REGULAR GYM WORKOUTS WITH COMPUTER ERGONOMICS IN POSTURE

A cross sectional comparative study

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Abstract

Computers play an increasingly important role in every perspective. The need to use computers increases as computer technology advances and software and computer packages are being developed. Due to this, work related musculoskeletal disorders started emerging from long working hours and following hazardous postures during work. This study aimed to investigate the impact of regular workouts and ergonomic interventions on musculoskeletal disorders (MSD) among computer employees.

This study contributes valuable insights into the potential effectiveness of combining regular workouts and ergonomic practices in reducing MSD risks among computer employees, providing actionable implications for workplace health and safety interventions. Muscular strength plays a key role in making the person to follow proper sitting posture during work. To build muscular strength, size, and power, resisted exercises and activities that make working muscles more efficient and harder than normal. Regular workouts in the gym play an essential role in building a person to work proficiently in their office by having them fit to follow the office ergonomics.

A cross-sectional comparative study was conducted over a 4-month duration involving 100 computer employees meeting specific inclusive criteria. Participants were divided into two groups using a simple random sampling method. Group A (n=50) followed a regimen of regular gym workouts targeting various muscle groups and adhered to computer ergonomics during work shifts, while Group B (n=50) received guidance solely on computer ergonomics.

Inclusion criteria encompassed individuals working with computers for over 8 hours daily, aged between 24 and 40, capable of regular muscle workouts six days a week, and possessing a RULA score between 2 and 7. The Rapid Upper Limb Assessment (RULA) tool was used to assess MSD risk based on biomechanical and postural load requirements.

Subjects underwent physical examinations and RULA assessments pre- and post-intervention. Data analysis involved evaluating the mean difference in RULA scores between the groups.

Anticipated outcomes included a reduction in MSD risk factors measured by the RULA scale. The study's statistical analysis aimed to determine the mean differences in pre-test and post-test RULA scores between Group A and Group B, elucidating the efficacy of the interventions in mitigating MSD risks among computer employees.

The research findings from this study indicate and concludes that consistent gym sessions, coupled with adhering to appropriate computer ergonomics, significantly enhance posture and lead to a notable decrease in work-related musculoskeletal disorders.

KEYWORDS: Work related musculoskeletal disorders, regular gym workouts, ergonomics, posture, rapid upper limb assessment scale.

INTRODUCTION

In today's rapidly evolving world, computers have become indispensable across all facets of life. Their pervasive utility has rendered them a cornerstone of modern-day existence. The presence of computer workstations has become ubiquitous in offices, underscoring the indispensability of computers in our daily routines. With ongoing advancements in computer technology and the continuous development of software and packages, rel**y** on computers has surged. However, this increasing dependence has brought forth a parallel rise in occupational health and safety concerns. The escalation of these issues poses potential risks, including diminished performance and dissatisfaction among individuals in various workplaces.

The heightened focus on work-related musculoskeletal disorders (WMSDs) among computer workers reflects an emerging concern. There's a notable apprehension about the potential surge in computer-related WMSDs due to increased dependence on computers. Studies have identified computer work as a significant risk factor for WMSDs, impacting the working-age population (Bernard, Sauter, Fine, Peterson, & Hales, 1994). These disorders carry substantial costs for employers, manifesting as absenteeism, reduced productivity, and elevated healthcare, disability, and worker's compensation expenses. Reports from the Bureau of Labor Statistics in 2001 revealed a staggering 372,683 back injury cases leading to days away from work. Computer employees are particularly susceptible to various risk factors, including awkward postures, repetitive movements, keyboard usage, forceful exertion, mechanical pressure, extreme temperatures, glare, inconsistent lighting, and prolonged exposure. Research suggests that interventions such as ergonomics training and appropriate workstation design can effectively prevent or alleviate musculoskeletal injuries commonly observed in office environments (Bayeh & Smith, 1999; Robertson & O'Neill, 1999; Sauter, Schleifer, & Knutson, 1991).

