

Evaluation of Working Postures at a Garden Maintenance Service to Reduce Musculoskeletal Disorder Risk (A Case Study of PT. Dewijaya Agrigemilang Jakarta)

Adisty Savitri¹⁾, Guntarti Tatik Mulyati²⁾ and Ibnu Wahid Fakhruddin Aziz²⁾

¹⁾ Student of Agroindustrial Technology Department, Faculty of Agricultural Technology

²⁾ Lecturer at Agroindustrial Technology Department, Faculty of Agricultural Technology Universitas Gadjah Mada, Jl. Flora No.1 Bulaksumur 55281, Indonesia.

Abstract

This research is carried out in order to evaluate the working postures of seven workers with different job categories at a garden maintenance service. These seven categories of works are divided into 23 work elements. The aim of this research is to investigate the presence of work-related pain symptoms, find all risk related to poor working postures, and finally propose sets of recommendations for improvement of working methods. Nordic Body Map questionnaire is used in the study to detect the occurrences of workrelated pain. Meanwhile, risk level assessment for working postures was carried out by means of Rapid Entire Body Assessment (REBA) method. All the two applied on seven job categories of workers.

The results showed that all workers observed experienced with pain symptoms both after and before carry out the work. According to REBA analysis, there are 82.6% medium level risk working elements, 10.9% high level risk, 4.3% very high level risk, and 2.2% low level risk. Recommendation for improvement of working posture was given for work element, namely fertilizer sowing (very high level risk), hedge trimming (high level risk), and pesticide spraying (high level risk). Implementation of these proposed improvements result on diminishing the frequency of occurrence and the level of risk on physical pain.

Keywords: Pain, work element, working postures, REBA, Nordic Body Map.

1. INTRODUCTION

The garden maintenance workers of PT. Dewijaya Agrigemilang are classified into seven job categories, which are grass cutting, hoeing and sticking, fertilizing, watering, trimming plant, disease spraying and cleaning. Each of them does the same job everyday in different areas. So, they do monotonous, continuous and repeated job.

They are working in crooking and squatting working position in the sticking, hoeing and cleaning jobs or standing and walking jobs while carrying heavy tools of the grass cutting workers, fertilizing, watering, trimming plant, and disease spraying (Fig. 1) and it may expose them to musculoskeletal disorders in the long term. Nala (1995) and Hagg (1991) suggest that working with body forced position can cause skeletal system disorder.



Figure 1. Working posture

Rapid entire body assessment method is used to examine the risk level of the workers while working. It is necessary to improve the working system of those at high risk level to reduce the risk. Nordic Body Map Instrument consists of 28 items that are especially used in ergonomic study (Park & Bae, 1997; Sutajaya, 1997; Budiono, 1985, Aik Suwarno, 1997). The results of the Nordic Body Map Instrument are used to support the improvement of the existing working system.

2. SUBJECTS AND METHODS

The workers of PT. Dewijaya Agrigemilang are 7 individuals and serve in the study as respondents. It is expected that they can represent 7 job categories. The study was conducted in May-July 2011. The workers worked in the garden area of Residential Real Estate Mega Kebon Jeruk-Puri Botanical, West Jakarta.

The observation of the use of old and new tools was conducted in the same garden

environment in uncontrolled condition. They did their job for 8 hours a day from 08.00 a.m to 04.00 p.m. The evaluation of the working posture was made using REBA method with REBA worksheet (Fig. 2). The REBA scoring level (Table 1) was used to determine whether the workers need to use new tools or not.

Tabel 1. Risk Level Working Posture

Action Level	REBA Score	Risk Level	Action
0	1	Negligible	non necessary
1	2 – 3	Low	Maybe necessary
2	4 – 7	Medium	Necessary
3	8 – 10	High	Necessary soon
4	11 – 15	very high	Necessary now

(Source : Charoonsri et al., 2008)

REBA Employee Assessment Worksheet

based on Technical note: Rapid Entire Body Assessment (REBA), Hignett, McAtamney, Applied Ergonomics 31 (2000) 201-205

A. Neck, Trunk and Leg Analysis

Step 1: Locate Neck Position
 +1 0-30° +2 20° in extension +2 in extension
 Step 1a: Adjust...
 If neck is twisted: +1
 If neck is side bending: +1

