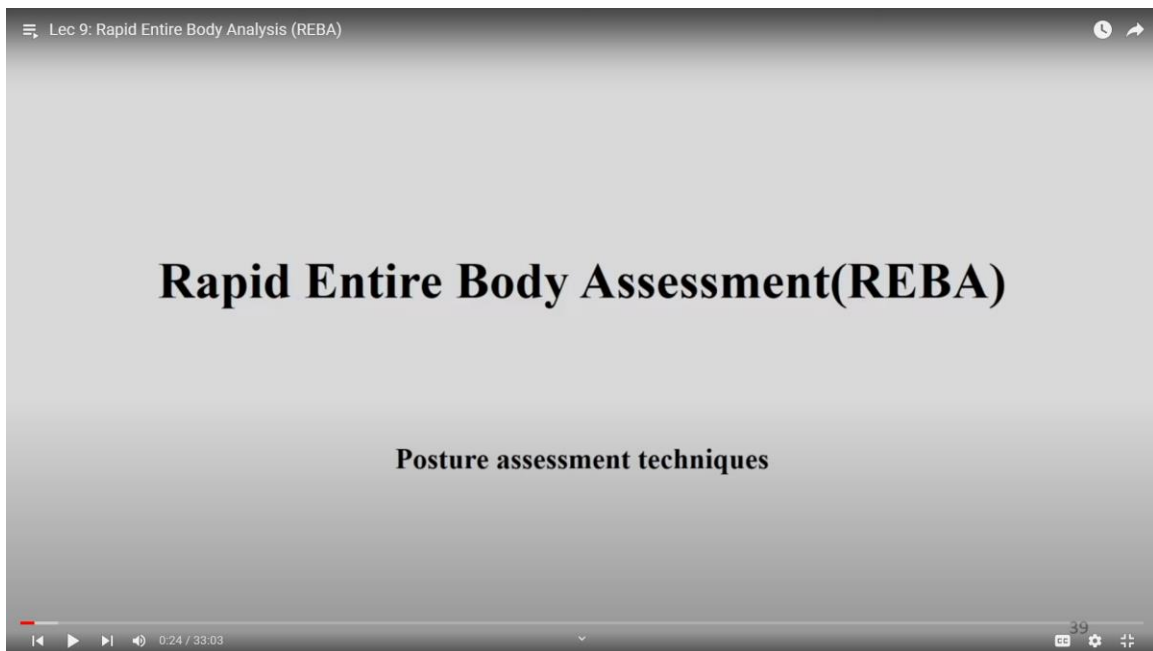
Department of Design

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Week – 02

Lecture - 09

Lec 9: Rapid Entire Body Analysis (REBA)

Welcome back. In the last class, we discussed a very important posture evaluation tool, which was the RULA rapid upper limb assessment. Now, in the next version or next advancement of that particular tool, take us to a new tool that was developed in 2001 by a similar group of researchers or the same group of researchers named rapid entire body assessment or REBA. In the short form, we call it REBA. So, let us go and understand its details. Before we go to REBA, I would like to mention that here it was developed in 2000.