Work-related upper limb musculoskeletal disorders (WRULDs) encompass a spectrum of ailments affecting the neck and upper limbs, spanning from the shoulders, upper arms, elbows, forearms, wrists, to the hands (Buckle, 1999). These disorders, also termed complaints of the arm, neck, and/or shoulder (CANS) (Huisstede, 2006), encompass various specific conditions with distinct diagnostic criteria and pathological findings. Among these conditions are tendon-related disorders like tendonitis, peripheral-nerve entrapment such as carpal tunnel syndrome, neurovascular/vascular disorders like hand-arm vibration syndrome, and joint/joint-capsule disorders including osteoarthritis. Additionally, WRULDs also encompass nonspecific conditions characterized primarily by complaints of pain or tenderness, often with limited or no identifiable pathological findings (Buckle, 1997; Yassi, 1997).

The risk factors for developing WRULDs include individual factors (e.g., inadequate strength, poor posture), physical requirements at the workplace (e.g., work requiring prolonged static posture, highly repetitive work, use of vibrating tools), and organizational and psychosocial factors (e.g., poor work-rest cycle, shift work, low job security, little social support) (Bernard 1997; Buckle 1997; Marras 2009; NIOSH 2001; Shanahan 2006; Yassi 1997).

Although a lot of research has been conducted in this area, it is believed implementation of ergonomics in the office environment is somewhat limited, especially in developing nations. Exercise is shown to keep physical functions (respiratory, circulatory, muscular, nervous, and skeletal systems) intact and supports other systems (endocrine, digestive, immune, or renal systems) that are important in fighting any known or unknown threat to our body (Lavie et al., 2019; Jiménez-Pavón et al., 2020).

Regular physical activity is one of the most important things you can do for your health. Exercises involve a series of sustained muscle contractions, of either long or short duration, depending on the nature of the physical activity. Effects of exercise on muscles can be considered short-term or immediate, both during and shortly after exercise; as well as long-term, lasting effects. Muscular strength enhances overall health and boosts athletic activity. A strong body allows performing movements and activities that require power without getting tired. Muscular strength helps you maintain healthy body weight by burning calories and enhancing body composition, which is the ratio between fat and muscle. To build muscular strength, size, and power, resisted exercises and activities that make working muscles more efficient and harder than normal. Regular workouts in the gym play an essential role in building a person to work proficiently in their office by having them fit to follow the office ergonomics.

Hectic work schedule has led to the unexpected cessation of almost all the fitness activities of the individuals, it has profoundly hampered the physical activities of fitness freaks (those who regularly go to the gym for their physical fitness), studies addressing the issues of computer employees, who used to spend a huge amount of time in front of the computer which makes them hardly spend time for a regular workout in order to maintain their physical fitness, health, and appearance. This study involves assessing the value of exercises and ergonomics with the help of the RULA (rapid upper limb assessment) scale to find the differences in the posture of computer employees.

RULA is a survey method developed for use in ergonomics investigations of workplaces where work-related upper limb disorders are reported. This tool requires no special equipment in providing a quick assessment of the postures of the neck, trunk, and upper limbs along with muscle function and the external loads experienced by the body. A coding system is used to generate an action list that indicates the level of intervention required to reduce the risks of injury due to physical loading on the operator.

Primary objective - The primary objective of this study is to examine the impact of integrating resisted exercises with workplace ergonomics on body posture.

Novelty of the study - While various studies have extensively discussed and analyzed the influence of ergonomics on body posture, a notable gap exists in assessing the combined effect of resisted exercises and workplace ergonomics. This study seeks to address this gap by specifically investigating the effectiveness of combining resisted exercises with workplace ergonomics in enhancing body posture among computer employees. The study aims to validate the role of exercises in sustaining optimal posture, contributing to the existing understanding of ergonomics' impact on posture and offering insights into the potential synergy between exercise interventions and ergonomic practices in the context of workplace health.

