The Future of Office Work: Ergonomic Lessons from the "New Normal"

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References

Amit, L. M., & Song, Y. W. (2021). **Effectiveness of Ergonomic Intervention in Work-related Postures and Musculoskeletal Disorders of Call Center Workers: A Case-control Study**. *Industrial Engineering & Management Systems*, *20*(2), 109-118.

Davis, K. G., Kotowski, S. E., Daniel, D., Gerding, T., Naylor, J., & Syck, M. (2020). **The home office: Ergonomic lessons from the "new normal"**. *Ergonomics in design*, *28*(4), 4-10.

- This presentation is based on two recently published studies on office ergonomics and intervention by **Amit & Song, 2021** and **Davies et al., 2020.**

Working from Home

"I'm not a cat."

A toddler interrupting her dad's live TV interview

COVID-19 and the “new normal”

- Business casual to home casual
- In-person meetings to web conferences
- In-person classrooms to virtual lessons
- Prolonged screen time in sedentary position
- **Working from home is predicted to become a permanent option**

Poorly designed office areas at home lead to discomfort or pain

Low back pain is the most common condition

Musculoskeletal Disorders (MSDs)

- disorders of the muscles, nerves, tendons, ligaments, joints, cartilage or spinal discs that was not caused by a slip, trip, fall, motor vehicle accident or similar accident (OSHA, n.d.).

Goal of Ergonomics

“To prevent musculoskeletal disorders.”

MSDs affect all age groups

The IMPACT of Musculoskeletal Disorders at a Glance

Musculoskeletal Disorders:

- Are common and costly
- Affect all age groups
- Contribute significantly to disability, undermining the ability to work, overall quality of life and contributing to a loss of independence
- Are often paired with other conditions and diseases (co-morbidities), affecting health overall
- Warrant more research and practice investments, commensurate with their heavy toll on health, costs, and well-being; and
- Can be prevented and treated more effectively—often with knowledge and practices that already exist

Musculoskeletal Disorders are COMMON

More than 1 in 2 adults—124 million Americans over 18—reported a musculoskeletal medical condition. That exceeds the next two most common health conditions: circulatory conditions (such as heart disease, stroke, and hypertension) and respiratory conditions (such as emphysema and chronic asthma).

Number of Americans over 18 who reported a musculoskeletal medical condition in 2015:

124 MILLION

More adults reported musculoskeletal conditions than any other self-reported medical conditions.

50.1 per 100

Source: National Health Interview Survey (NHIS)_Adult sample, 2015. http://www.cdc.gov/nchs/nhis/data-questionnaires-documentation.htm. July 23, 2016

MSDs are costly!

Musculoskeletal Disorders are COSTLY

The economic impact of musculoskeletal disorders can be measured in several ways.

DIRECT COSTS

are the costs within the healthcare system, such as treatments provided in clinics and hospitals, including emergency departments, and the cost of prescription medications.

INDIRECT COSTS

represent estimates of lost wages, since adults of working age (in the 18-64 age range) with musculoskeletal disorders miss work more and may earn less.

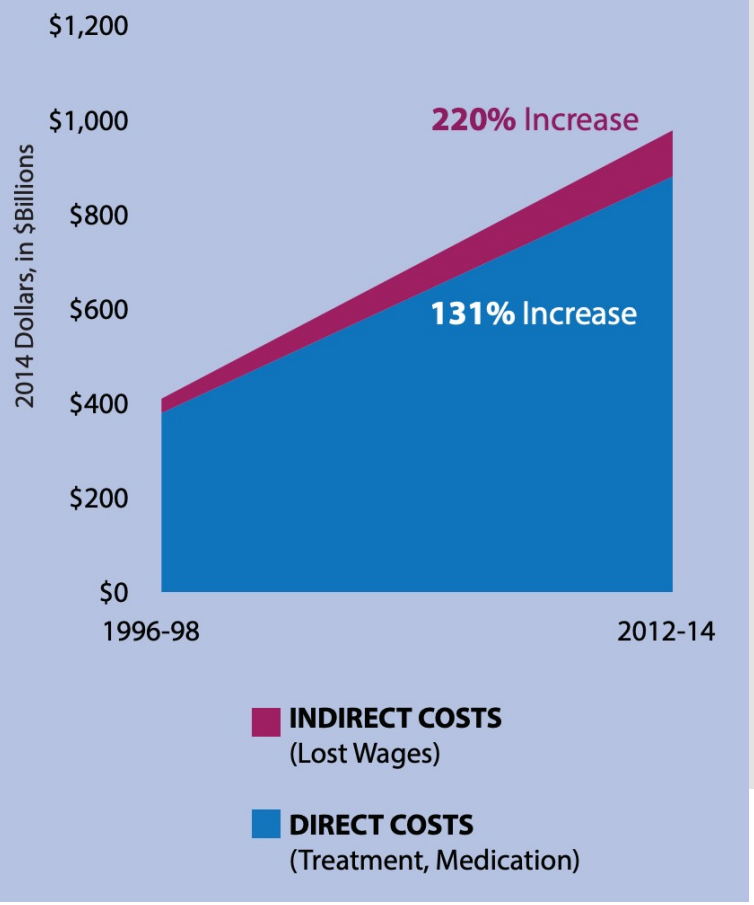
Both types of costs have jumped significantly—so much so that they constitute a significant proportion of the US Gross Domestic Product (GDP). GDP is a standard measure of an entire economy —the total value of all the goods and services provided in a year.