Introduction

- RULA was developed by Hignett and McAtamney (2000) to assess the unpredictable working postures found in health care and other service industries.
- To evaluate whole body postural MSD and risks associated with job tasks.
- Assign scores for each body region: wrists, forearms, elbows, shoulders, neck, trunk, back, legs and knees.
- It's a rating of the posture, force and movement required while performing the task.
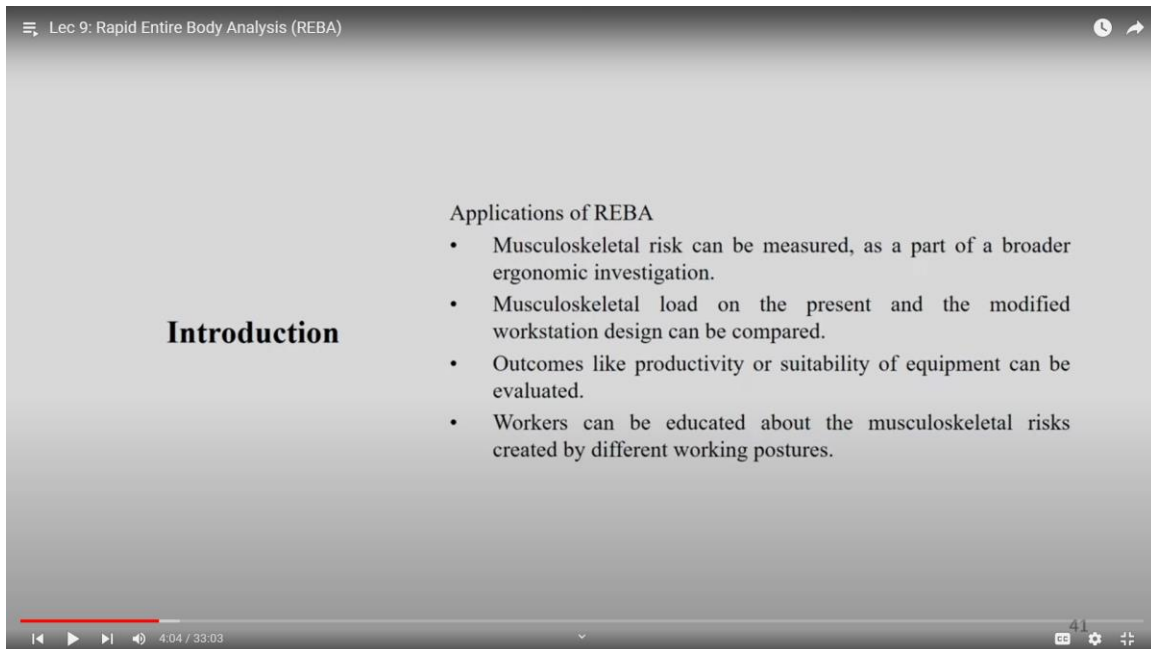
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It is the group of these people, a similar group to McAtamney, who developed our tool, which is RULA. Hignett and McAtamney developed this tool. To assess the unpredictable working posture found in healthcare and other service industries. Now, when this tool was developed, they mainly did studies in the healthcare sector.

If you look at RULA, you understand this RULA tool is mainly used where you are sitting and doing the job. Now, if you look at other industries, due to the Industrial Revolution, most of the industries adopted such a posture. However, in the healthcare industry, where patient handling is a major chunk of work, here and there, you cannot really go for only a sitting job. There are a lot of whole-body activities. So, from that perspective, they started understanding how we can understand those details and evaluate them.

So, they developed REBA. To evaluate whole body postural MSD and risk associated with job tasks. Assign a score for each body region. So, what they will do? They will do similar things in RULA, such as the wrist, forearm, elbow, shoulder, neck, trunk, back, legs, and knee. They will be assigning a score, and they will take it forward.

It is a rating of posture, force, and movement required while performing that particular task. So, first, they will talk about the posture of these body parts, neck, trunk, limbs, and all, and then they will go for the force and the movement as we did in RULA. So, what are the applications of RULA? So, musculoskeletal risk can be measured. Of course, this particular posture assessment tool is either OWAS or RULA or REBA or QEC.

Ultimately, it gives an understanding of the kind of risk available for the development of musculoskeletal disorders.

Applications of REBA
- Musculoskeletal risk can be measured, as a part of a broader ergonomic investigation.
- Musculoskeletal load on the present and the modified workstation design can be compared.
- Outcomes like productivity or suitability of equipment can be evaluated.
- Workers can be educated about the musculoskeletal risks created by different working postures.

Introduction

So, musculoskeletal risk can be measured as a part of broader ergonomics intervention. So, the musculoskeletal load on the present and modified workstation design can also be compared. So, if you have two varieties or three varieties of workstations where similar work can be done, you can test the kind of musculoskeletal load arising due to the adaptation of the posture. So that you can really compare and choose which is the best one, and you can go ahead with further modifications. So, outcomes like productivity or suitability of the equipment can also be evaluated using this particular tool, REBA.

Workers can be educated about the musculoskeletal risks created by different working postures. This is a very important point. It is also applicable to RULA and WASH. Once you understand that, yes, this particular posture is not correct, then you can really discuss why this posture is not correct or is not comfortable for them, or it is if they are adopting this particular posture for longer hours; what is going to happen? So, as it is not a lot of depicted pictures are there, explaining the position of your body parts, it is always helpful for someone to explain to the workers or the adapters or the operators, and then you can take it further as you can train them, you can explain to them why this is not good, why this is good.