METHODOLOGY

A cross-sectional comparative study, spanning four months, involved a total sample size of 100 computer employees. Selection criteria included individuals aged 24 to 40, regardless of gender, working with computers for more than 8 hours a day, capable of regular muscle workouts for six days a week, and having a RULA score between 2 and 7. Exclusions comprised those with a history of degeneration, severe deformity, spinal or cranial surgery, cardiovascular impairments, recent fractures, or pregnancy, unwilling participants and those who were not commit themselves to do regular workouts.

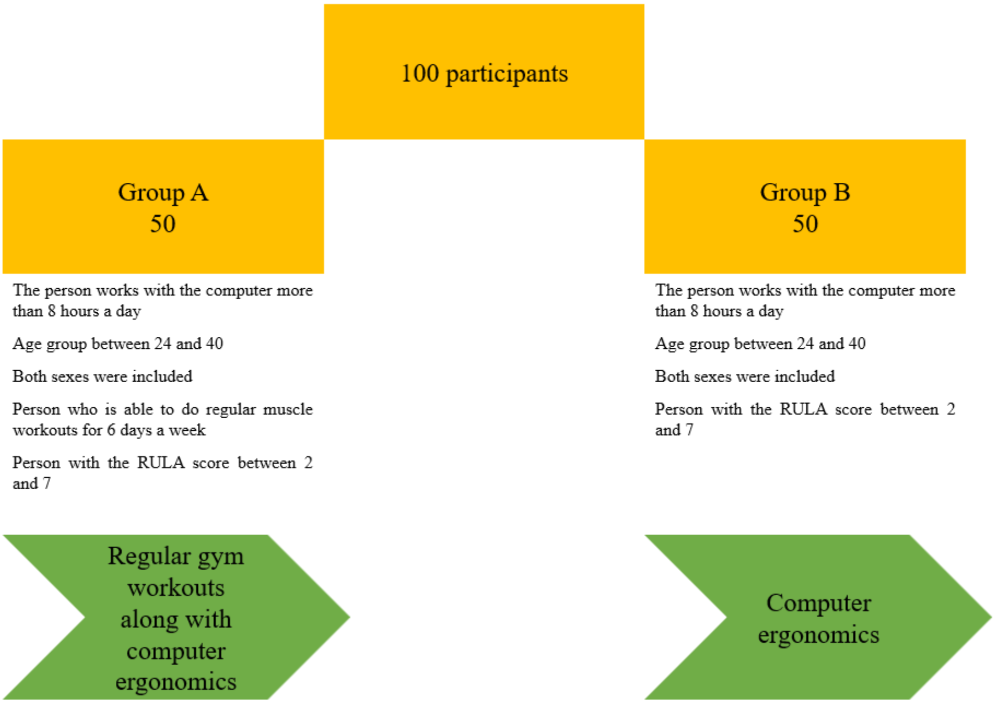
Table 1 - Variables

Variables	Independent variables	Dependent variables
1	Workouts	Level of musculoskeletal disorders
2	Ergonomics	

OPERATIONAL TOOL: Rapid upper limb assessment (RULA)

The Rapid Upper Limb Assessment (RULA) serves to assess ergonomic risk factors related to upper extremity musculoskeletal disorders (MSDs). This evaluation tool takes into account the biomechanical and postural demands placed on the neck, trunk, and upper limbs during job tasks. It utilizes a concise worksheet to assess body posture, force exertion, and repetition. Scores are allocated for distinct body regions (Arm/Wrist in section A, Neck/Trunk in section B). These scores are then used to compute risk factor variables using tables, resulting in a singular score indicating the level of MSD risk. Scores between 1-2 suggest negligible risk, requiring no immediate action, whereas a score of 6-7 indicates high-risk levels, necessitating immediate intervention.

