

LERFAT

(Lower Extremity Risk Factor Assessment Tool)

User Manual

DRAFT

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Introduction

What is LERFAT?

The **Lower Extremity Risk Factors Assessment Tool (LERFAT)** is a tool that can be utilized to assess jobs for risk factors that are associated with lower-extremity work-related musculoskeletal disorders (LE-WMSDs). The input of the LERFAT are presented as occupational and worker-specific factors. The occupational factors assessed in the tool include lower extremity postures and activities and lifting as well as carrying activities. The worker-specific factors assessed in the tool include basic demographics (e.g. age, weight) and basic information about the worker's lower extremities (e.g. type of shoes worn at work, prior injuries to knees or hips, playing sports that involve cutting or turning). Although it is advisable to involve worker-specific factors during the assessment, users can omit this factor during the assessment. Omitting the worker-specific factors means that we only rely on occupational factors to determine the degree of risk. The assessment results using the tool are presented as the degree of risk, which can be one among five to six levels of risks: acceptable, slight, moderate, high, very high. **A listing of the risk factors present in the assessed job is provided as additional assessment results.**

Lower extremity work-related musculoskeletal disorders

NIOSH (2018) defined musculoskeletal disorders (MSDs) as "*soft-tissue injuries caused by sudden or sustained exposure to repetitive motion, force, vibration, and awkward positions which may affect the muscles, nerves, tendons, joints and cartilage in your upper and lower limbs, neck and lower back.*" In the lower extremity part of the body, the MSDs may occur in the joints such as knee and hip or the segmental parts of the lower extremity such as thigh and calf. Although it may happen in the segmental parts, LERFAT only focused assessing risk factors associated with lower extremity work-related musculoskeletal disorders (LE-WMSDs) in the three joints of the lower extremities: hip, knee, and ankle. During the development of the LERFAT, we performed a literature review using keywords representing the LE-WMSDs in the joints which was further validated by subject-matter experts (SME) through a series of Delphi surveys. The risk factors associated with LE-WMSDs in the hip came from the literature and SME opinions on specific MSDs: hip osteoarthritis and hip pain. The risk factors associated with LE-WMSDs in the knee were identified from specific MSDs such as knee osteoarthritis, knee meniscal disorders, and knee pain. Meanwhile, the plantar fasciitis and foot/ankle pain are two MSDs which were utilized as the keywords to identify risk factors associated with LE-WMSDs in the foot/ankle.

Publications related to LERFAT

The comprehensive report of the development, the validity assessment, as well as the reliability, usefulness, and usability assessment of the LERFAT can be read in the following documents:

Ardiyanto, A.. (20XX). Title of dissertation/thesis (Doctoral dissertation). Retrieved from <http://url.com> -- TBD

Ardiyanto, A., Lavender, S., Di Stasi, S., & Sommerich, C. (2019). The Development of a Comprehensive List of Risk Factors for Hip Work-Related Musculoskeletal Disorders: Delphi Survey. In R. H. Goossens & A. Murata (Eds.), *Proceedings of the AHFE 2019 International Conference on Social and Occupational Ergonomics* (pp. 369–378). Cham: Springer.

Questions about LERFAT?

If you have further questions on LERFAT, please contact the developer, Ardiyanto ('Ardi') at **ardiyanto.1@osu.edu**

Quick Start Guide: Working with LERFAT in 4 steps

1. Enabling the macros

LERFAT was developed by incorporating macros in Microsoft Excel. After opening the LERFAT, a dialog box will appear asking whether you want to disable or enable the macros in the file. To enable LERFAT, the user must enable macros by clicking the 'Enable Macros' or 'Enable Content' button (Figures 1 and 2). Hence, all functions in the LERFAT spreadsheet can work properly.

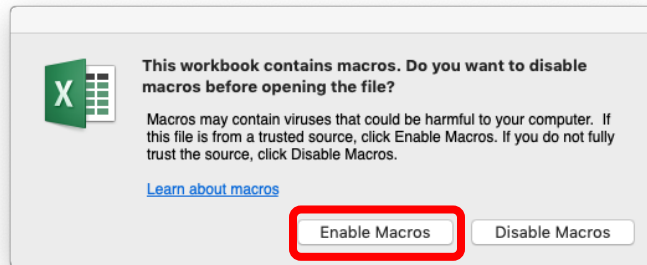


Figure 1. Enabling macros dialog box on Microsoft Excel for Mac

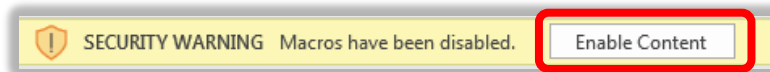


Figure 2. Enabling macros dialog box on Microsoft Excel for Office 365 (Windows)

2. Filling out the inquiries of the job information sheet

The job information sheet is the first worksheet that will appear after opening the LERFAT. At this sheet, you are asked to fill out the job-related information such as the date, the analyst name, the subject/job ID, the job description, choose units of measurement, and whether or not to include consideration of worker-specific factors in the assessment. The first four inquiries are optional, which means they can be left blank. However, choices should be made for the last two inquiries, the units and the considerations of the worker-specific factors, because they will have an impact assessment process. When you have finished responding to the inquiries of the job information window, please click the 'start assessment from the beginning' button in the bottom right side of this window.