So, this particular point is very, very important. You can really explain which part of the body of the operator is causing them more danger or more risk. So, you have individual

body scoring and body part scoring. So, it always helps to know how this is going to create difficulties in the long run, okay? So, this is a very important application.
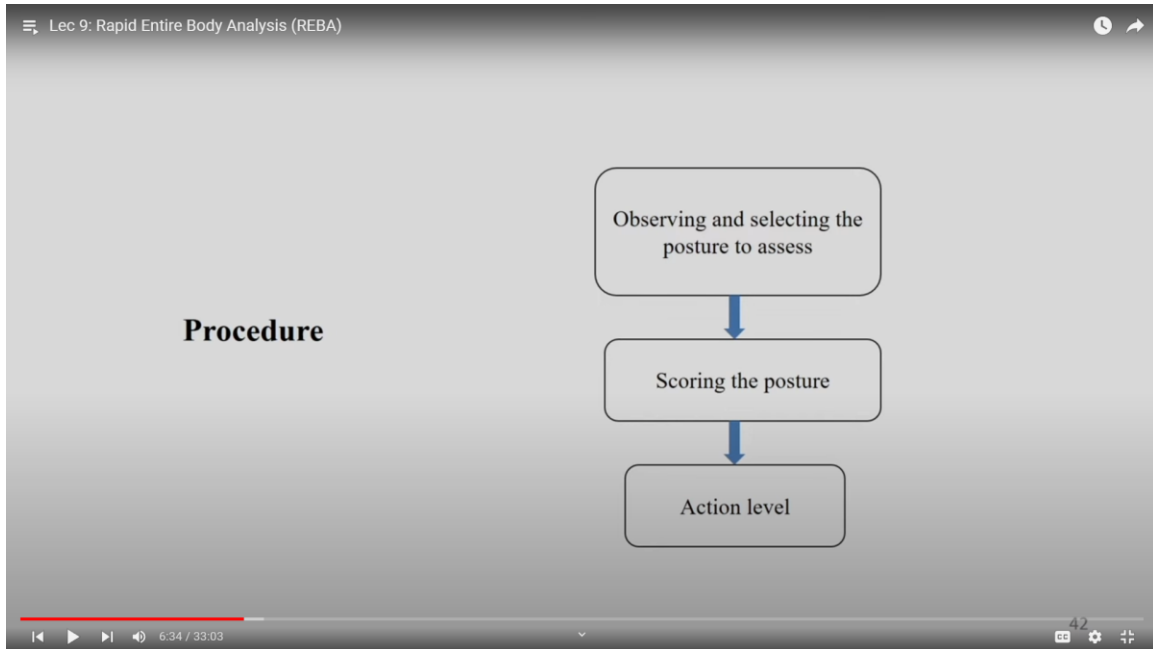
The procedure is very, very similar to what we did in RULA. So, observing and selecting the posture to assess, do you remember how we select posture? Yes, we select posture. Those postures are frequently occurring in a work cycle or a job cycle. So, frequently occurring posture or the posture which the operator is holding for longer hours or more than 50 percent of their working cycle. So, if that way you select posture.

Of course, for a longer run, you know someone cannot hold a posture for 8 hours, same posture. So, they are adapting different postures in the working conditions. So, you can select. Of course, this selection is definitely connected to the objective of your research. So, whatever objectives you have set before starting this particular posture analysis, based on that and the assumption of frequently occupied posture or posture which the operator is holding for longer hours, you select the posture.

Procedure

- A total of 13 steps are involved in the assessment process.
- It can be divided into two sections A and B.
- Section A deals with the neck, trunk and leg analysis and section B deals with arm and wrist analysis.
- 3 tables are present for scoring the postures.

