StrainAnalysis

A program for estimating risk of work related musculoskeletal disorders

Contents

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1. Introduction

The StrainAnalysis program is intended to aid in the identification of jobs and job tasks that may present an increased risk for work related musculoskeletal disorders in the distal upper extremities (from the elbow down to the fingers). The program is based upon the Strain Index equation, which was published by Moore and Garg in the American Industrial Hygiene Association Journal in May 1995. This equation takes into account the interplay among a number of weighted ergonomic stressors and calculated a numerical figure which is associated with the risk of workers developing musculoskeletal disorders of the upper extremities. The work of Moore and Garg suggests that job tasks with a strain index of 5.0 or greater present such a risk, while tasks with a strain index less than 5.0 are unlikely to be associated with such risk. Interested readers and users of this system are encouraged to obtain a copy of this article.

In addition to the strain index itself, the program provides the numerical multipliers for each of the ergonomic stressors. This is helpful in job analyses in that it aids in the identification of the specific components of a task which are most in need of ergonomic remediation.

In its present form, the strain index does not address neck problems, nor does it address proximal upper extremity problems (such as shoulder strain). Vibration related problems are also not included in this job analysis system.

2. Data Collection

To use this system for job task analysis, **the job analyst or ergonomics team collects data for task variables**. This analysis takes place during observation of the job being performed by a worker or workers. The worksheet at the end of this document can be used for this purpose, and the data then entered on a PC running the software. A more efficient means of performing data entry may be to bring a laptop, notebook or pen-tablet type computer right to the workstation. This would allow calculation of multipliers and strain index while the job is being observed. Performing the analysis in this manner could help in making immediate ergonomic changes and then observing the effect of these changes in the strain index and multiplier figures. Thus the system could be used for task analysis and immediate task remediation.

The specific data to be collected will be discussed below.

A. Department. This refers to the particular department or business unit in which the job task was evaluated. This seems to be the most appropriate term to use for most businesses but may not specifically apply to all businesses.

B. Date. The date of most recent analysis of the task in question. Any date format you prefer can be used (i.e. 12/3/99, 3 Dec 99, December 3 1999, etc.). This date does not interact with other data and we do not anticipate any Y2K problems.

C Job Title. If there is a specific job title in which the task in question is performed, it is entered here. Some information or identifier is required here (e.g., Machinist).

D. Job Task. This is the actual task being analyzed. It may be a large part of the job, or it may be a small or infrequent task within the job title (e.g., burring). This is a required field.

E. Analyst. This is the person primarily responsible for ergonomic job analysis of the specific task in question. In many cases there may be a team performing the analysis, but one individual should be identified as the primary analyst.

F. Total Observation Time. This is simply the length of time the job task was observed by the analyst or ergonomics team. This will vary quite a bit from one task to another. For very rapid, repetitive tasks with short cycle times it may not take very long to acquire all the information needed, while other tasks might take quite a bit longer. It is important to observe the task for a sufficient period of time to get a good sense of the task requirements, for as many repetitions of the complete job cycle as feasible. The time data are entered in the appropriate boxes (minutes and seconds).

G. Total Effort Time. During the period of observation, this is the amount of time the worker is actually performing the ergonomically stressful task, measured using a stopwatch. In a job cycle, the worker may be applying force for a small percent of the cycle time, or may be applying force for the entire cycle. Over a number of job cycles, an average effort time can be estimated. This parameter (Total Effort Time) represents the amount of time that work is being done, and does not include rest periods between exertions (while the Total Observation Time includes rest time, if any). For example, if a job cycle takes one minute, and during this cycle the worker applies force for 30 seconds, and the job is observed for 10 minutes, the Total Effort Time is 5 minutes (300 seconds). The time data are entered in the appropriate boxes (minutes and seconds).

H. Efforts Observed. Over the course of observation of the task, the actual number of efforts observed (or job cycles) is tracked using a counter. This number is entered in the appropriate box.

I. Hours per Day. This refers to the number of hours per day (assuming a 5-day workweek) the worker performs the job task being analyzed. This figure is entered in the appropriate box. (If it is not a whole number, use decimals; i.e. one and a half hours is represented as 1.5).

J. Intensity of Effort. There are five categories which can be accessed by clicking on the down arrow to the right of the dropdown list box, or (with explanations) by clicking the "Info" button. These categories are somewhat subjective and are based on the use of verbal descriptors: Light, Somewhat Hard, Hard, Very Hard, Near Maximal. If in doubt, a consensus should be sought among ergonomic team members and workers performing the job task.

K. Postures. There are five categories that can be accessed by clicking on the down arrow to the right of the dropdown list box, or (with explanations) by clicking the "Info" button. These categories are somewhat subjective and are based on the use of verbal descriptors: Very Good, Good, Fair, Bad, Very Bad. These refer to hand/wrist postures and correlate somewhat with measured ranges of motion (as described in the "Info" screen). If in doubt, a consensus should be sought among ergonomic team members and workers performing the job task. It is important to realize that these are estimates of overall upper extremity postural demands. For example, even if the actual hand/wrist posture qualified for a "Good" rating, a job that required awkward positioning of the thumb joints would push the posture rating into a less favorable category.

L. Speed. There are five categories that can be accessed by clicking on the down arrow to the right of the dropdown list box, or (with explanations) by clicking the "Info" button. These categories are somewhat subjective and are based on the use of verbal descriptors: Very Slow, Slow, Fair, Fast, and Very Fast. If in doubt, a consensus should be sought among ergonomic team members and workers performing the job task.

After all data are entered, click the Calculate button to perform the calculations.

3. Calculated Items

The StrainAnalysis program calculates efforts per minute, percent duration of effort, the strain index for the task, as well as multipliers for each of the task variables. The multipliers provide a weighted assessment of the ergonomic stress on the distal upper extremity for the associated task variable. For each multiplier, the lower the value the more favorable the task variable.