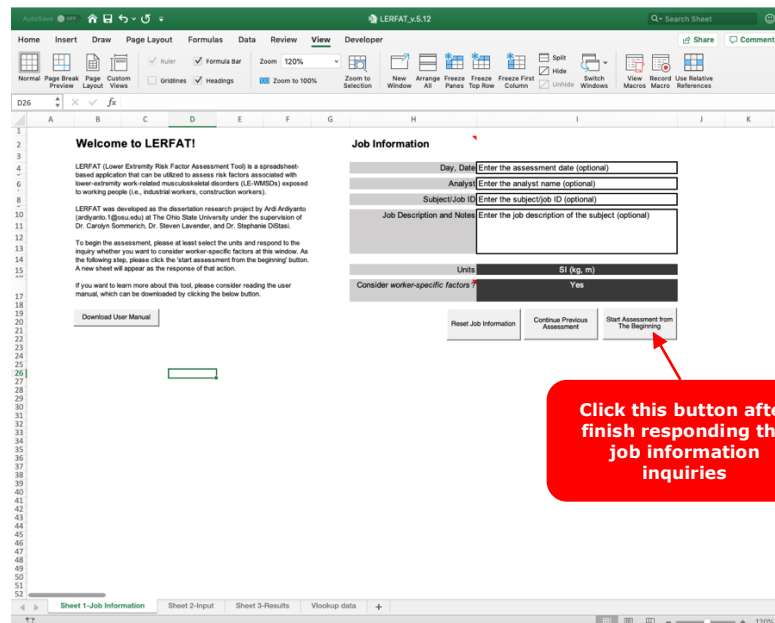


Figure 3. 'Job Information' Sheet

3. Inserting the assessment inputs

After clicking the 'start assessment' button of the job information sheet, a new sheet which is the input window will appear. The input window is the place where you are requested to respond to several inquiries in determining the assessment inputs; these inputs specifically address potential stressors to the lower extremities. In inserting the inputs, the users need to answer the inquiries by clicking the available options or typing the responses, as directed by the tool. There are 10 - 42 inquiries which are utilized to assess the occupational and worker-specific risk factors associated with LE-WMSDs. The inquiries related to the worker-specific factors will appear if you choose to consider the worker-specific factors by putting responses 'Yes' in the previous sheet.

Input Window Download Printable Inquiries

Occupational Factors Inputs

Lower Extremity Posture and Activities

Driving	Does the job involve driving (while sitting) activities?	No
Jumping	Does the job involve jumping activities?	No
Kneeling	Does the job involve kneeling postures?	No
Sitting	Does the job require sitting postures?	No
Squatting	Does the job require squatting postures?	No
Stair climbing	Does the job require stair climbing activities?	No
Standing	Does the job require standing postures?	No
Walking	Does the job require walking activities?	No

Manual Material Handlings

Does the job involve lifting and/or carrying activities? No

Whole-Body Vibration Exposure

Does the job make the worker exposed to whole-body vibration? No

Worker-specific Factors Inputs

Demographics

Gender	Click and select from the drop-down list
Age (years)	Type any numbers >0
Weight (kg)	Type any numbers >0
Height (cm)	Type any numbers >0

Medical History associated with LE-WMSDs

Hip injury in the past, hip joint abnormality, or hip osteoarthritis	No
Knee injury or severe knee pain in the past, and/or knee osteoarthritis	No
Foot/ankle injury in the past	No
Osteoporosis	No
Rheumatoid Arthritis	No

Shoes

Daily working shoes	Click and select from the drop-down list
Subjective opinion on how well the shoes support the foot	Click and select from the drop-down list

Sports participations

Cutting, pivoting, jumping, lateral movement sports; 50 hours/year	Click and select from the drop-down list
--	--

Others

Perceived Job Stress	Click and select from the drop-down list
----------------------	--

Reset inputs
Return to Job Information
Calculate Risks

Figure 4. Input Window Sheet

Continuing with the risk calculation process. If you are done in inserting all inputs, please click the 'calculate risk' button in the bottom end of the sheet (Figure 6).

Downloading the printable version of the input window inquiries. You can download the printable version of the input window inquiries by clicking the 'download printable version.' The button is located in top right of the sheet (Figure 5). You may use this printable version when direct input to the LERFAT spread-sheet app is challenging.

Resetting the inputs. If you want to reset the inputs that you have inserted, click the 'reset input' button in the bottom end of the sheet (Figure 6). If you click this button, you will be asked whether you are sure you want to reset all inputs in this sheet.

Returning to the job information sheet. If you previously choose 'No' for the consideration of the worker-specific factors, but you change your mind, hence, you want to consider these factors in the assessment, you can return to the job information window to do that (Figure 6).