Step 2: Locate Trunk Position
 +1 in extension +2 0-20° +3 20-60° +4 60°+
 Step 2a: Adjust...
 If trunk is twisted: +1
 If trunk is side bending: +1

Step 3: Legs
 +1 +2 Adjust: 30-60° +50° Add +1 Add +2

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

Step 5: Add Force/Load Score
 If load < 11 lbs: +0
 If load 11 to 22 lbs: +1
 If load > 22 lbs: +2
 Adjust: If shock or rapid build up of force: add +1

Step 6: Score A, Find Row in Table C
 Add values from steps 4 & 5 to obtain Score A. Find Row in Table C.

Scoring:
 1 = negligible risk
 2 or 3 = low risk, change may be needed
 4 to 7 = medium risk, further investigation, change soon
 8 to 10 = high risk, investigate and implement change
 11+ = very high risk, implement change

SCORES

Table A

	Neck		
	1	2	3
Legs	1 2 3 4	1 2 3 4	1 2 3 4
Trunk Posture Score	1 2 3 4 5 3 4 5 6 7 8 9	1 2 3 4 3 3 5 6 7 8 9	1 2 3 4 3 3 5 6 7 8 9

Table B

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

Table C

Score A (score from table A + load/force score)	Score B, (table B value + coupling score)											
	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	4	5	6	7	7	8	8	8	8
4	3	4	4	5	6	7	8	8	9	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	10	10	10	11	11	11
8	8	8	8	9	10	10	10	10	10	11	11	11
9	9	9	9	10	10	10	11	11	11	12	12	12
10	10	10	10	11	11	11	11	11	12	12	12	12
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	12

B. Arm and Wrist Analysis

Step 7: Locate Upper Arm Position:
 +1 +2 in extension +2 20° 20° 20-45° +3 45-90° +4 90°
 Step 7a: Adjust...
 If shoulder is raised: +1
 If upper arm is abducted: +1
 If arm is supported or person is leaning: -1

Step 8: Locate Lower Arm Position:
 +1 +2 90-100° 100° 0-60°

Step 9: Locate Wrist Position:
 +1 15° +2 15°
 Step 9a: Adjust...
 If wrist is bent from midline or twisted: Add +1

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 range 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

Final REBA Score = Table C Score + Activity Score

Task name: _____ Reviewer: _____ Date: ____/____/____
 provided by Practical Ergonomics
 rbarber@ergosmart.com (816) 444-1667

This tool is provided without warranty. The author has provided this tool as a simple means for applying the concepts provided in REBA. © 2000 Nordic Consulting, Inc.

Figure 2. REBA Worksheet (Hignett and McAtamney, 2000)

The number of musculoskeletal complaints was recorded by using Nordic Body Map Questionnaire (fig. 3). The workers were requested to fill up the same questionnaire before and after working.

NORDIC BODY MAP QUESTIONNAIRE

No.	Location	Grade of complaints			
		A	B	C	D
0	Pain/stiff in the upper neck				
1	Pain in the lower neck				
2	Pain in the left shoulder				
3	Pain in the right shoulder				
4	Pain in the left upper arm				
5	Pain in the back				
6	Pain in the right upper arm				
7	Pain in the waist				
8	Pain in the buttock				
9	Pain in the bottom				
10	Pain in the left elbow				
11	Pain in the right elbow				
12	Pain in the left lower arm				
13	Pain in the right lower arm				
14	Pain in the left wrist				
15	Pain in the right wrist				
16	Pain in the left hand				
17	Pain in the right hand				
18	Pain in the left thigh				
19	Pain in the right thigh				
20	Pain in the left knee				
21	Pain in the right knee				
22	Pain in the left calf				
23	Pain in the right calf				
24	Pain in the left ankle				
25	Pain in the right ankle				
26	Pain in the left foot				
27	Pain in the right foot				

Figure 3. Nordic Body Map Questionnaire. Worker tick (√) in the column based on what they felt in their body segment. A : no pain (1 points), B : moderate pain (2 points), C : pain (3 points), D : very painful (4 points)

3. RESULTS AND DISCUSSION

The characteristics of every work performed by the workers are summarized in table 2.

