#4 Manual Material Handling

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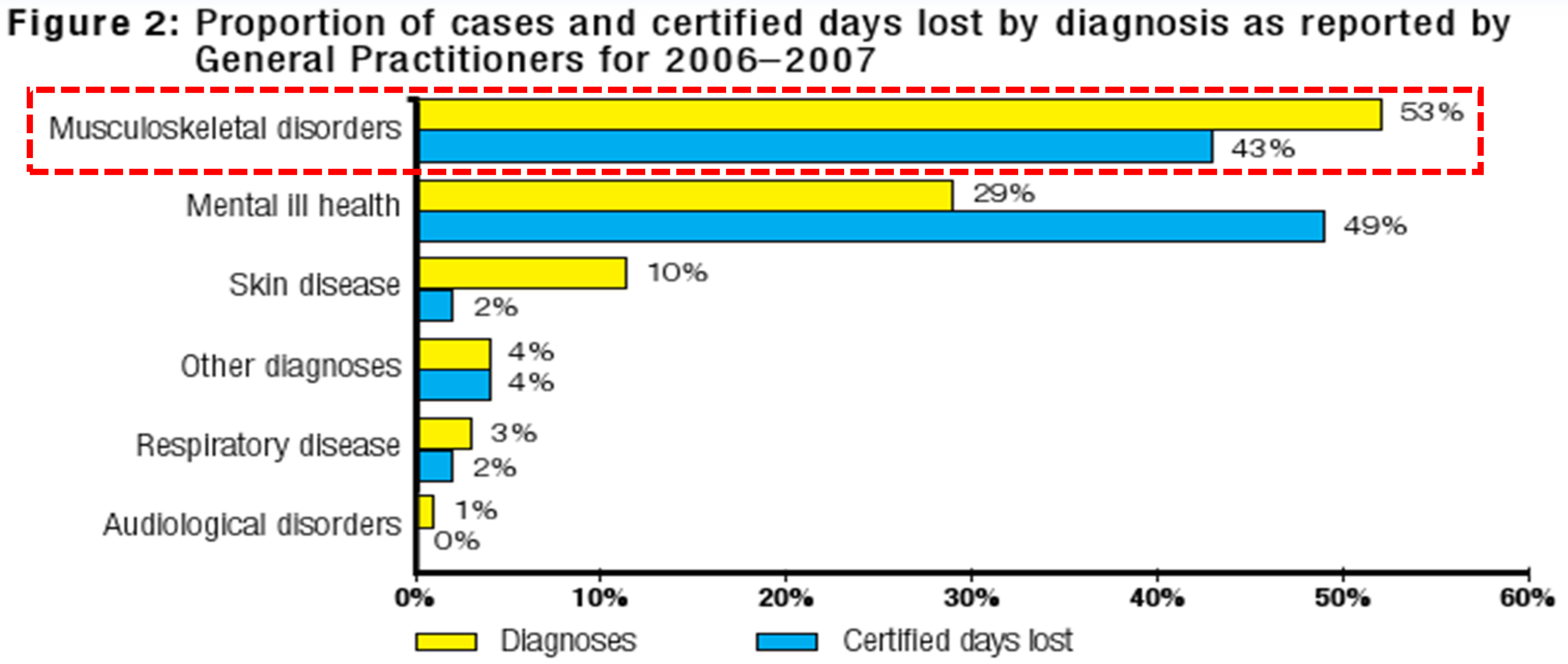
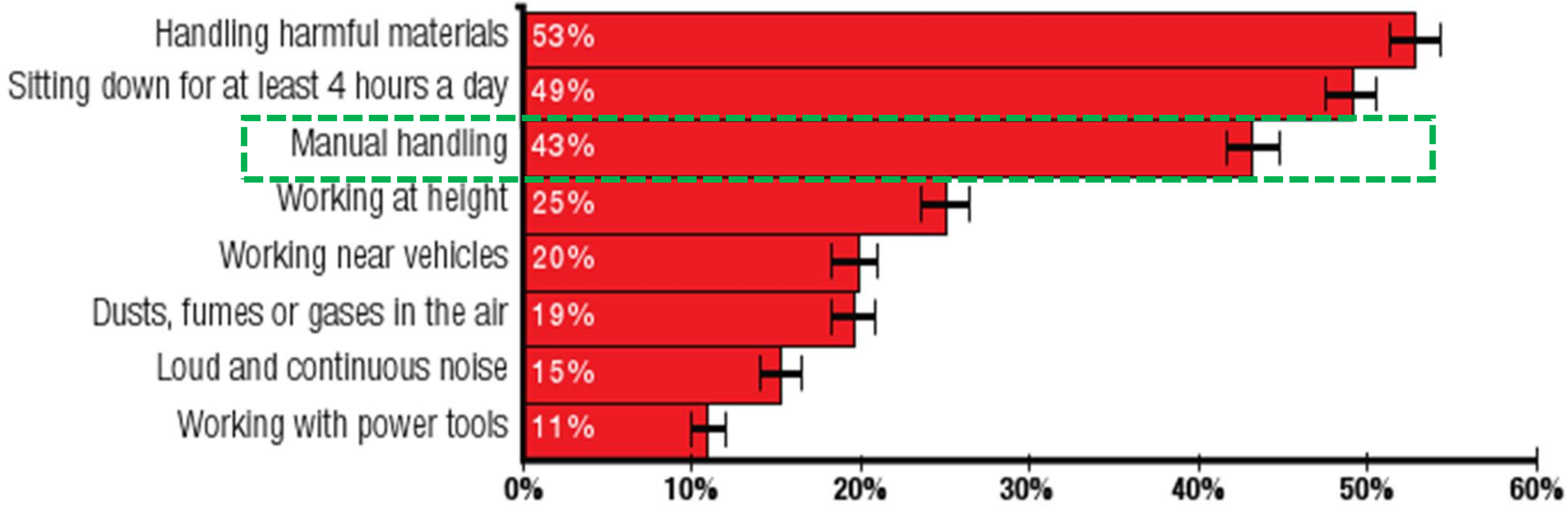
Fact about MSDs