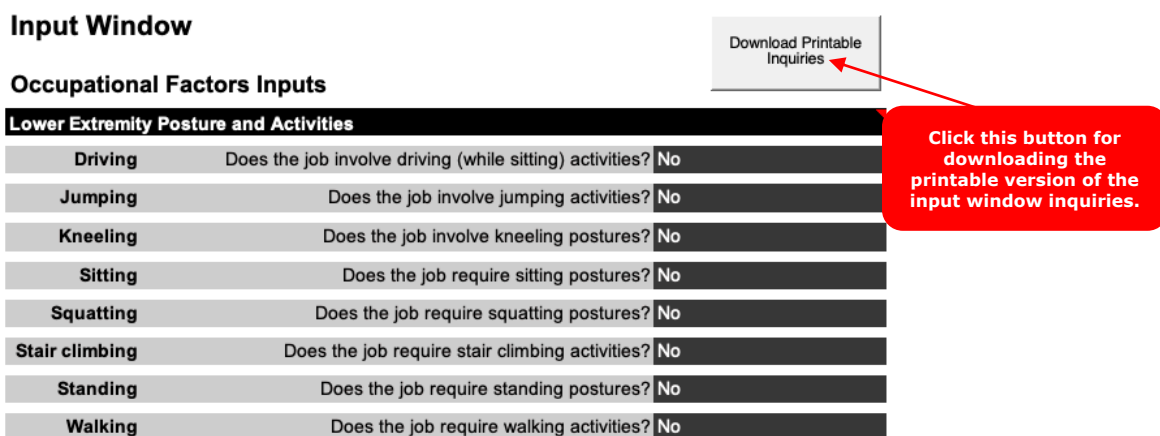


Figure 5. The button for downloading the printable version of the input window inquiries

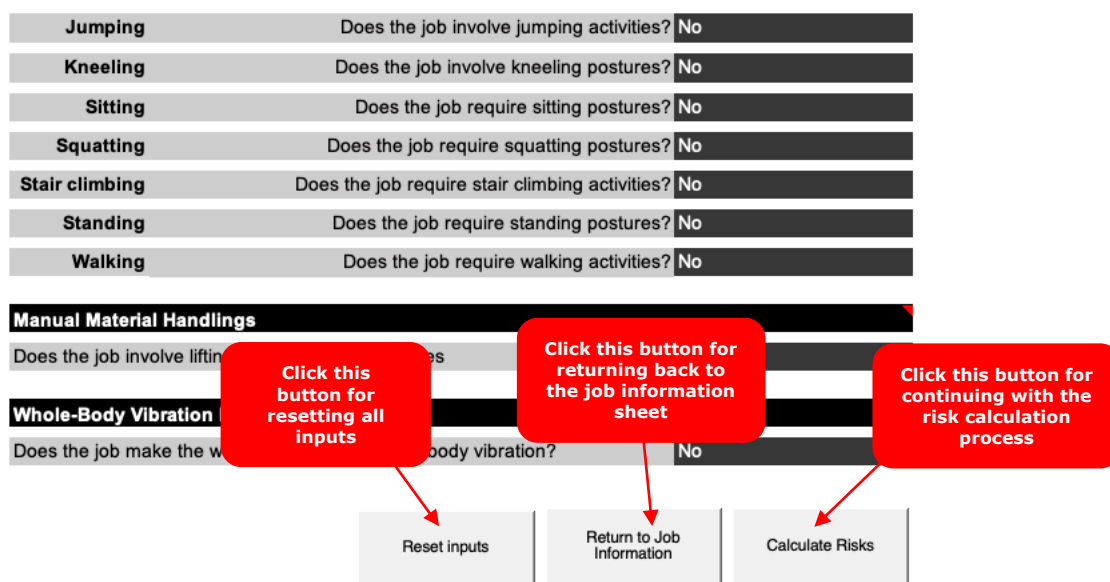


Figure 6. Four buttons of the Input Window Sheet

4. Reviewing the assessment results

After clicking the 'calculate risk' button of the job information sheet, a new sheet, which is the 'assessment results' sheet, will appear (Figure 7). The 'assessment results' sheet displays the outputs of the assessment separately for each region of the lower extremity (hip, knee, ankle). Results are provided separately for work factors and personal factors. The assessment results of the occupational risk factors are color-coded, to facilitate interpretation, using traffic light colors of red for the highest degree of risk, yellow for moderate risk, and green for lowest degree of risk. The assessment results of the worker-specific factors are presented using the listing of risk factors present in the assessed jobs. Further details about the assessment outputs and details about the other parts of the assessment tool are provided in the 'Anatomy of LERFAT' chapter, which begins on page 8.



Figure 7. The 'assessment results' sheet

5. Advanced steps (optional)

If you want to understand how each of the inputs contributed to the calculation to determine the degree of risk for each lower extremity part, click 'show risk calculation' button in the assessment results sheet (Figure 8). After clicking this button, a new sheet will appear. If you want to learn more about the scores or the calculation behind them, consider reading the 'How does the LERFAT calculate the risks?' chapter on page 14.

Returning to the input window sheet. If you want to review or edit the inputs, please click the 'return to input window' button in the top right of the sheet (Figure 8)

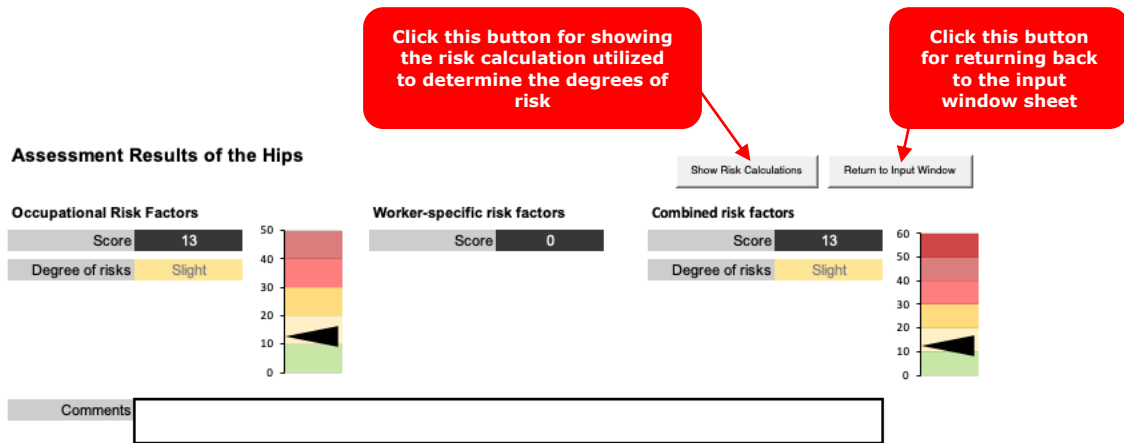


Figure 8. Two buttons of the assessment results sheet

Anatomy of the LERFAT

Job Information Sheet

The job information sheet (Figure 9 9) is the first worksheet that will appear after opening the LERFAT.