Table 2. Working Time for Each Element

Job Category	Working Element	Working Time (minute)
Grass cutting	Taking tools	3
	Filling fuel	16
	Grass cutting	388
	Keeping tools	3
Sticking and hoeing	Wild vegetation uprooting	133
	Sticking	142
	Hoeing	144
Fertilizing	Opening fertilizer sack	3
	Showing fertilizer	408
	Lifting fertilizer sack	0.07
	Keeping tools	3
Watering	Assembling watering tools	6
	Watering	381
	Rolling tube	11
	Keeping tools	5
Trimming Plant	Tree Trimming	318
	Hedge Trimming	408
	Shrubs Trimming	404
Spraying diseases	Filling pesticide	18
	Pesticide spraying	357
	Tool checking	4
Cleaning	Sweeping	355
	Garbage collecting	38
	Moving garbage bags	9

The improvement of the working method using new tools was made to the working elements at high and very high risk levels of working posture considering working time for each element of work (Figure 3).

The following graph (Fig. 4) shows that there was a close correlation between the risk levels of the working postures on each of the working elements of the seven working classifications. The job 1 consisted of the working elements of taking and keeping tools (A1), fuel filling (B1), grass cutting (C1). The job 2 consisted of the working elements of wild vegetation uprooting (A2), sticking (B2), and hoeing (C2). The job 3 consisted of the working elements of fertilizer sack opening (A3), fertilizer sowing (B3), fertilizer sack lifting (C3), tools keeping (D3). The job 4 consisted of the working elements of watering tool assembling (A4), watering (B4), and tube rolling (C4), tools keeping (D4). The job 5 consisted of the working k2 elements of tree trimming (A5), fencing plant cutting (B5), and shrubs trimming (C5). The job 6 consisted of the working elements of pesticide filling (A6), pesticide spraying (B6), and tool checking (C6). The job 7 consisted of the working elements of sweeping (A7), garbage collecting (B7), and garbage bag moving (C7).

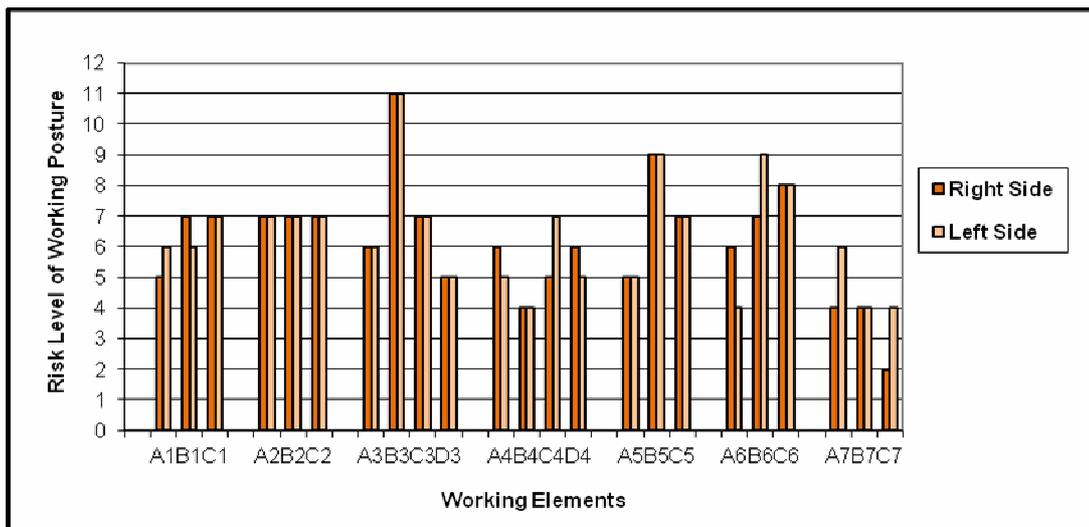


Figure 4. The risk level of working posture of garden maintenance worker

The fertilizing job was done for 388 minutes (more than 6 hours) at the very high posture risk level and caused them musculoskeletal disorder of their lower waist, lower neck, back, lower left and right arms, right and left wrists, left and right knees and left and right legs. Considering that the main disorders took place to the lower waist, the new tools must be used to reduce the working load. The recommended tools (Figure 5) were fertilizer sowing tool that enabled the workers to show the fertilizer in up-right body position.