(Case study : British worker)

Fact about Manual Handling

Figure 10: Percentage of British workers that report selected working condition in 2008*



** Source: Fit3 worker survey 2008.*

(Case study : British worker)

Manual Material Handling (MMH)

(See video about MH Safety)

Manual Material Handling System

Individual (Worker)

- Physical
- Sensory
- Personality
- Experience
- Health
- Activity

Material

- Load
- Dimension
- Distribution of load
- Handles
- Stability of load

Workplace

- Workplace geometry
- Environment
- Frequency

Company (Industry)

- Teamwork
- Safety policy
- HSE people
- Shifting
- Insurance support
- Personal protective equipment

How to measure ???

Biomechanical approach
→ remember ??

Physiological (or cardiovascular) approach
→ HR, O_2 consumption, energy consumption.

Psychological approach →
stress level, load index

Mixed approach →
combine several methods

Types of Manual Handling Task

Pulling/pushing

Holding

Carrying

Lifting

The Revised NIOSH Lifting Equation

Lifting Task, defined as the act of manually grasping an object of definable size and mass with two hands, and vertically moving the object without mechanical assistance.

NIOSH : National Institute of Occupational Safety and Health

Lifting Task Limitations

1. MH activities other than lifting are minimal and **do not require significant energy expenditure**, especially when repetitive lifting tasks are performed.
2. The revised lifting equation **does not include task factors to account for unpredicted conditions**, such as unexpectedly heavy loads, slips, or falls.
3. The revised lifting equation as **not designed** to assess tasks involving **one-handed lifting**, **lifting while seated or kneeling**, or **lifting in a constrained or restricted work space**.
4. The revised lifting equation assumes that the **worker/floor surface coupling provides at least a 0.4** (preferably 0.5) coefficient of static friction between the shoe sole and the working surface.
5. The revised lifting equation assumes that lifting and lowering tasks **have the same level of risk for low back injuries**.