 Once you select the posture, then what do you do? You give the scoring to the body parts as we did in RULA. Once we do the scoring, we have a similar precomputed table, and from those precomputed tables, what do we do? We try to get the final reading, the final score of REBA, and, from the final score, of course, the action level. So, a total of 13 steps are involved, as we did in RULA as well. What does it do? It can be divided into two major sections, section A and section B. Here, section A deals with the neck, trunk, and leg. In RULA, in section A, we did with the upper arm, lower arm, wrist, and wrist to wrist, whereas, in REBA, in section B, we dealt with the arm and wrist.
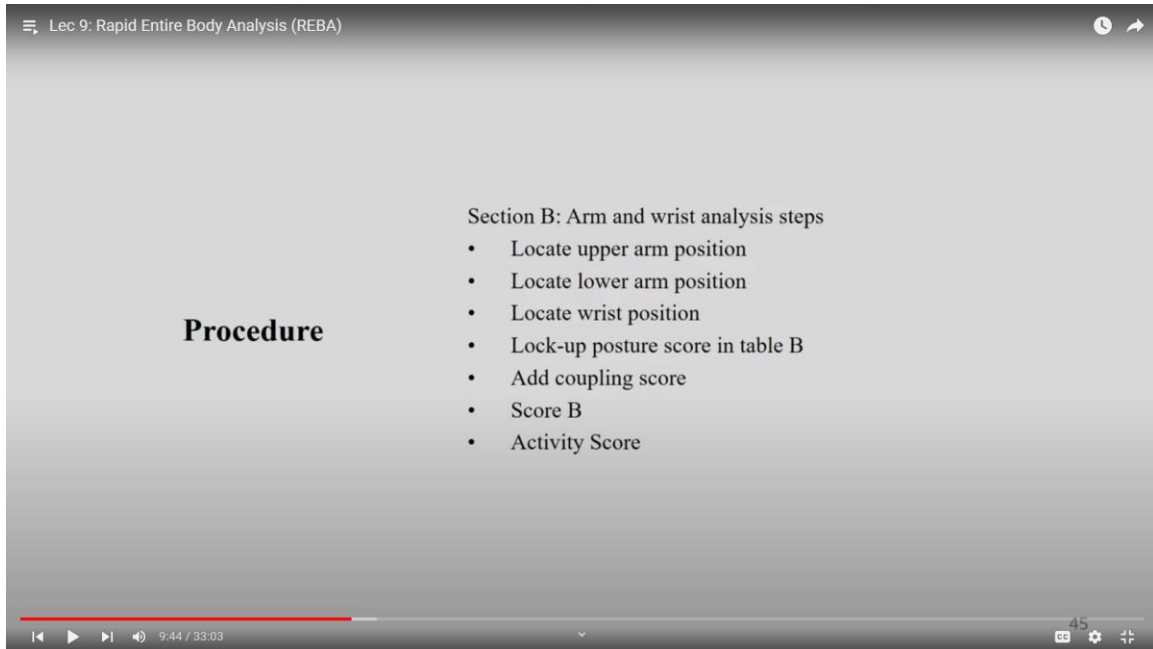
Procedure

Section A: Neck, trunk and leg analysis steps
- Locate neck posture
- Locate trunk posture
- Legs
- Look-up posture score in Table A
- Add force/load score
- Score A, find row in Table C

So, this is a little different, and three precomputed tables are there; from that, we will get

the scoring. So, for section A, we have a trunk. So, locate the neck posture, trunk posture, and leg, and look up the posture score in Table A at the force and load score, score A, which is found in Table C. In the next arm and wrist analysis, the upper arm, lower arm, wrist position, and lock up the posture score in the B like table B, add the coupling score, then here it is a little different. Here, we are talking about coupling and how you hold things.

Procedure

Section B: Arm and wrist analysis steps
- Locate upper arm position
- Locate lower arm position
- Locate wrist position
- Lock-up posture score in table B
- Add coupling score
- Score B
- Activity Score

So, that coupling is involved, and then you get the score B, and then you go for the activity score. So, let us start with this particular example or this particular understanding of how we get the neck score. So, for the neck, if the neck is not straight, the assumption is that when you are working, of course, the neck is in a forward-bending condition. Looking straight, you really cannot do any job; it is very difficult in an industrial situation. So, here, the modification is if it is 10 to 20 degrees forward bending, then it is plus 1.

A. Neck, Trunk and Leg Analysis

Step 1: Locate Neck Position

10-20° +2 20°+ in extension

+1

+2

1

Neck Score

Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

Example posture

Neck scoring

Scenario:
The operator performing an assembly task on the table as shown in the above example posture.
Step 1: Locate neck position
- Neck inclination is about 10-20°   = +1
- No neck twist   = 0
- No side bend of the neck   = 0

Neck score   = 1

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If it is more than 20 degrees, then it is plus 2 or anything in the extension direction that is plus 2. In a similar kind of adjustment, if your neck is twisted, move in these two sides that are twisting, so you have plus 1, and the neck is bending these two sides like this, then it is bending. So, twisting is this. Again, I am repeating this because we get confused while doing the exercise and collecting the data. So, this is twisting, and this is bending. So, once we get these scores, finally, we get the value of the neck score.