PROCEDURE:



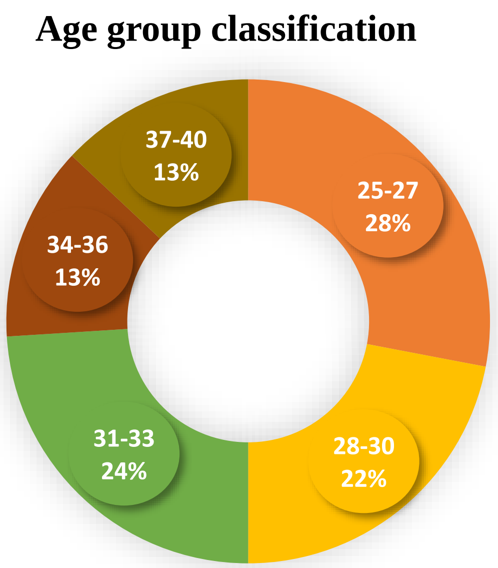
The total of 100 participants divided into two and segregated as **Group A** and **Group B**. 50 subjects in **Group A** underwent regular gym workouts routine concentrating on different muscle groups in a week. And they were instructed to follow the computer ergonomics when they are dealing with computers all through the shift. 50 subjects in **Group B** were explained about computer ergonomics and were advised to follow the same when they are working with computers all through their shift. All the subjects were given their proper gym exercise routine and ergonomics by providing the brochures. They were followed regularly once a week and clarified their doubts. Following the study, the subjects were advised to follow the regular exercises and ergonomics and thanked for their participation co-operation in the study. The data was noted separately and was taken for analysis.

The anticipated outcome of this study was a reduction in musculoskeletal disorder (MSD) risk factors, specifically observed and measured through the Rapid Upper Limb Assessment (RULA) tool, indicating an improvement in ergonomic conditions and a decrease in potential injury risks associated with the examined work environment.

The statistical analysis will primarily focus on determining the mean difference between the pre-test and post-test scores within Group A (the experimental group) and Group B (the control group), specifically concerning the Rapid Upper Limb Assessment (RULA) scale. This analysis aims to ascertain any significant changes or variations in ergonomic risk factors before and after the intervention, providing insights into the effectiveness of the applied interventions on musculoskeletal disorder risks.

Results

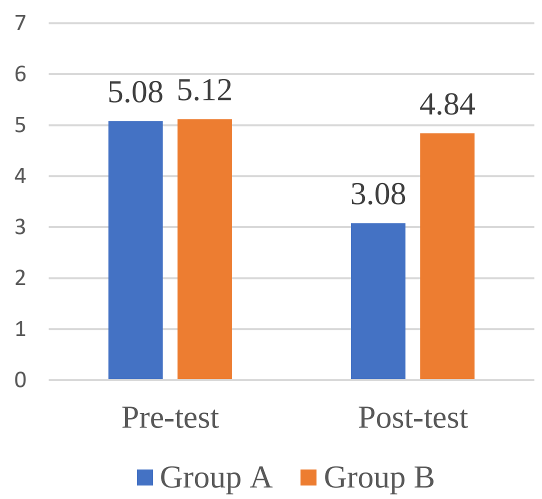
The study, conducted over four months, encompassed 100 participants, among whom 71 were men and 29 were women, with age ranges from 25 to 40 years. These participants were split into two groups via random sampling, disregarding gender, leading to a varied age representation: approximately 28% within 25-27 years, 22% within 28-30 years, 24% within 31-33 years, and 13% each within 34-36 and 37-40 years. Group A participants adhered to a combined regimen of workplace ergonomics and gym workouts, while Group B solely followed workplace ergonomics guidelines.



All participants underwent physical assessments, wherein the RULA (Rapid Upper Limb Assessment) scores were computed and documented. Initial RULA scale measurements showed a mean pretest score of 5.08 (SD -1.0069) for Group A and 5.12 (SD - 1.0028) for Group B. Following the intervention, post-test RULA scores exhibited a notable decrease in mean values: Group A displayed a mean score of 3.08 (SD - 1.0069), whereas Group B showed a mean of 4.84 (SD – 0.997). This contrast in pretest and post-test values of RULA scores was analysed within each group.