Lifting Task Indicator

RWL (*Recommended Weight Limit*) adalah **rekomendasi batas beban** yang dapat diangkat oleh manusia **tanpa menimbulkan cidera** meskipun pekerjaan tersebut dilakukan secara **repetitive** dan dalam **jangka waktu tertentu.**

LI (*Lifting Index*)digunakan untuk mengetahui **index pengangkatan** apakah proses pengangkatan menimbulkan **resiko cidera tulang belakang atau tidak**.

Advantages of The Revised NIOSH Lifting Equation

- Help identify potentially hazardous lifting jobs.
- Help in design/ modification process.
- Help prioritize evaluation of lifting tasks

Recommended Weight Limit (RWL)

RWL = LC x HM x VM x DM x AM x FM x CM

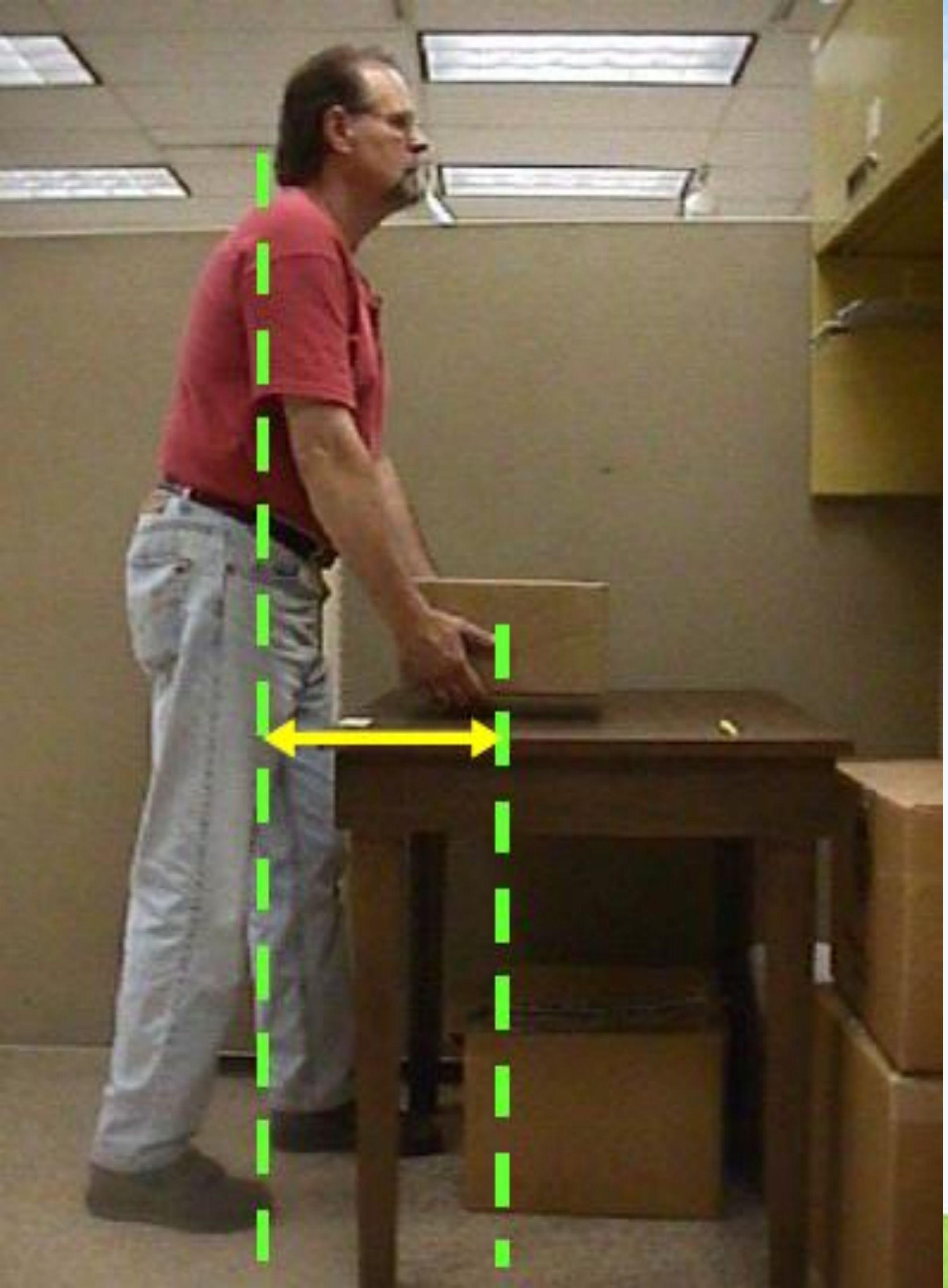
- LC : ***(Lifting Constanta)*** konstanta pembebanan
- HM : ***(Horizontal Multiplier)*** faktor pengali horisontal
- VM : ***(Vertical Multiplier)*** faktor pengali vertikal
- DM : ***(Distance Multiplier)*** faktor pengali perpindahan
- AM : ***(Asymmetric Multiplier)*** faktor pengali asimentrik
- FM : ***(Frequency Multiplier)*** faktor pengali frekuensi
- CM : ***(Coupling Multiplier)*** faktor pengali kopling (handle)