So, this is again a picture that is adapted from one of the internet sources, and from here, we can understand what the neck score is. So, if you look at the neck bending, it is around 10 to 20 degrees. So, the score value is 1. It is not twisted; it is not bent. The person is looking straight like that. This eye vision is very straight.

So, it is not this side or this side, so it is 1. So, the neck score for this particular posture, which is described in this figure, is 1. Now, going for like trunk. So, trunk, we have a few more modifications. One is if you are standing straight, so 0 movement ok, then it is plus 1.

A. Neck, Trunk and Leg Analysis — Scores

Step 1: Locate Neck Position

Step 1a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

Step 2: Locate Trunk Position

Step 2a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

Step 3: Legs

Adjust:

Step 4: Look-up Posture Score in Table A
Using values from steps 1-3 above,
Locate score in Table A

Table A scoring

- Step 1- 3 involves the neck, trunk and leg analysis.
- Step 4 gives the neck, trunk and leg score from Table-A as 2.

If anything is an extension, then plus 2 or forward bending 0 to 20 degrees, that is plus 2. 20 to 60 degrees forward bending plus 3, more than 60 degrees plus 4. Once we have these values, then again, we will have a similar kind of adjustment for twisting and bending. Twisting means the whole body is moving either on the left side or the right side that is twisting.

So, plus 1 or side bending. So, from the lumbar region, if you are bending on this side or this side, then it is plus 1. So, in this particular figure, there is no such bending. So, we can see that forward bending is approximately 20 to 60 degrees, which is why it is plus 3. Now, leg. What leg say? Leg says if the foot is placed evenly on the floor, then it is plus 1.

If it is 1 is placed, 1 is not placed, plus 2. If the knee is bent 30 to 60 degrees, then 1 more plus 1. And if it is more than 60 degrees, it is bending bent, then it is plus 2. So, here you get a little more details about the leg. First, you need to see if feet is the basic scoring is if feet are placed evenly on the floor or not.

If it is placed, then it is plus 1. If 1 is placed, and another is not placed, then it is plus 2. After that, you have to see whether the knee is bent or not. If the knee is in a bent condition, then it is, and then you have to see at what angle. So, if it is 30 to 60 degrees, then add 1 plus 1.

And if it is more than 60 degrees, then it is plus 2. So, here in this figure, you can see

one knee is in bent condition. So, first is 1, and then the leg score becomes 2. So, what we are getting over here, here we are assuming this, okay. Now, here is one thing: from which angle, like which side are you considering, the right side or the left side?

If you are here, you can do it from both sides. First, you do it from the left-right side or the operating side, so the dominant hand side, and you can do it from the other side. So, for this example, we have taken the score value of 1 as a leg, trunk as 3, and neck as 1, okay. So, you already know how to read these types of tables. So, here you go for the neck first, which is 1.

So, your score remains in this particular region, then you go for the trunk, so that was 3. So, this particular section and then your leg is 1, so this particular section, so that means your score became 2, fine. So, your score became 2. Now, what you have to do is add load and force score, and you have to check what the final value is. So, it says you look at here, you look at here, so if it is load is less than 11 pounds, then there is no score adding like plus 0.

- Steps 4-6 are for calculating the score for Group-A.
- 1 Kg = 2.205 pounds (lbs)
- The neck, trunk and leg score is 3

If it is 10 11 to 22 plus 1 more than 22, then 22 pounds, you can convert it into kg as well, as per your requirement, then it is 2. So, adjustment is if shock or rapid build-up score no sudden jerk is there, then also you can add plus 1. So, that way, you can adjust the score, and then you can go for the next requirement or next part of the analysis. What is the next part of the analysis? The next part of the analysis is your arm and wrist, okay?