Upon comparison, the mean difference between pre and post-test RULA scores illustrated a considerable variance: Group A experienced a mean difference of 2.00, whereas Group B exhibited a mean difference of 0.28. These findings demonstrate a substantial disparity in the reduction of ergonomic risk factors assessed by the RULA scale between the two groups, underscoring the impact of the combined ergonomic intervention and workout routine on Group A in contrast to Group B.

Graphical representation of pre-test and post-test values on RULA scale of GROUP A and GROUP B



The graphical representation illustrates the mean difference observed between the pre-test and post-test scores of two distinct groups. Upon careful comparison, evident and substantial variations in the values of mean differences between the post-test results were notable. Specifically, Group A displayed a notably higher mean difference compared to Group B. This discrepancy signifies a considerable alteration in the ergonomic risk factors assessed through the intervention in both groups, where the experimental Group A experienced a more pronounced shift in these factors compared to the control Group B.

Discussion

The primary aim of this research was to compare the impacts of workplace ergonomics combined with regular gym workouts on individuals. Sedentary work, particularly involving prolonged sitting and incorrect posture, is known to contribute significantly to musculoskeletal disorders (MSDs). With the prevalence of computercentric occupations, workers face increased risks, especially concerning upper extremities and the neck. Repetitive movements associated with computer usage, such as keyboard and mouse operations, often lead to muscle and tendon strain. Previous studies have highlighted these concerns among computer operators, emphasizing the importance of mitigating MSD risk factors (Ljiljana Blagojević, 2012).

The study employed the Rapid Upper Limb Assessment (RULA) scale, evaluating participants' postures while working at computers, thereby indicating the severity level of potential MSDs. Higher RULA scores suggest an increased risk of MSDs. This research aimed to educate participants on MSD risk factors, emphasizing computer ergonomics and a regimen of regular gym workouts targeting essential muscles crucial for maintaining proper posture.

In Group A, participants diligently followed a six-day-per-week muscle workout routine in addition to adhering to computer ergonomics. They progressively adapted their working posture during computer tasks, demonstrating improvements in posture and ergonomics, as indicated by a significant mean difference between pre-test and post-test results.

Conversely, Group B participants were solely advised on computer ergonomics without engaging in any muscle workouts throughout the study. However, their results did not exhibit a substantial mean difference between pre-test and post-test scores.

The findings highlighted the efficacy of combining workplace ergonomics with regular gym workouts in enhancing posture. Statistical analysis indicated a significant disparity between the groups, emphasizing that the group engaged in both ergonomics and regular workouts benefitted more compared to the group practicing ergonomics alone. This suggests that integrating regular workouts into workplace ergonomics significantly contributes to improving individuals' posture and mitigating MSD risk factors.

Conclusion

The study presents two pivotal conclusions regarding the impact of interventions on musculoskeletal disorders (MSDs) among computer employees. Firstly, both Group A (Experimental Group) and Group B (Control Group) demonstrated a significant reduction in RULA scores, indicating a positive effect on mitigating MSD risk factors within both groups. Secondly, when evaluating the effectiveness of the interventions, Group A, comprising individuals engaged in regular gym workouts alongside workplace ergonomics, exhibited a notable and more substantial reduction in RULA scores compared to Group B (Control Group).

These findings underscore the significant benefits derived from combining regular gym workouts with workplace ergonomics. It can be inferred that this combined approach plays a vital role in effectively reducing the risk of musculoskeletal disorders among computer employees. Therefore, this study underscores the importance and efficacy of integrating regular gym workouts with workplace ergonomics as an effective strategy to minimize the risk of musculoskeletal disorders in the context of computer-based occupations.