Welcome to LoRFo!

Lower Extremity Risk Factors Evaluator (LoRFo) is a spreadsheet based application that can be utilized to assess risk factors associated with lower-extremity work-related musculoskeletal disorders (LE-WMSDs) exposed to the workers.

LoRFo was developed as the dissertation research project by Ardiyanto Ardiyanto at The Ohio State University under the supervision of Dr. Carolyn Sommerich, Dr. Steven Lavender, and Dr. Stephanie DiStasi.

For starting the assessment process using LoRFo, please at least select the units and respond to the inquiry whether you want to consider worker-specific factors or not at this window. After that, please click the start assessment button and a new window will appear.

If you want to learn more about this tool please consider reading the user manual which you can download [here](#).

Job Information	
Day, Date	Monday, 04/04/2019
Analyst	Ardi Ardiyanto
Subject/Job ID	S-01
Job Description and Notes	Material Handlers. Lifting and carrying small parts from the conveyor end to the palletes.
Units	English (lbs, feet, inches)
Consider worker-specific factors?	Yes

Start Assessment

Figure 9. The 'Job Information' Sheet

1. Day, Date. Enter the day and date when the assessment was performed. This inquiry is optional. You can leave it blank.

2. Analyst. Enter the analyst name for documentation. This inquiry is optional. You can leave it blank.

3. Subject/Job ID. Enter the subject or job ID. We highly recommend not putting the subject name for maintaining the subject confidentiality. This inquiry is optional. You can leave it blank.

4. Job Description and Notes. Enter the job description or any notes about the assessed job or subject. This inquiry is optional. You can leave it blank.

5. Units. Select the preferred units by clicking the cell. There are two options for the units: SI (kg and m) and English (lbs, foot, and inches).

6. Consider worker-specific factors?. If you want to include worker-specific factors such as demographics (age, gender, body weight, and height), the medical history associated with LE-WMSDs, and sports participation in the assessment, please answer 'Yes' by clicking the cell.

7. Start Assessment Button. If you finished filling out all inquiries in the job information window, you can start the assessment by clicking the button.

Input Window Sheet

After clicking the start assessment button in the job information sheet, while the job information sheet will be hidden, a new sheet will pop-up. The newly displayed sheet is the 'input window' sheet (Figures 10 and 11). Two main sections of the input window are the occupational factor inputs section and the worker-specific inputs section.

If the user chooses not to consider the worker-specific risk factor by clicking 'No' as the response of the 'consider the worker-specific risk factor?' query in the previous sheet (the job information sheet), the inquiries related to the worker-specific inputs will not be displayed on the input window page.

Input Window

Occupational Factors Inputs

Lower Extremity Posture and Activities

Driving	Does the job involve driving (while sitting) activities?	No
Jumping	Does the job involve jumping activities?	No
Kneeling	Does the job involve kneeling postures?	No
Sitting	Does the job require sitting postures?	No
Squatting	Does the job require squatting postures?	No
Stair climbing	Does the job require stair climbing activities?	No
Standing	Does the job require standing postures?	No
Walking	Does the job require walking postures?	No

Manual Material Handlings

Does the job involve lifting and or carrying activities	No
---	----

Whole-Body Vibration Exposure

Does the job make the worker exposed to whole-body vibration?	No
---	----

Figure 10. Occupational Factors Section of the Input Window

Worker-specific Factors Inputs

Demographics

Gender	NA
Age (years)	NA
Weight (kg)	NA
Height (cm)	NA

Medical History associated with LE-WMSDs

Hip injury in the past, hip joint abnormality, or hip osteoarthritis	No
Knee injury or severe knee pain in the past, and or knee osteoarthritis	No
Foot/ankle injury in the past	No
Osteoporosis	No
Rheumatoid Arthritis	No

Shoes

Daily working shoes	NA
Subjective opinion on how well the shoes support the foot	NA