Table B scoring

 Let us go ahead with the next table. What does it say? Similar kind of scoring system. So, the upper arm is 0 to 20 degrees forward or 0 to 20 degrees backward, it is plus 1. If it is more than 20 degrees in the backward direction or in extension, then plus 2, 20 to 45 degrees plus 2. So, here it is similar. Now 45 to 90 degrees plus 3, and more than 90 degrees it is plus 4.

  It is a similar kind of adjustment, and it says that if the shoulder is raised, then you add one more value that is plus 1. If your upper arm is abducted, again, I am explaining what abduction is. Abduction is when your arm is away from your body. So, if you are doing some job a little far from your body, then what will happen? To hold that particular posture, you will have more strain on your trunk, shoulder muscles, and arm muscles, right? So, you have to give one more additional score that is plus 1. Whereas, if your arm is resting on the armrest, then you subtract 1, or if the person is leaning, then also it is minus 1.

 So, it is minus 1. If your arm is supported, then it is minus 1. Now, let us go for the lower arm. Here we have only two scores, 0, sorry, 60 to 100-degree movement, then plus 1. More than 100 degrees or below 60 degrees, then it is what plus 2.

 So, this is an arc of 180 degrees, right? It is an arc of 180 degrees. So, this is the most comfortable zone of work. This is the most comfortable zone of work. So, anything between that you have plus 1. If anything is not in this region, it is plus 2.

Step 7: Locate Upper Arm Position:

Step 7a: Adjust...
If shoulder is raised: +1
If upper arm is abducted: +1
If arm is supported or person is leaning: -1

Upper Arm Score **6**

Step 8: Locate Lower Arm Position:

Lower Arm Score **2**

Step 9: Locate Wrist Position:

Step 9a: Adjust...
If wrist is bent from midline or twisted : Add +1

Wrist Score **3**

Step 10: Look-up Posture Score in Table B
Using values from steps 7-9 above, locate score in Table B

Step 11: Add Coupling Score
Well fitting Handle and mid rang power grip, *good*: +0
Acceptable but not ideal hand hold or coupling
acceptable with another body part, *fair*: +1
Hand hold not acceptable but possible, *poor*: +2
No handles, awkward, unsafe with any body part,
Unacceptable: +3

Step 12: Score B, Find Column in Table C
Add values from steps 10 &11 to obtain
Score B. Find column in **Table C** and match with
Score A in row from step 6 to obtain Table C Score.

Step 13: Activity Score
+1 1 or more body parts are held for longer than 1 minute (static)
+1 Repeated small range actions (more than 4x per minute)
+1 Action causes rapid large range changes in postures or unstable base

Posture Score B **9**

+

Coupling Score **1**

=

Score B **10**

Table B

Upper Arm Score \ Wrist	Lower Arm 1			Lower Arm 2		
Wrist	1	2	3	1	2	3
1	1	2	2	1	2	3
2	1	2	3	2	3	4
3	3	4	5	4	5	5
4	4	5	5	5	6	7
5	6	7	8	7	8	8
6	7	8	8	8	9	9

Table C

Score A	Score B											
	1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	2	3	3	4	5	6	7	7	7
2	1	2	2	3	4	4	5	6	6	7	7	8
3	2	3	3	3	4	5	6	7	7	8	8	8
4	3	4	4	4	5	6	7	8	8	9	9	9
5	4	4	4	5	6	7	8	8	9	9	9	9
6	6	6	6	7	8	8	9	9	10	10	10	10
7	7	7	7	8	9	9	9	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	11	11	11	12	12	12	12
10	10	10	10	11	11	11	11	12	12	12	12	12
11	11	11	11	11	12	12	12	12	12	12	12	12
12	12	12	12	12	12	12	12	12	12	12	12	12

- Steps 10-12 are for calculating the score for Group B.
- 1 Kg = 2.205 pounds (lbs)
- The arm and wrist score is 10

Section B scoring

Then you have to do the wrist position plus 1. Suppose it is a 15-degree flexion and extension or more than that, so plus 1 and plus 2. So, here you get all these values. So, you need to look for this particular table. Sorry, this particular table. You have to look for this particular table, and you get the score. Once you get this particular value that is from table B, we call it score B; you have to go for the coupling factor or coupling score. Why coupling? Now, we have seen that while doing any kind of activity, if your holding procedure is not very correct or is difficult, then you have extra musculoskeletal load on the body.