Between 1996 and 2014, the costs of musculoskeletal disorders represented increasing shares of GDP, from 3.44% of GDP in 1996 to 5.76% of GDP in 2014, exceeding defense spending for that year.

In all of these categories—direct costs, indirect costs, and share of GDP—the economic impact of musculoskeletal disorders is increasing.

The combination of a growing and aging population guarantees that these costs will increase, unless current trends are reversed.

Jumps in TREATMENT COSTS and LOST WAGES because of MUSCULOSKELETAL DISORDERS, 1996-98 – 2012-14 (2014 dollars), in $Billions



The Ergonomic Assessment

(Davis et al., 2020)

Participants

- Faculty and staff at the University of Cincinnati
- **41 workstations**
- Two pictures (back and side) were assessed by an ergonomist

The Ergonomic Assessment

(Davis et al., 2020)

Methodology

Home workstation components assessed:

- **Monitor** (primary/secondary, laptop/external, too high/too low, centered/off-centered)
- **Chair** (chair type, hard seat, too high/too low, five casters, armrests, lumbar support, feet on floor, etc.)
- **Worksurface** (hard front edge, glare, too dark, task light)
- **Input devices** (external keyboard, laptop keyboard, laptop touchpad or mouse, external mouse)
- **Type of workstation** (sitting, standing, other)

Trends in COVID-19 Home Office

(Davis et al., 2020)

Table 1. Summary of the Types of Chairs, Workstations, Input Devices, and Monitors in the Submitted Home Offices

Type of chair		Type of workstation		Type of input device		Type of monitor	
Office chair	24	Sitting table	3	Laptop keyboard (primary)	22	Laptop	12
Dining chair	11	Sitting desk	35	Laptop keyboard (secondary)	9	External monitor	7
Nonchair	6	Sitting on bed or couch	3	External keyboard (primary)	19	Laptop and external monitor	16
		Standing desk	4	Laptop touchpad (primary)	19	Multiple monitors	4
		Treadmill	1	Laptop touchpad (secondary)	12		
				External mouse (primary)	22		

Trends in COVID-19 Home Office

(Davis et al., 2020)

Table 2. Summary of the Characteristics for the Chair, Monitor, and Workstation

Chair height		*Monitor height*	
Chair too high	1	Primary external monitor too high	1
Chair too low	17	Primary external monitor correct height	10
Chair at right height	19	Primary external monitor too low	12
N/A	4	Secondary external monitor too high	1
Seat of chair		Secondary external monitor correct height	1
Hard seat	25	Secondary external monitor too low	5
Seat with cushion	12	Laptop monitor too low	30
Couch/bed	3	*Monitor location*	
Armrest		Primary external monitor centered	12
Armrests present	22	Primary external monitor off centered	8
No armrests	15	Secondary external monitor centered	4
Armrests used	7	Secondary external monitor off centered	11
Armrests properly adjusted	4	Laptop monitor centered	21
Back support of chair		Laptop monitor off centered	7
Lumbar support	8	*Other considerations*	
No lumbar support	30	Feet not on floor	3
Back against chair	11	Task light	25
Back not against chair	25	Glare	7
Edge of workstation surface		Too dark	3
Hard front edge	37		
Rounded edge	1		

Examples of common problems found in the home offices:

(a) poor chair, hard edge on desk surface, external monitor off to side,

(b) hard and nonadjustable wood chair,

(c) large monitor to side, laptop monitor too low, no back on chair…

(g) split between external monitors directly in front

Potential Low-Cost and Effective Fixes

(Davis et al., 2020)