Limitations:

The study's short duration limits the assessment of sustained effects; therefore, a long-term study would be valuable for more comprehensive insights into the lasting impact of interventions. Lack of regular and close monitoring of participants throughout the study might have affected the accuracy and consistency of the data collected. Participants were not followed on a daily basis, which could have provided a more detailed understanding of the changes over time. The study was conducted with a relatively small sample size, potentially limiting the generalizability of the findings. Inability to obtain participant photographs due to discomfort might have restricted additional visual data for analysis.

Recommendations:

Future research endeavours should focus on long-term investigations to ascertain the durability and persistence of the observed effects. Increasing the sample size in subsequent studies could attract more attention from researchers and enhance the study's statistical power. Future studies could explore and analyse predisposing factors contributing to the development of musculoskeletal disorders (MSDs) in computer employees, providing a deeper understanding of these conditions and potential preventative measures.

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Appendix I - Regular gym workouts schedule

Rest interval – 30 seconds

Day 1: legs, shoulders, and abs

Legs: dumbbell squats — 3 sets of 6–8 reps

Shoulders: standing shoulder press — 3 sets of 6–8 reps

Legs: dumbbell lunge — 2 sets of 8–10 reps per leg

Shoulders: dumbbell upright rows — 2 sets of 8–10 reps

Hamstrings: Romanian dumbbell deadlift — 2 sets of 6–8 reps

Shoulders: lateral raises — 3 sets of 8–10 reps

Calves: seated calf raises — 4 sets of 10–12 reps

Abs: crunches with legs elevated — 3 sets of 10–12 reps

Day 2: chest and back