So, if you are carrying something and the carriage has a good coupling, then you have less difficulty handling such a load. However, the same weight, if the coupling is not good, you find it more difficult or more strenuous than the earlier one. So, in this particular tool in REBA, we use coupling, okay? So, we have a descriptive definition, and then accordingly, we choose what type of coupling it is. What it says is a fitting handle, a very nice handle, and a mid-range power grip.

So, you have some mid-range power grip. So, we call it as good, then no extra load. So, it is 0. Acceptable, but not ideal.

Okay, fine. You can use that particular handle. It is acceptable. However, it is not ideal to hold or couple. Okay, then it is okay. Coupling is acceptable with another body part, then it is fair.

So, plus 1. So, you have difficulties, but it is okay like you can do it. So, then plus 1 and hand are not acceptable. However, it is possible. Here is one thing: if it is not possible, then such a posture will definitely not be in the industry, right? If it is not possible to occupy, then definitely that is not there.

So, it is very difficult. However, if it is possible to manage, then it is poor or plus 2 and has no handles, extremely awkward, and very unsafe with any body part, then it is unacceptable, and we give the scoring of 3, okay, plus 3. So, in step 12, what exactly do we do? So, we add all these values. So, we have a table from table B, we have a score, and we use the coupling. So, we have a total value of score B.

Now, we have a score of A, and we have a score of B. What do we do with these scores? We will go for the, looking for this particular score in table C. So, what it says that add values from steps 10 and 11 to obtain the score B and find the column in table C and match with the score A in the row from the step 6 to obtain which you already obtained and then you get the score C. And this particular value score C is actually going to give you the action level. Here, this is a little different than RULA.

Once we get the grand score in RULA, we stop. However, in REBA, we have some more additions. What is that addition? The addition is these activity scores, these activity scores. This is not there in RULA. In REBA, these are extra things. What does it say? Plus 1, 1 or more body parts are held for longer hours than 1 minute.

So, you are talking about static posture. So, if you have some score, then again, you have to add one if the posture is static in nester. Repeated small-range action that is more than 4 per minute. So, more than 4 times you are repeating the job per minute, then it is plus 1. One more thing is that action causes rapid or large range changes in the posture or it is unstable in actual in base, then also plus 1. So, this activity scoring is something that gives a more dynamic or more realistic understanding of the working posture.

So, once you get the score, then you have to go for your final value. So, you have a score of C. So, these scores are supposed for this example, so you get this value. So, for score A and Table C, from what you do from score A, you have 3, and for score B, you have 10. So, the final value becomes 8. Once this is 8 and you find you have an activity score that is 1, then the final score becomes or REBA score becomes 9.

For this particular example, your case can be different. So, you need to find out that. Now, once you have that particular scoring, what do you have to do? You have to look for the action level. Very similar to we did in REBA.

REBA action level

Score	Level of MSD risk
1	Negligible risk, no action required
2-3	Low risk, change may be needed
4-7	Medium risk, further investigation, change soon
8-10	High risk, investigate and implement change
11+	Very high risk, implement change now

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 1 is negligible. Now, you need not worry about it; no action is required. 2 to 3 low-risk changes may be needed. So, that is, the score is 2 to 3, and 4 to 7 is medium risk; further investigation and changes are required. However, it is soon, So you do it. However, there is no emergency. Now, 8 to 10 high-risk investigations and implementation are required, and more than 11 or more than that, it is very high risk to implement the change now or immediately.

Advantages

- Relation between the score and regional pain can be demonstrated.
- Outcomes like productivity and suitability of equipment can be evaluated.
- Workers can be educated regarding high risk postures.
- Comparison can be made between the pre and the post intervention stages.
- Quick and easy to use.

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 So, these are the action levels you have to derive from your REBA. Fine. So, let us understand what the advantages are. A relation between the score and regional pain can be demonstrated. As I mentioned in RULA, suppose you have prevalence, point prevalence, or weekly prevalence of back pain. You can really see what trunk posture is

available or what kind of trunk posture is being opted for or adopted by the operator, and you can really find the relation between them. So, it is very, very easy.