Sport participations

Cutting, pivoting, jumping, lateral movement sports; 50 hours/year	No
--	----

Others

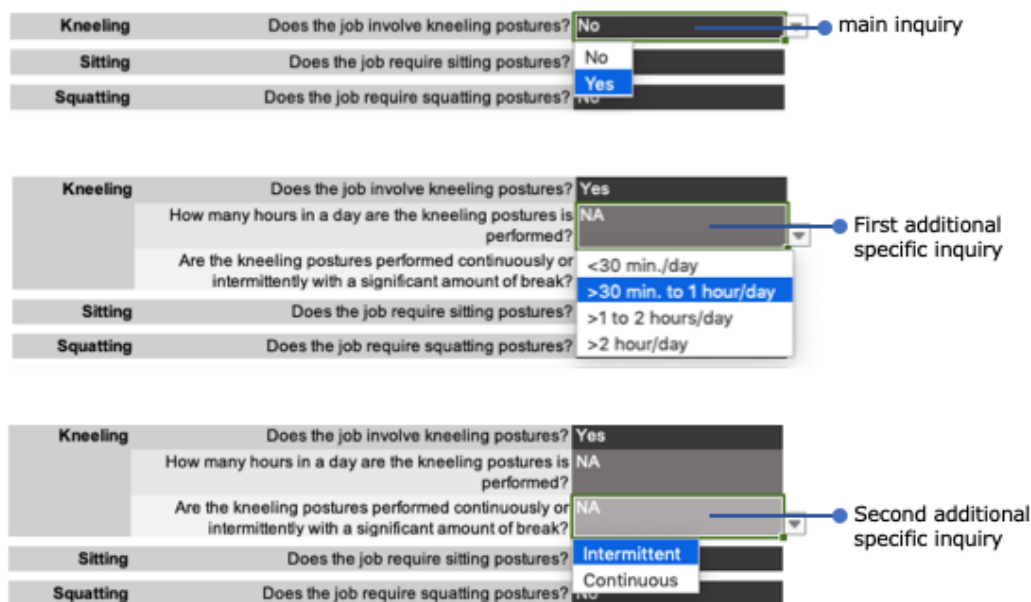
Perceived Job Stress	NA
----------------------	----

Figure 11. Worker-specific Factors section of the Input Window

1. *Occupational Risk Factor Inputs.* Enter the exposure associated with occupational risk factors.

1a. *Lower Extremity Postures and Activities.* Enter the exposure associated with lower extremity postures and activities by clicking the 'No/Yes' dropdown. By choosing "Yes," additional specific inquiries may appear. For most postures or activities, the additional inquiries ask the exposure quantity (duration) and whether the duration was performed intermittently or continuously. For the explanation about several terminologies utilized in this tool, i.e., intermittently and continuously, please refer to the Nomenclature chapter on Page 17.

Please leave the dropdown on 'No' for the lower extremity postures and activities not part of the investigated jobs.



1b. *Manual Material Handling.* Enter the exposure associated with lifting and carrying activities by clicking the 'No/Yes' dropdown. By choosing 'Yes,' three additional inquiries will appear (Figure 11). The additional inquiries ask whether the observed employee lifts/carries loads at specific ranges in a particular frequency. To respond to the additional inquiries, click the No/Yes dropdown.

Leave the dropdown on 'No,' if the observed employee does not do any lifting or carrying activities as part of his/her job.

Manual Material Handlings	
Does the job involve lifting and or carrying activities	Yes
Does the job involve lifting and or carrying activities on the below load ranges	
>2 times/day	
>=10 kg, but <25 kg; >2 times/day	No
>=25 kg, but <50 kg; >2 times/day	No
>=50 kg; >2 times/day	No

Figure 12. Inquiries associated with manual material handling activities

1c. *Whole-body vibration.* Enter the exposure associated with exposure to whole-body vibration by clicking the 'No/Yes' dropdown. By choosing 'Yes,' one additional inquiry, which asks the duration of the whole-body vibration exposure, will appear. To respond to the additional inquiry, click the dropdown and select the range of duration which represents the whole-body vibration exposure duration for the observed employee.

Leave the dropdown on 'No,' if the observed employee is not exposed to any whole-vibration.

Whole-Body Vibration Exposure

Does the job make the worker exposed to whole-body vibration? Yes

If the job make the worker exposed to **whole body vibration (WBV)**, how long the worker exposed to WBV? NA

<2 hour/day
2 hours/day to < whole shift about and >whole shift

Figure 13. Inquiries associated with whole-body vibration exposure

2. Worker-specific Risk Factor Inputs. Enter the exposure associated with worker-specific risk factors such as demographics, medical history related to LE-WMSDs, and sports participation.

2a. Demographics. Enter the gender identity, by clicking the 'Female/Male' dropdown. To enter the age, body weight and height, type the values in the designated cells. The units of the body weight and height will follow the units that were chosen in the job information window. For the SI units, the unit of the weight is in kg, while the unit of the height is in cm. For the English units, the unit of the weight is in lbs, while the unit of the height is in feet and inches.

2b. Medical history associated with LE-WMSDs. Enter the medical history associated with LE-WMSDs by clicking the 'No/Yes' dropdown for each inquiry.

2c. Shoes. Enter the shoe-related exposures: type of shoes worn daily and subjective opinion on how well the shoes support the feet, by choosing the options after clicking the dropdown.

Daily working shoes. Five shoe types are available as the options: work boots, athletic shoes/casual shoes/high-heeled shoes <6 cm/ high-heeled shoes >6 cm.

Subjective opinion on how well the shoes support the foot. Five levels are available as the options: very well, well, neutral, poorly, and very poorly.

2d. Sports participation. Enter the sports-related exposures by clicking the 'No/Yes' dropdown for each type of sport.

2e. Others. Enter the perceived job stress by choosing the options after clicking the dropdown. Four levels are available as the options: not at all stressful, mildly stressful, moderately stressful, and very stressful.

Buttons on the Input Sheet

Job information Button. This button has the functions for returning to the job information window. However, returning to the job information window will reset all of the inserted inputs.

Download printable inquiries Button. This button has the functions for downloading the printable (pdf) version of all inquiries of the input window.