1. LC (Load Constanta)

L (load weight) : weight of the object to be lifted (in pounds or kilograms), including the container.

LC → 23 kg (230N) or 51 lbs

(acceptable to 75% of female population)



2. HM (Horizontal Multiplier)

H → distance of the hands away from the mid-point between ankles.

Measure at the origin & destination of lift.

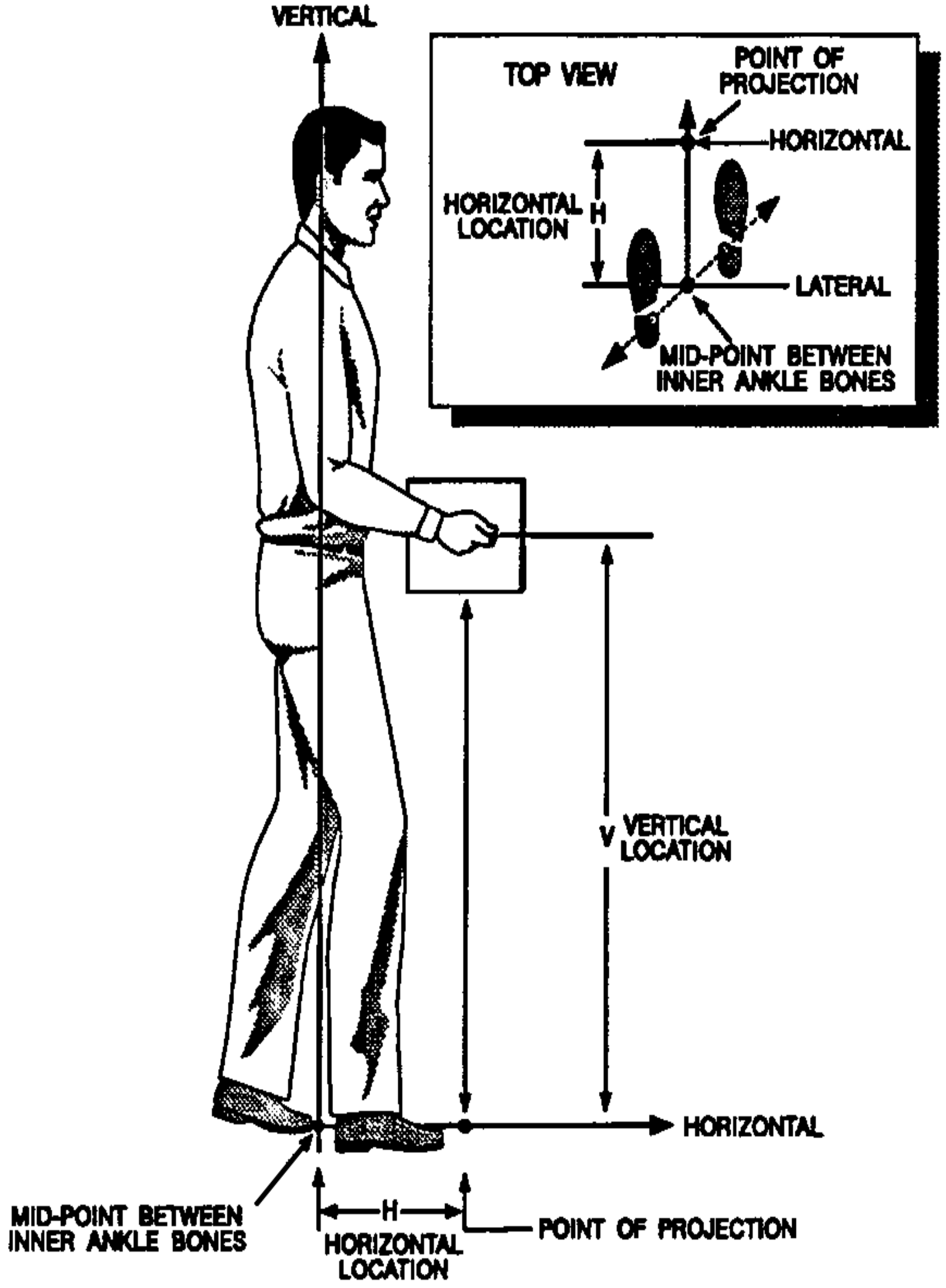
HM (cm) = 25 / H
HM (inch) = 10/ H

3. VM (Vertical Multiplier)

V → distance of the hands above the floor.

Measure at the origin & destination of lift.