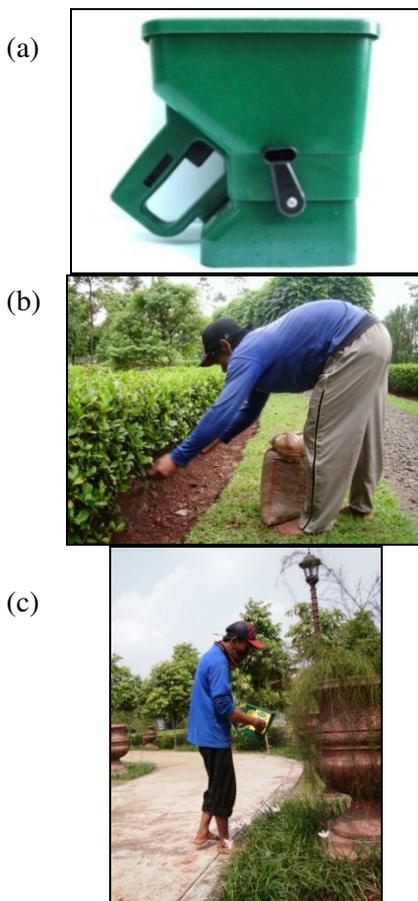


Figure 5. (a) Fertilization tool, (b) Old posture, (c) New posture

The use of the new fertilizer sowing tool resulted in the reduction of the high risk of the working posture to medium risk level.

The working element of fencing plant cutting was done for about 408 minutes and at high risk level and hence it is necessary to improve the working method as soon as possible that enabled more ergonomic working posture.

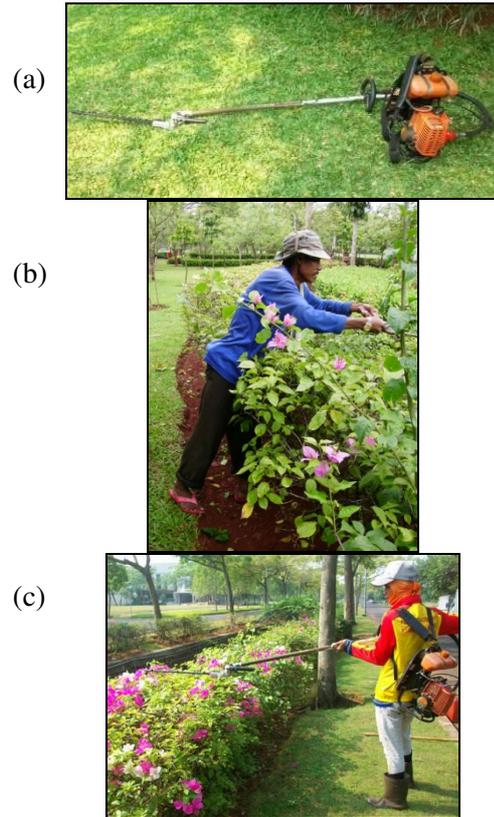


Figure 6. (a) Hedge trimming tools, (b) Old posture, (c) New posture

The use of the recommended new tools for the working element of hedge trimming indicated that there was a decrease in the risk level from high to medium level in the right posture and to low level in the left posture.

The working element of pesticide spraying was done for 357 minutes on average at high posture risk in the left posture and medium in the left posture.



Figure 7. Pesticide spraying tool



Figure 8. (a) Old posture, (b) New posture

The use of the recommended pesticide spraying tool with the pumping handle on the side of the body indicated that there was a significant reduction from the high working risk in the left posture to the medium risk in the left posture.

The use of the new tools decreased the number of the body parts affected by the disorders. The results of Nordic Body Map Questionnaire for the fertilizing workers indicated that there was a significant decrease in the number of the body parts affected by the disorders from 35% to 7%. The different score is 17 point (old posture: 52 points, new posture: 35 points) that represent reduction of 32.6%. It was caused the workers could work in the better body position than before.