Reset Inputs Button. This button has the functions to reset all input values of the input window.

Calculate Risks Button. This button has the function to calculate the risks based on the inputs. By clicking this button, while the input window will disappear, the 'assessment results sheet' will pop-up.

Assessment Results Sheet

After clicking the 'calculate risks' button in the input window sheet, a new sheet will pop-up. The newly displayed sheet is the 'assessment results' sheet (Figure 14).

The assessment results sheet presents the risk calculation results determined based on the inserted inputs. The LERFAT divided the assessment results into three parts: assessment results of the hips, knees, and foot/ankles. Since there are no differences between the layouts of the three sections (meaning the three parts of the lower extremity) of the assessment results, the following explanation only discusses the anatomy of the assessments results for the knees (though the explanation pertains to the results display for each part of the lower extremity).

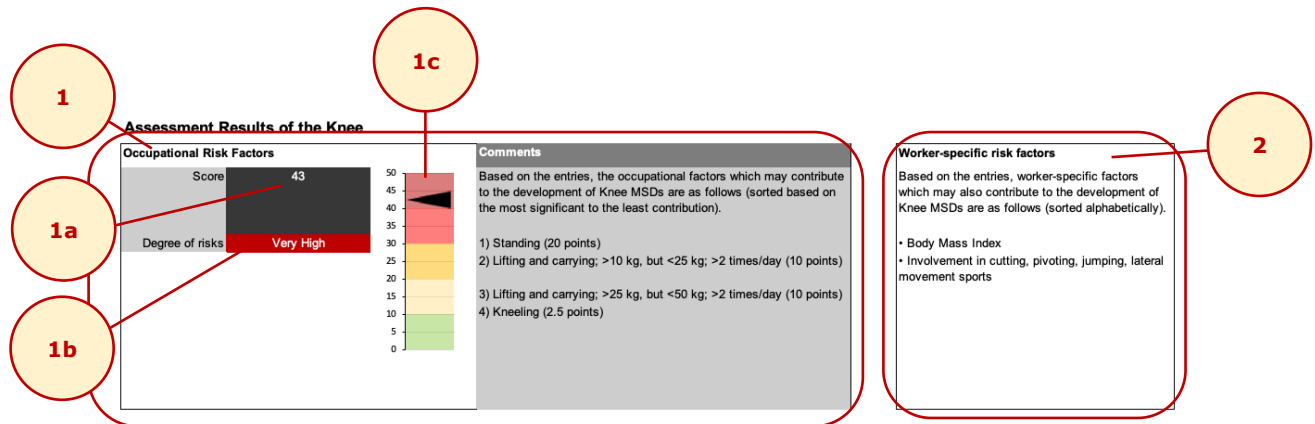


Figure 14. The 'Assessment Results' Sheet

1. Occupational risk factor section. This section provides information about the assessment results of the occupational factors. Three types of information are available in this section: 1a) the **score** of the occupational risk factor, 1b) the **degree of risk**, and 1c) the **graphical representation** of the score or the degree of risks.

1a. Score of the Occupational Risk Factors. The score refers to the final calculation as the assessment results of the occupational risk factors. Further explanation of the score calculation is provided in the next chapter on Page 14.

1b. Degree of risk. The degree of risk is the verbal descriptor of the score. In determining the verbal descriptor of the score, five levels of risks are utilized (Table 1). An employee is exposed to an acceptable level of occupational risk if the score is less than 10. A score greater or equal to 10 but less than 20 indicates that the employee is exposed to a slight level of occupational risk. A score greater or equal to 20 but less than 30 indicates that the employee is exposed to a moderate level of occupational risk. A score greater or equal to 30 but less than 40 indicates that the employee is exposed to a high level of occupational risk. If a score greater than 50 is observed, an extremely high level of occupational risk exposes the employee.

Table 1. Verbal descriptor of the score as the degree of risk

Score	Degree of Risk
<10	Acceptable
10 to <20	Slight
20 to <30	Moderate
30 to <40	High
40 to <50	Very High
≥50	Extremely High

1c. Graphical representation of the score. In order to make the comprehension of the degree of risk easier, a color-coded graphical representation is also presented in addition to the verbal descriptor.

1d. Comments. The comments section provides information about the list of occupational risk factors present in the assessed jobs. The list of risk factors is sorted based on the most contributing to the least contributing factors.

2. Worker-specific risk factor section. This section provides information about the assessment results of the worker-specific factors. The results are presented using the list of risk factors present in the assessed jobs. The list of risk factors is sorted alphabetically.

How does the LERFAT calculate the risks?

In calculating the scores to determine the degree of risk for each lower extremity part (hip, knee, and foot/ankle), each of the inquiry responses of the occupational factors is assigned a specific score (Table 4). The scores vary depending on several factors such as exposure quantity (duration) of the factors and whether the exposure is intermittent or continuous. The summations of the scores are utilized to determine the occupational risk factor (ORF) scores (Equations 1). Furthermore, the list of risk factors as the assessment output for the worker-specific factors are determined based on Table 5.

$$\text{Total of the ORF Scores} = \sum_{i=1}^n \text{ORF}_i \quad \text{Equation 1}$$

Furthermore, the following passage, as well as Tables 2 and 3, provide an example of the calculation in determining LERFAT scores.