VM (cm) = 1−0,003|V−30|
VM (inch) = 1−0,0075|V−30|

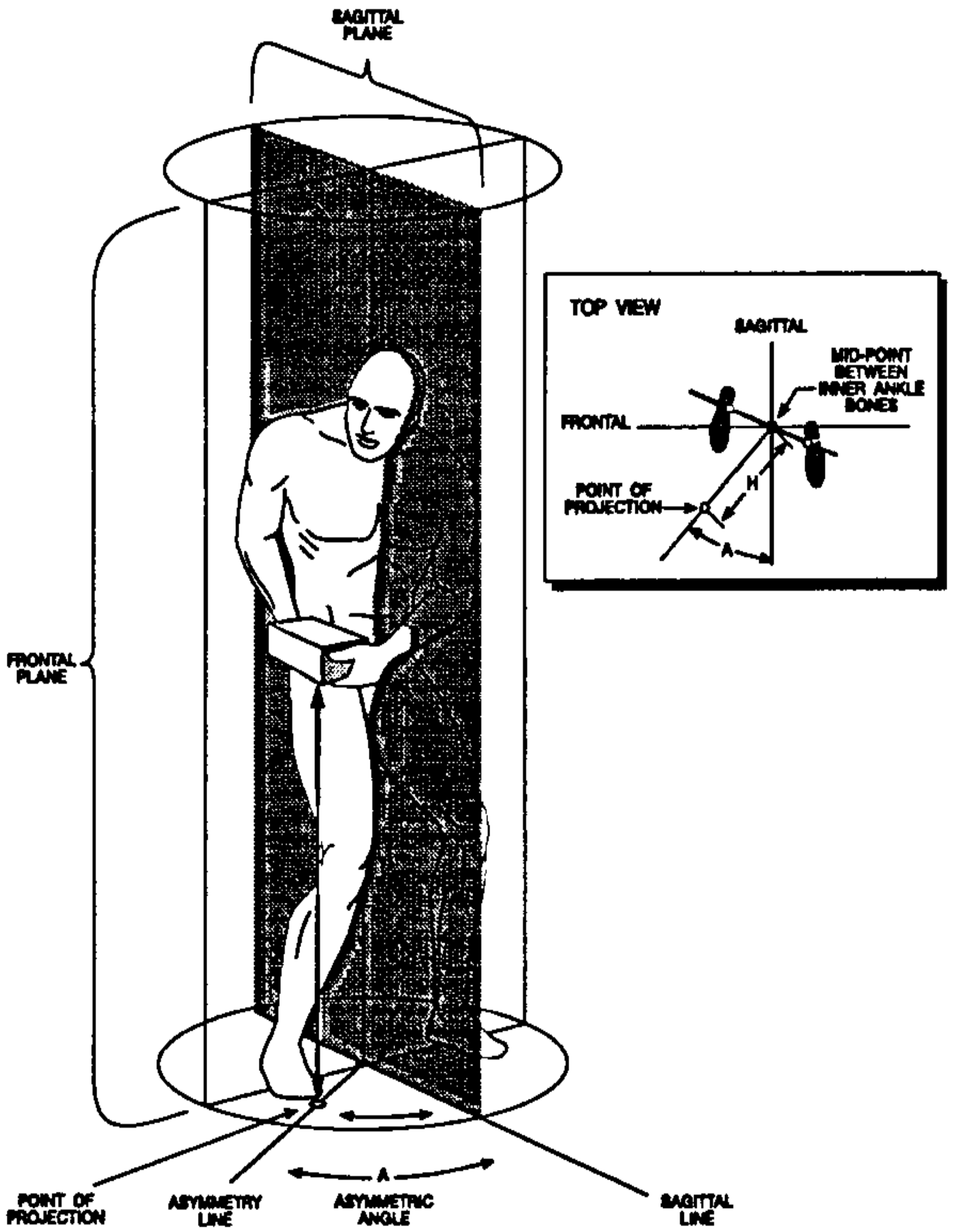


4. DM (Distance Multiplier)

D → absolute value of the difference between vertical heights at the destination and origin of the lift.

DM (cm)= (0,82 + (4,5/D))

DM (inch)= (0,82 + (1,8/D))



5. AM (Asymmetric Multiplier)

A (asymmetry angle) → the location <u>of the load relative to the worker's mid-sagittal plane</u>, as defined by the neutral body position.

Measure at the origin & destination of lift.

AM = (1 – (0,0032 A))

Frequency Multiplier Table (FM)

Frequency Lifts/min (F) ‡	Work Duration					
	≤1 Hour		>1 but ≤2 Hours		>2 but ≤8 Hours	
	V < 30†	V ≥ 30	V < 30	V ≥ 30	V < 30	V ≥ 30
≤0.2	1.00	1.00	.95	.95	.85	.85
0.5	.97	.97	.92	.92	.81	.81
1	.94	.94	.88	.88	.75	.75
2	.91	.91	.84	.84	.65	.65
3	.88	.88	.79	.79	.55	.55
4	.84	.84	.72	.72	.45	.45
5	.80	.80	.60	.60	.35	.35
6	.75	.75	.50	.50	.27	.27
7	.70	.70	.42	.42	.22	.22
8	.60	.60	.35	.35	.18	.18
9	.52	.52	.30	.30	.00	.15
10	.45	.45	.26	.26	.00	.13
11	.41	.41	.00	.23	.00	.00
12	.37	.37	.00	.21	.00	.00
13	.00	.34	.00	.00	.00	.00
14	.00	.31	.00	.00	.00	.00
15	.00	.28	.00	.00	.00	.00
>15	.00	.00	.00	.00	.00	.00

†Values of V are in inches. ‡For lifting less frequently than once per 5 minutes, set F = .2 lifts/minute.

6. FM (Frequency Multiplier)

F → average number of lifts per minute over a 15 minute period.