The results of the Nordic Body Map of the hedge trimming workers indicated that their lower neck was free of the disorder, while their shoulders and knees were still affected by mild pain because they had to carry the tool on their back. Meanwhile, their upper arms were free of the disorders. There was a decrease in the working posture score from high risk level to medium risk level. the decreasing number of the body parts affected by the disorders from 50% to 29%. The different score of Nordic is 22 point (old

posture : 56 points, new posture : 34 points) that represent reduction of 39.3% .

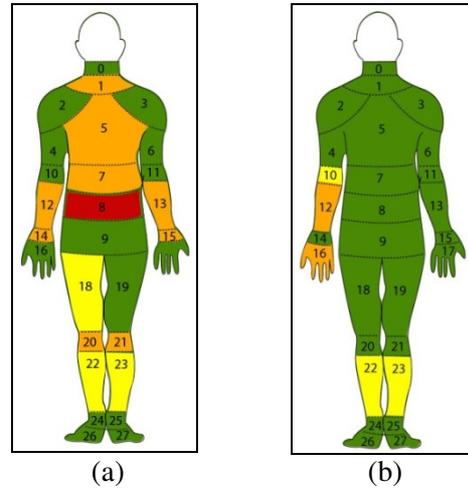


Figure 9. The Results of Nordic Body Map Questionnaire of the Workers Fertilizing Plants (a) Old tools, (b) New tools

Green: no pain, yellow: moderate pain, orange: pain, red: very painful

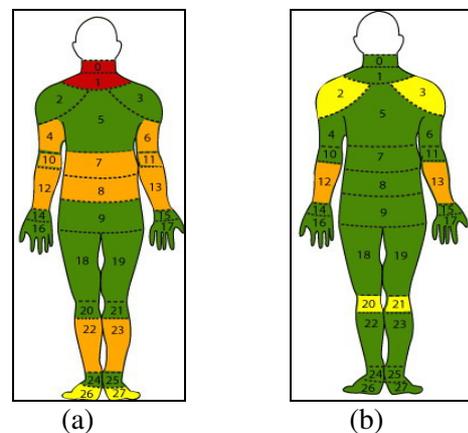


Figure 10. The Results of Nordic Body Map Questionnaire of the Workers Hedge Trimming (a) Old tools, (b) New tools

Green: no pain, yellow: moderate pain, orange: pain, red: very painful

The results of the Nordic Body Map of the pesticide spraying workers indicated that the use of new tools has freed them from the pain in the left arm that used to pump the tool with the hand position above shoulder, but the

pain of the affected legs has not been reduced significantly (Fig. 11).

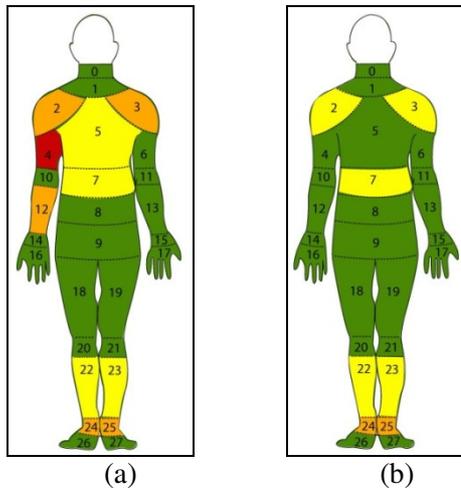


Figure 11. The Results of Nordic Body Map Questionnaire of the Workers Pesticide Spraying (a) Old tools, (b) New tools

Green: no pain, yellow: moderate pain, orange: pain, red: very painful

There was a decrease in the working posture score from high risk level to medium risk level,. the number of the body parts affected by the disorders from 36% to 25%. The different score of Nordic is 8 point (old posture : 45 points, new posture : 37 points) that represent 17.8% reduction.

CONCLUSION

The garden maintenance workers worked from 08.00 to 16.00 and experienced musculoskeletal disorders caused by the use of the working tools. There was 15.2% of all of the working elements at high risk level and caused musculoskeletal disorders. The use of the new tools could decrease the risk level of the working posture and reduced the number of the body parts affected by the musculoskeletal disorders.

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