It gives you a real understanding of the actual risk factors. It gives an indication, it gives the direction. So, outcomes like productivity and suitability of equipment can also be evaluated. Workers can be educated regarding high-risk posture. Comparisons can be made between the pre-and post-investment and intervention stages that I do for OWAS, RULA, REBA, and many other tools where we have some scoring.
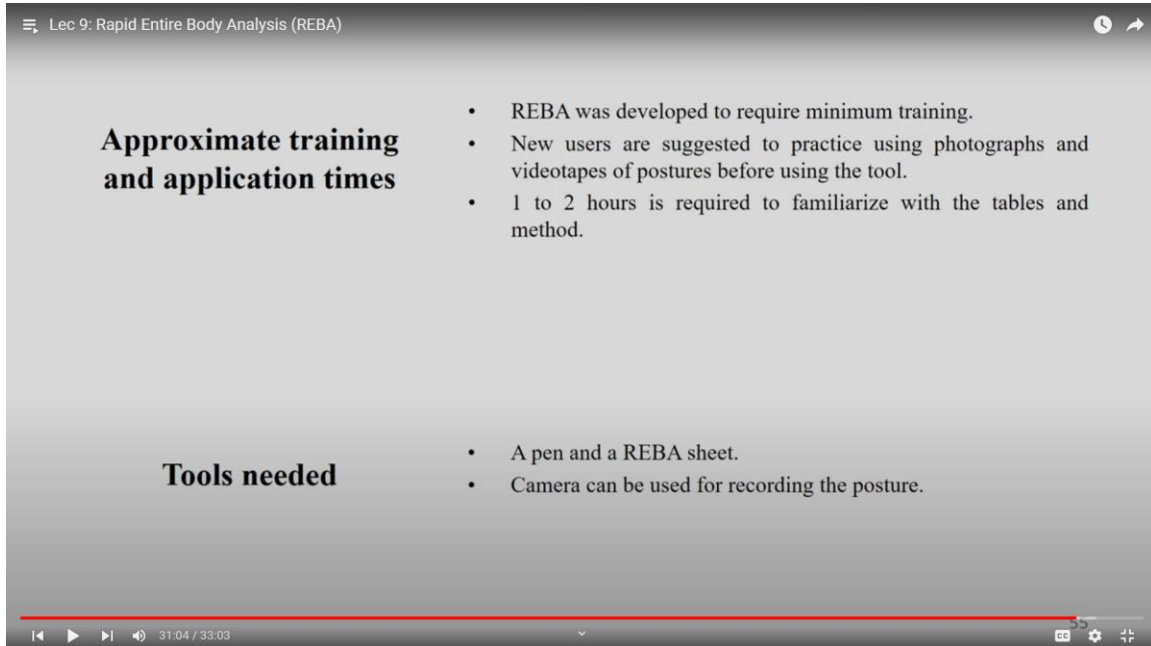
So, we do pre- and post. So we can see if there is any improvement. It is very quick and easy, and it is similar to the photographic method that we use for OWAS or RULA; we can use it for REBA as well. Disadvantages, task duration, recovery time, and vibration are things we cannot consider or cannot understand about these factors in this particular tool. Organizational and psychological factors are also not being considered. Capturing the right photograph may be very difficult, which may cause the wrong interpretation of the posture and which may lead you to wrong data collection. So, that is why collecting the correct photograph is very, very important, and really, you need to do it very nicely and effectively.

Only once you have the correct photograph and correct body posture positioning will you get the correct value or good observation. Several REBA assessments may be required for one task; of course, just one posture analysis will not give the entire picture of the whole task, and you have to choose the most extreme posture that I mentioned earlier. also, your very extreme posture only you should be taken care of. So, what is the approximate time that you require? Very similar to RULA, REBA was developed to

require minimum training; new users are suggested to practice using photographs and videotapes of the posture before they use the tool for actual data collection. And 1 to 2 hours is required to familiarize. So, very, very easy, you need a pen and a REBA sheet because the scoring system is very important.

So, you need a REBA sheet with you to give the rating and a camera, of course, to capture a correct photograph. So, these are the things associated with REBA. As I mentioned, very easy tool. So, all of you go and start clicking photographs, whatever is required for you, and using the REBA data sheet, you can analyze the final REBA score, and you can do the intervention. If required, again, you check what kind of improvement is needed.

 If improvement happens, then it is very good. If improvement does not happen, then you look for ways to make the improvement. So, that is all for today for REBA. We will go for the QEC quick exposure checklist in our next class. Thank you.