Chest: dumbbell bench press or floor press — 3 sets of 6–8 reps

Back: dumbbell bent over rows — 3 sets of 6–8 reps

Chest: dumbbell fly — 3 sets of 8–10 reps

Back: one-arm dumbbell rows — 3 sets of 6–8 reps

Chest: pushups — 3 sets of 10–12 reps

Back/chest: dumbbell pullovers — 3 sets of 10–12 reps

Day 3: arms and abs

Biceps: alternating bicep curls — 3 sets of 8–10 reps per arm

Triceps: overhead tricep extensions — 3 sets of 8–10 reps

Biceps: seated dumbbell curls — 2 sets of 10–12 reps per arm

Triceps: bench dips — 2 sets of 10–12 reps

Biceps: concentration curls — 3 sets of 10–12 reps

Triceps: dumbbell kickbacks — 3 sets of 8–10 reps per arm

Abs: planks — 3 sets of 30-second holds

Day 4: legs, shoulders, and abs

Legs: dumbbell squats — 3 sets of 6–8 reps

Shoulders: Standing shoulder press — 3 sets of 6–8 reps

Legs: dumbbell lunge — 2 sets of 8–10 reps per leg

Shoulders: dumbbell upright rows — 2 sets of 8–10 reps

Hamstrings: Romanian dumbbell deadlift — 2 sets of 6–8 reps

Shoulders: lateral raises — 3 sets of 8–10 reps

Calves: seated calf raises — 4 sets of 10–12 reps

Abs: crunches with legs elevated — 3 sets of 10–12 reps

Day 5: Chest and back

Chest: dumbbell bench press or floor press — 3 sets of 6–8 reps

Back: dumbbell bent-over rows — 3 sets of 6–8 reps

Chest: dumbbell fly — 3 sets of 8–10 reps

Back: one-arm dumbbell rows — 3 sets of 6–8 reps

Chest: pushups — 3 sets of 10–12 reps

Back/chest: dumbbell pullovers — 3 sets of 10–12 reps

Day 6: arms and abs

Biceps: alternating bicep curls — 3 sets of 8–10 reps per arm

Triceps: overhead tricep extensions — 3 sets of 8–10 reps

Biceps: seated dumbbell curls — 2 sets of 10–12 reps per arm

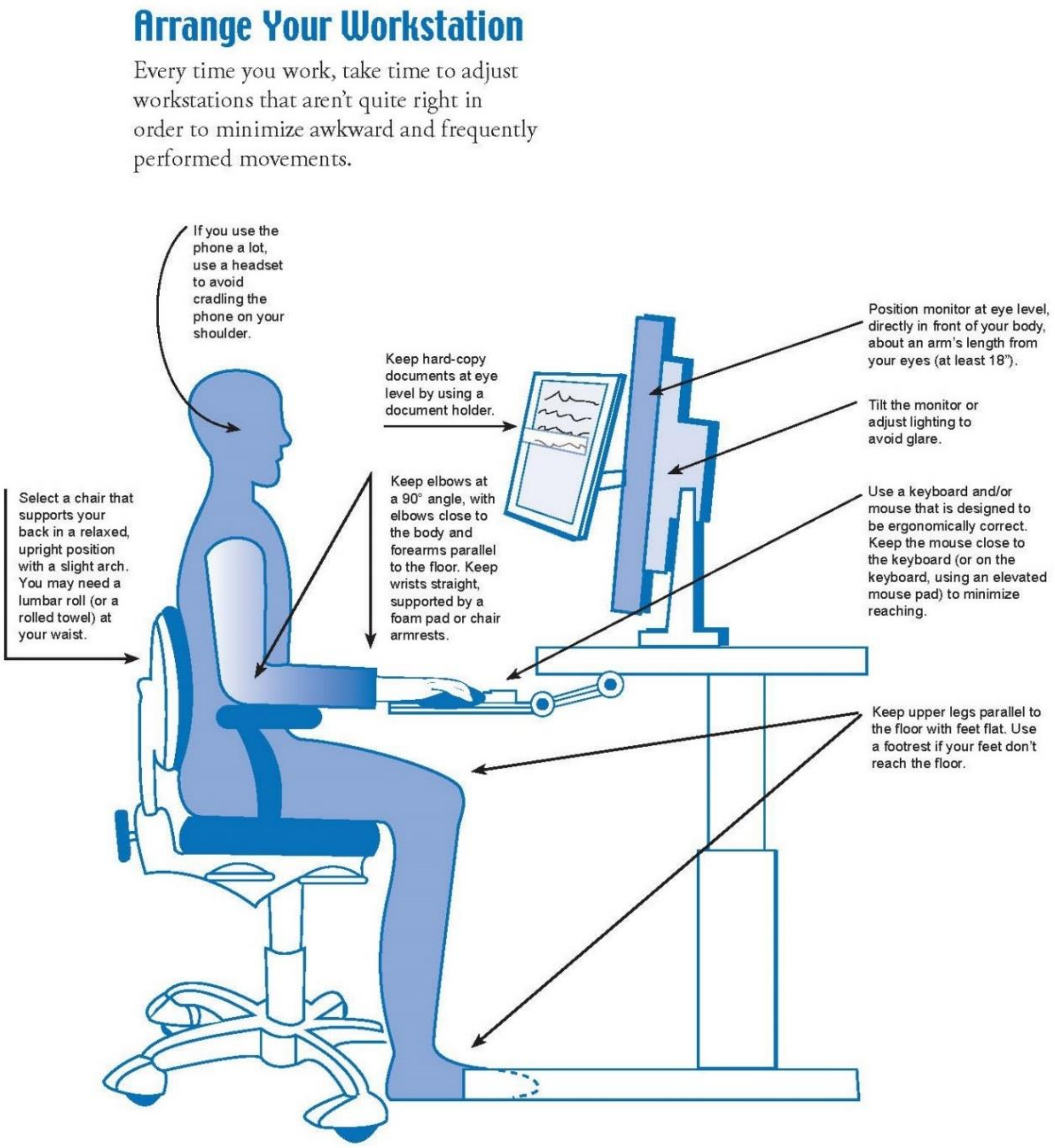
Triceps: bench dips — 2 sets of 10–12 reps

Biceps: concentration curls — 3 sets of 10–12 reps

Triceps: dumbbell kickbacks — 3 sets of 8–10 reps per arm

Abs: planks — 3 sets of 30-second holds.