Emily is a 45 years old, female worker who worked at an automotive parts manufacturing plant. Her job is stacking two metal parts, placing them into the fixture, and pushing the button of the machine joining the parts. During a typical working day, she repeats the task 1000 times. The metal parts weigh 3 lbs. She does the tasks while standing for an 8-hour shift with standard breaks (a 10 min. break in the morning and the afternoon and a 30 min. lunch break mid-shift). Her weight is 200 lbs., and she is 5'8'' tall. Emily does not have any medical history of injuries or significant disorders in the lower extremities. She wears the same steel-toe shoes every day, which she thought it provides very well support to her feet.

Table 2. Occupational risk factor scores of Emily's job

Items of the occupational factors	Hip Score	Knee Score	Foot/ankle score
Standing on hard floor continuously for 8 hours	20	20	30
Lifting and carrying: <22 lbs; >2 times/day	0	0	0
Total OF Score	20	20	30

Table 3. The list of worker-specific risk factors of Emily's job

Hip	<ul style="list-style-type: none"> Gender: Female Body Mass Index: 30.4 ($\geq 30 \text{ kg/m}^2$)
Knee	<ul style="list-style-type: none"> Gender: Female Age: 45-<50 Body Mass Index: 30.4 ($\geq 30 \text{ kg/m}^2$)
Foot/ankle	<ul style="list-style-type: none"> Gender: Female Body Mass Index: 30.4 ($\geq 30 \text{ kg/m}^2$)

Table 4. Individual scores for occupational factors

Leg postures or activities	Quantitative Exposure	Score for risk calculations					
		Hip		Knee		Foot/ankle	
		C*	I*	C	I	C	I
Driving	<8 hours/day	0	0	0	0	0	0
	8 to <10 hours/day	0	0	10	10	0	0
	>=10 hours/day	0	0	20	20	0	0
Jumping >1 m	No	0	0	0	0	0	0
	Yes	0	0	20	20	0	0
Kneeling	<30 min./day	0	0	0	0	0	0
	30 min. to <1 hour/day	0	0	20	20	0	0
	1 to <2 hours/day	10	0	30	20	0	0
	>=2 hour/day	10	0	30	30	0	0
Sitting	<2 hours/day	0	0	0	0	0	0
	>=2 hours/day	20	10	0	0	0	0

Squatting	30 min. to <1 hour/day	0	0	20	10	0	0
	1 to <2 hours/day	0	0	20	20	0	0
	>=2 hours/day	0	0	30	30	0	0
Stair climbing	<10 flights/day	0	0	0	0	0	0
	>=10 to <15 flights/day	0	0	10	10	0	0
	15 to <30 flights/day	20	20	20	20	0	0
	>=30 flights/day	20	20	20	20	0	0
Standing on hard floor	<2 h./day	0	0	0	0	0	0
	2 to <4 h./day	0	0	20	20	0	0
	4 to <8 h./day	20	10	20	20	0	0
	>=8 h./day	20	10	20	20	30	20
Standing on anti-fatigue mat	<2 h./day	0	0	0	0	0	0
	2 to <4 h./day	0	0	20	20	0	0
	4 to <8 h./day	20	10	20	20	0	0
	>=8 h./day	20	10	20	20	20	10
Walking on even surface	<2 hours/day	0	0	0	0	0	0
	>=2 hours/day	10	10	0	0	0	0
Walking on uneven surface	<2 hours/day	0	0	0	0	0	0
	>=2 hours/day	10	10	10	10	0	0
Lifting and carrying	No lifting or carrying	0	0	0	0	0	0
	<22 lbs; >2 times/day	0	0	0	0	0	0
	22 to <55 lbs; >2 times/day	0	0	10	10	0	0
	55 to <110 lbs; >2 times/day	0	0	10	10	0	0
	>=110 lbs; 2 times/day	10	10	20	20	0	0
Whole body vibration exposure	<2 hour/day	0	0	0	0	0	0
	2 to <8 h./day	10	10	0	0	0	0
	>=8 h./day	10	10	0	0	20	20

*) C = Continuously, I = Intermittently

Table 5. Items of worker-specific factors associated with LE-MSDs

Items of risk factors associated with LE-MSDs in the hip	Demographics
	Body Mass Index: 25 to <30 kg/m ²
	Body Mass Index: ≥30 kg/m ²
	Gender: Female
	Medical history associated with LE-MSDs in the Hip
	Hip Injury in the past
	Hip joint abnormality
	Inflammatory Arthritis in hip
	Hip rotation imbalance
	Sports Participation
	Tennis: weekly
	Track/field: >2 hours/week
	Cutting, pivoting, jumping, lateral movement: >50 hours/year
Items of risk factors associated with LE-MSDs in the knee	Demographics
	Age: 45-<50
	Age 50-<55
	Age: ≥55
	Body Mass Index: <25 kg/m ²
	Body Mass Index: ≥30 kg/m ²
	Gender: Female
	Medical history associated with LE-MSDs in the knee
	Hip Injury in the past
	Knee pain in the past
	Knee injury in the past
	Foot/ankle injury in the past
	Heberden's node
	Malalignment of the knee
	Sports Participation
	Soccer: weekly
Rugby/ American Football: weekly	