Duration is classified as :

- Short (1 hour)
- Moderate (1–2 hours)
- Long (2–8 hours)

See FM Table

7. CM (Coupling Multiplier)

C → classification of the quality of the hand-to-object coupling (e.g., handle, cut-out, or grip).

See CM Table

Hand-to-Container Coupling Classification

GOOD	FAIR	POOR
1. For containers of optimal design, such as some boxes, crates, etc., a "Good" hand-to-object coupling would be defined as handles or hand-hold cut-outs of optimal design [see notes 1 to 3 below].	1. For containers of optimal design, a "Fair" hand-to-object coupling would be defined as handles or hand-hold cut-outs of less than optimal design [see notes 1 to 4 below].	1. Containers of less than optimal design or loose parts or irregular objects that are bulky, hard to handle, or have sharp edges [see note 5 below].
2. For loose parts or irregular objects, which are not usually containerized, such as castings, stock, and supply materials, a "Good" hand-to-object coupling would be defined as a comfortable grip in which the hand can be easily wrapped around the object [see note 6 below].	2. For containers of optimal design with no handles or hand-hold cut-outs or for loose parts or irregular objects, a "Fair" hand-to-object coupling is defined as a grip in which the hand can be flexed about 90 degrees [see note 4 below].	2. Lifting non-rigid bags (i.e., bags that sag in the middle).