Specific calculated items are as follows.

A. Efforts per Minute. This is simply based on the number of efforts observed and the total observation time.

B. Percent Duration of Effort. This is based on the total effort time and total observation time, and is simply the percentage of time during the task in which work is being done (as opposed to rest time).

C. Multipliers:

a. Efforts per Minute Multiplier. This is a function of efforts per minute, and varies from 0.5 to 3.0, depending on how repetitive the task is. However, in the case in which percent duration of effort is 100%, this multiplier is automatically set to 3.0 regardless of the efforts per minute.

b. Percent Duration of Effort Multiplier. This is a function of percent duration of effort, and varies from 0.5 to 3.0.

c. Intensity of Effort Multiplier. This is a function of intensity of effort. It varies from 1.0 to 13.0. As you can see, this is heavily weighted and thus intensity of effort is an important task variable.

d.   Posture Multiplier. This is a function of the hand/wrist posture estimate, and varies from 1.0 to 3.0.

e. Speed Multiplier. This is based on the speed of the job and varies from 1.0 to 2.0.

f. Hours per Day Multiplier. This is a function of the hours worked (at the job being evaluated) per day, and varies from 0.25 to 1.5.

D.   Strain Index. This is an overall estimate of the relative risk of an association between a job task and distal upper extremity work related musculoskeletal disorders. A figure lower than 5.0 is suggestive of a lower such risk, while the incidence of these types of problems may climb when the Strain Index is 5.0 or greater.

4. Controls

The user interface provides a number of controls accessible to the user.

A. Calculate button. After all appropriate data are entered, click the Calculate button to obtain the various multipliers, percent duration of effort, efforts per minute, and strain index.
B. New Task button. This button clears the screen and prepares the database for entry of a new task. After entering a new job task, and performing the calculations, click any arrow on the Data Control (see below) to save this job to the database.
C. Browse Database button. This button brings up a screen that shows the database (Strain.mdb) in which job data are store, in a table format.
D. Data control. This is the long bar along the bottom of the main screen, with arrowheads at either end. The caption within this control indicates the current record being viewed or edited. The far left and far right arrows bring up the first and last records in the database, respectively. The near left and near right arrows move to the previous and next record, respectively.
E. Intensity of Effort Info button and drop down list. The Info button provides a screen that gives suggestions on the various choices for intensity of exertion. Clicking the button for a given intensity category returns to the main screen with your choice selected in the drop down list. Once you have a familiarity with the choices available then simply use the drop down list by clicking the small down arrow.
F. Postures Info button and drop down list. The Info button provides a screen that gives suggestions on the various choices for hand/wrist postures. Clicking the button for a given posture category returns to the main screen with your choice selected in the drop down list. Once you have a familiarity with the choices available then simply use the drop down list by clicking the small down arrow.
G. Speed Info button and drop down list. The Info button provides a screen that gives suggestions on the various choices for job speed. Clicking the button for a given speed category returns to the main screen with your choice selected in the drop down list. Once you have a familiarity with the choices available then simply use the drop down list by clicking the small down arrow.

5. Menu Items

There are a number of other user functions accessible through the various menu items.

A. File Menu:
   a. Find. This allows the user to search the database for a previously entered job task. The database can be searched by Department, Job, or Task.
   b. Delete. This deletes the current record from the database.
   c. Print. This prints a simple report on the current record (the job currently on the screen). The printout includes the department, the job title, the task being analyzed, the analyst performing the analysis, the date of the analysis (not the date it was printed), the task variables (hours per day,

percent duration of effort, efforts per minute, intensity of efforts, hand/wrist postures, and speed) and the strain index score.
- d. Exit. This closes the program (providing a prompt before closing in case Exit was clicked accidentally).
- B. Edit. This is similar to the edit function in most Windows programs:
  - a. Cut. This cuts out the selected text (such as a job title) but holds it in the Windows clipboard so that it can be reused (perhaps in a New Task entry).
  - b. Copy. This copies the selected text to the clipboard without cutting it from the selected field.
  - c. Paste. Anything stored in the clipboard is entered in the selected field.
- C. Jobs. This is another way to navigate the database (In addition to using the arrow buttons on the data control).
  - a. Next. Moves to the next record in the database.
  - b. Previous. Moves to the previous record in the database.
- D. Help. A standard help function.
  - a. Contents. Opens help.
  - b. About. Some information about the program.

6. Database

The data collected and calculated using the StrainAnalysis program are stored in an "Access" type database (filename "Strain.mdb"). The "Browse Database" button provides a view of part of the database in a table format. The table is "read only" and editing the database must be done on the main screen.

7. Worksheet

Attached to this Readme document is a worksheet, which can be printed and used at the job site for data collection (however if a laptop or other portable computer is available the worksheet is unnecessary).

8. Errors

There are a number of possible error sources, such as entering letters in fields in which numbers are expected, leaving fields blank, deleting the database file or other program files, etc. If unanticipated errors occur which render the program unusable, please contact us by email at georgepwhite@earthlink.net.

StrainAnalysis Worksheet

Date_____   Analyst_____

Department_____

Job_____

Task_____

Total Observation Time_____Min _____Sec

Total Effort Time_____Min _____Sec

Efforts Observed_____

Hours per Day at this task_____

Intensity of Effort (circle one):
 Light   Somewhat Hard   Hard   Very Hard   Near Maximal

Hand/Wrist Postures (circle one):
Very Good   Good   Fair   Bad   Very Bad

Speed of Work (circle one):
Very Slow   Slow   Fair   Fast   Very Fast

Strain Index (from program):_____

_____   _____
Signature of Analyst   Date