	Cutting, pivoting, jumping, lateral movement: >50 hours/year
	Psychosocial factors
	Perceived job stress: \geq moderately stressful
	Physical inactivity
Items of risk factors associated with LE-MSDs in the foot/ankle	Demographics
	Age 50-<55
	Age: \geq 55
	Body Mass Index: <25 kg/m ²
	Body Mass Index: \geq 30 kg/m ²
	Gender: Female
	Medical history associated with LE-MSDs in the foot/ankle
	Hip Injury in the past
	Knee injury in the past
	Foot/ankle injury in the past
	Lower back injury in the past
	Flat foot or high arched foot
	Vascular disorders
	Rheumatoid Arthritis
	Osteoporosis
	Pronated foot posture
	Sports Participation
	Soccer: weekly
	Rugby/ American Football: weekly
	Cutting, pivoting, jumping, lateral movement: >50 hours/year
	Shoes
	High-heeled shoes (>6cm)
	No shoes rotation
	Poor or very poor shoes support (self-reported)
	Others
	Fear of re-injury

Nomenclature

Intermittently vs. continuously performed activities/postures

In several additional inquiries, LERFAT asks whether the exposure quantity (duration) of the lower extremity postures were performed intermittently or continuously (Figure 15). The lower extremity postures considered as performed continuously if the postures were maintained without or with brief postural breaks. On the other hand, the lower extremity postures considered as performed intermittently if the postures were maintained with a significant amount of postural break. We define the postural break if the worker does a significantly different posture compared to the previously maintained postures. Note: We do not consider lunch break as a postural break for the lower extremity postures.

The image shows a survey form for kneeling postures. The first question is 'Does the job involve kneeling postures?' with a 'Yes' response. The second question is 'How many hours in a day are the kneeling postures is performed?' with a response of '>30 min. to 1 hour/day'. The third question is 'Are the kneeling postures performed continuously or intermittently with a significant amount of break?' with a dropdown menu showing 'Intermittent' selected. A red box highlights the third question and its dropdown menu.

Figure 15. Example of inquiries which asked about intermittently or continuously performed postures

Example of continuously performed postures

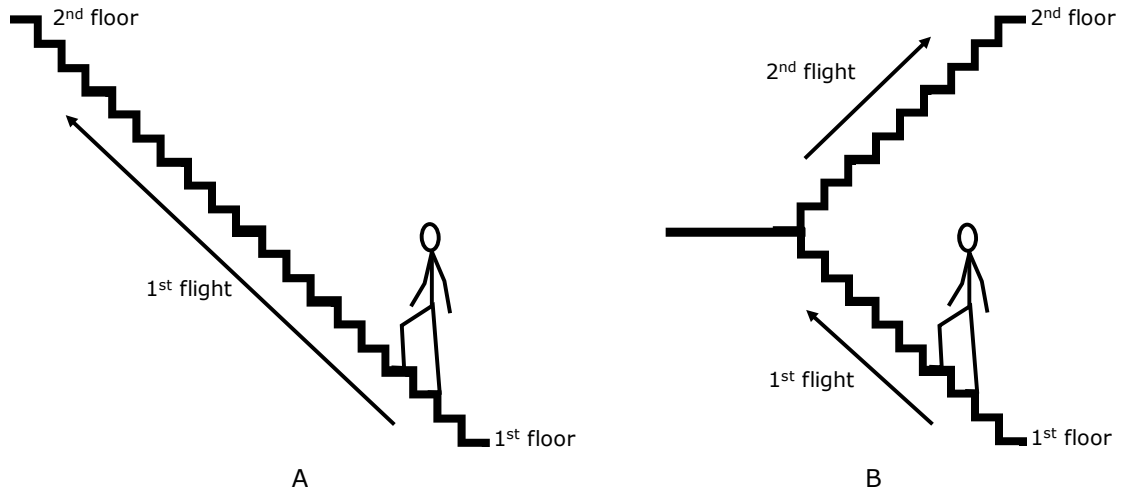
<p>Kelly, who has the responsibility for stacking two metal parts and pushing the button of the machine that joins the parts, does the tasks while standing. She works in this posture for an 8-hour shift with a 30 minute lunch break in the middle of the day.</p>	<p>Since we do not consider lunch break as a postural break, it can be inferred from the description that she maintains a standing posture continuously for 8 hours/day.</p>
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Example of intermittent duration

<p>John works in an automotive parts maker company, and he has the job description of monitoring five welding robots. In monitoring the welding robots, he needs to stand for about 5 minutes several times. There are five touch-screen monitors which are monitored by John. Since each monitor is placed about 15 feet apart, he needs to walk as well as stand to perform his job. The activity monitoring performed by the ergonomics department indicates that in total he stands for 4 hours, while the rest of the time he is walking.</p>	<p>We can infer that the worker stands for 4 hours/day and walks for 4 hours/day. Because he needs to walk in between the periods of time that he stands, each activity/posture was considered as performed intermittently.</p>
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Number of flights as the unit of stair climbing exposure quantity

The unit of the stair climbing exposure quantity is the number of flights. This unit is different from the units of other posture/activity exposure quantities which are commonly expressed using total duration in a day (hours or minutes/day). A flight of stairs is an interrupted series of stairs. Walking between two floors usually requires one or two flights of stairs (Figure 16).



A
B
Figure 16. Number of flights between two floors:
A) Walking between two floors with one flight of stairs;
B) Walking between two floors with two flights of stairs

Walking on uneven and even surfaces

One of the inquiries about a worker's walking activity asks whether the walking occurs on even or uneven surfaces. Walking on an even surface means that the walking is performed on a flat or same level surface without any sudden changes of the surface level. On the other hand, if a sudden change of surface level is experienced during walking because of things such as potholes or uneven paving or flooring, we can define this as walking on uneven surfaces.