Coupling Multiplier

Coupling Type	Coupling Multiplier	
	V< 30 inches (75 cm)	V ≥ 30 inches (75 cm)
Good	1.00	1.00
Fair	0.95	1.00
Poor	0.90	0.90

		METRIC	U.S. CUSTOMARY
Load Constant	LC	23 kg	51 lb
Horizontal Multiplier	HM	(25/H)	(10/H)
Vertical Multiplier	VM	1-(.003 |V-75|)	1-(.0075 |V-30|)
Distance Multiplier	DM	.82 + (4.5/D)	.82 + (1.8/D)
Asymmetric Multiplier	AM	1-(.0032A)	1-(.0032A)
Frequency Multiplier	FM	From Table 5	From Table 5
Coupling Multiplier	CM	From Table 7	From Table 7

Lifting Index (LI)

LI = Load Weight / RWL

- Jika LI ≤ 1 → tidak mengandung resiko cidera tulang belakang
- Jika LI > 1 → mengandung resiko cidera tulang belakang.

JOB ANALYSIS WORKSHEET

DEPARTMENT ____________________

JOB TITLE ____________________

ANALYST'S NAME ____________________

DATE ____________________

JOB DESCRIPTION

____

____

____

STEP 1. Measure and record task variables

Object Weight (lbs)		Hand Location (in)				Vertical Distance (in)	Asymmetric Angle (degrees)		Frequency Rate	Duration	Object Coupling
		Origin		Dest.			Origin	Destination	lifts/min	(HRS)	
L (AVG.)	L (Max.)	H	V	H	V	D	A	A	F		C

STEP 2. Determine the multipliers and compute the RWL's

RWL = LC × HM × VM × DM × AM × FM × CM

		LC		HM		VM		DM		AM		FM		CM		
ORIGIN	**RWL =**	51	×		×		×		×		×		×		=	Lbs
DESTINATION	**RWL =**	51	×		×		×		×		×		×		=	Lbs