Appendix II - Computer ergonomics



Appendix III - Rapid upper limb assessment (RULA)

RULA Employee Assessment Worksheet

Task Name:

Date:

A. Arm and Wrist Analysis

Step 1: Locate Upper Arm Position:

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

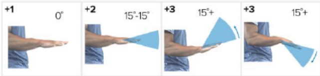
Upper Arm Score

Step 2: Locate Lower Arm Position:

Lower Arm Score

Step 2a: Adjust...
If either arm is working across midline or out to side of body: Add +1

Step 3: Locate Wrist Position:



Step 3a: Adjust...
If wrist is bent from midline: Add +1

Step 4: Wrist Twist:
If wrist is twisted in mid-range: +1
If wrist is at or near end of range: +2

Wrist Twist Score

Wrist Score

Step 5: Look-up Posture Score in Table A:
Using values from steps 1-4 above, locate score in Table A

Posture Score A
+

Step 6: Add Muscle Use Score
If posture mainly static (i.e. held>1 minute),
Or if action repeated occurs 4X per minute: +1

Muscle Use Score
+

Step 7: Add Force/Load Score
If load < .4.4 lbs. (intermittent): +0
If load 4.4 to 22 lbs. (intermittent): +1
If load 4.4 to 22 lbs. (static or repeated): +2
If more than 22 lbs. or repeated or shocks: +3

Force / Load Score
=

Step 8: Find Row in Table C
Add values from steps 5-7 to obtain Wrist and Arm Score. Find row in **Table C**.

Wrist & Arm Score

Scores

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

Table C		Neck, Trunk, Leg Score 1	2	3	4	5	6	7+
Wrist / Arm Score	1	1	2	3	3	4	5	5
	2	2	2	3	4	4	5	5
	3	3	3	3	4	4	5	6
	4	3	3	3	4	5	6	6
	5	4	4	4	5	6	7	7
	6	4	4	5	6	6	7	7
	7	5	5	6	6	7	7	7
	8+	5	5	6	7	7	7	7

Scoring: (final score from Table C)
1-2 = acceptable posture
3-4 = further investigation, change may be needed
5-6 = further investigation, change soon
7 = investigate and implement change

RULA Score

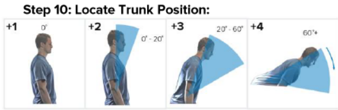
B. Neck, Trunk and Leg Analysis

Step 9: Locate Neck Position:

Neck Score

Step 9a: Adjust...
If neck is twisted: +1
If neck is side bending: +1

Step 10: Locate Trunk Position:



Step 10a: Adjust...
If trunk is twisted: +1
If trunk is side bending: +1

Trunk Score

Step 11: Legs:
If legs and feet are supported: +1
If not: +2

Leg Score

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

Step 12: Look-up Posture Score in Table B:
Using values from steps 9-11 above, locate score in Table B

Posture B Score
+

Step 13: Add Muscle Use Score
If posture mainly static (i.e. held>1 minute),
Or if action repeated occurs 4X per minute: +1

Muscle Use Score
+

Step 14: Add Force/Load Score
If load < .4.4 lbs. (intermittent): +0
If load 4.4 to 22 lbs. (intermittent): +1
If load 4.4 to 22 lbs. (static or repeated): +2
If more than 22 lbs. or repeated or shocks: +3

Force / Load Score
=

Step 15: Find Column in Table C
Add values from steps 12-14 to obtain Neck, Trunk and Leg Score. Find Column in **Table C**.

Neck, Trunk, Leg Score

based on RULA: a survey method for the investigation of work-related upper limb disorders, McAtamney & Corlett, Applied Ergonomics 1993, 24(2), 91-99