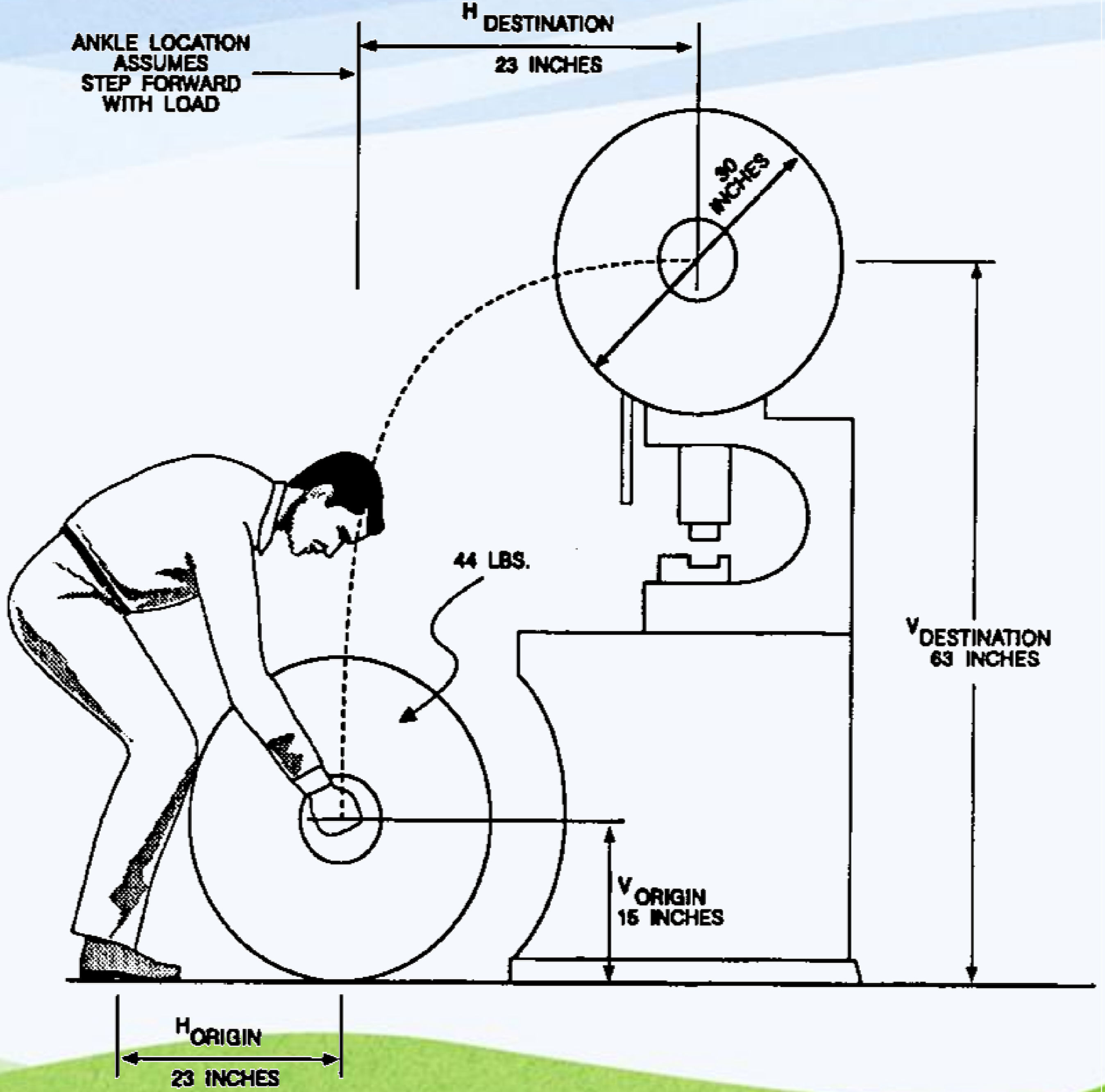
STEP 3. Compute the LIFTING INDEX

ORIGIN LIFTING INDEX = OBJECT WEIGHT (L) / RWL = ______ = [ ]

DESTINATION LIFTING INDEX = OBJECT WEIGHT (L) / RWL = ______ = [ ]

Figure 3: Single Task Job Analysis Worksheet

Let's Try…!!!



Loading Punch Press Stock

ORIGIN

- LC = 51 lbs
- HM = 10 / H = 10 / 23 = 0,43 inches
- VM = 1 – (0,0075|V–30|) = 1 – (0,0075|15–30|) = 0,8875
- DM= 0,82 + (1,8/D) = 0,82 + (1,8/(|15–63|)) = 0,8575
- AM = 1 – (0,0032A) = 1 – (0,0032*0) = 1
- FM = 1 (F<0,2 lifts/min; V<30 inches)
- CM = 0,95 (Fair; V<30 inches)

RWL = 16,3 lbs

LI = L / RWL = 44/16,3 = 2,7

D E S T I N A T I O N

- LC = 51 lbs
- HM = 10 / H = 10 / 23 = 0,43 inches
- VM = 1 – (0,0075|V–30|) = 1 – (0,0075|63–30|) = 0,7525
- DM = 0,82 + (1,8/D) = 0,82 + (1,8/(|15–63|) = 0,8575
- AM = 1 – (0,0032A) = 1 – (0,0032*0) = 1
- FM = 1 (F<0,2 lifts/min; V<30 inches)
- CM = 1 (Good; V<30 inches)

RWL = 14,5 lbs

LI = L/RWL = 44/14,5 = 3

Designing to avoid back pain

More importantly, NIOSH equation gives ways to reduce injury :

- reduce horizontal distance
- keep load at waist height
- reduce distance to be travelled
- reduce twisting
- add handles
- reduce frequency of lifts

Thank you…

Have an enjoy study and see you next week…