Chair

Ideally…

- Adjustable height
- Adjustable armrests
- Five casters
- Lumbar support

ErgoChair Pro

$499

A pillow to increase seat height

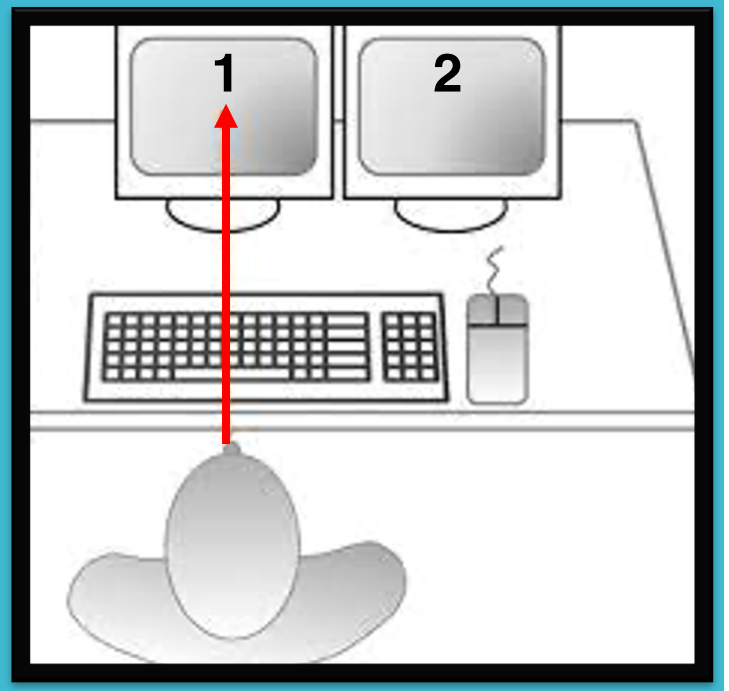
A. DIY potential fixes for chair:

1. Putting a pillow on the seat to elevate the seat height
2. Putting a pillow and/or rolled up towel behind the back to provide lumbar support and back support and eliminate the need to lean away from the back of the chair
3. Wrapping the armrests when they are low and not adjustable
4. Move the chair closer to the desk or table to encourage having the back against the back of the seat

B. Using a laptop DIY potential fixes

1. Place a lap desk or large pillow under the laptop to raise the monitor when using it on the lap

2. Use an external keyboard and mouse, along with raising the monitor by placing a stack of books or a box under the laptop when using a laptop desk

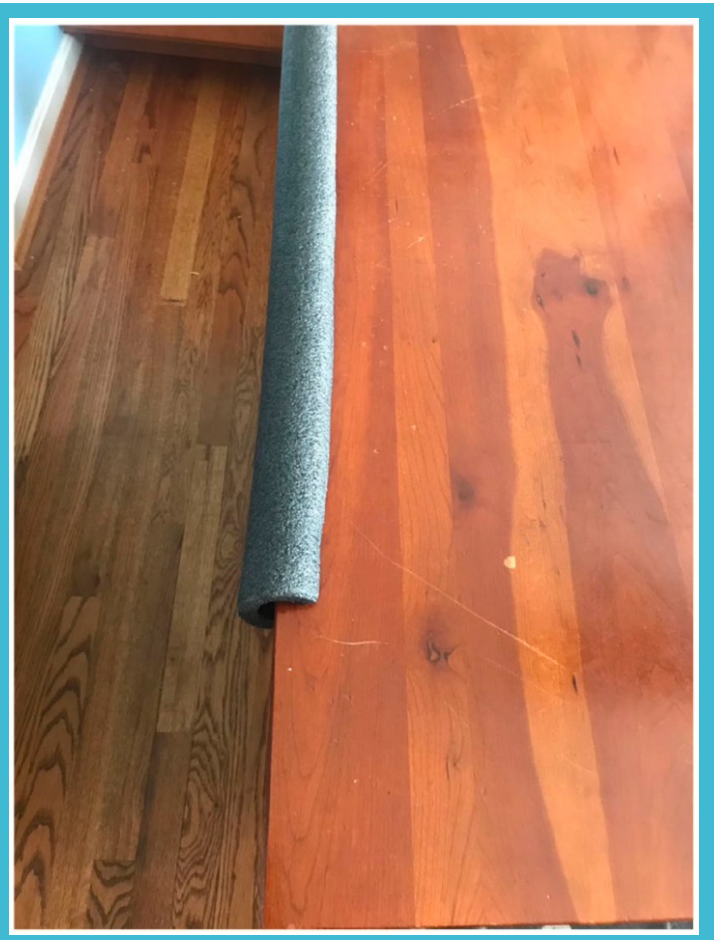


Primary monitor directly in front

B. Using a laptop DIY potential fixes

3. When possible, use an external monitor at right height (e.g., top at eye height) and centered on the person

4. When using dual or multiple monitors, it is key to keep the primary monitor directly in front of you and to place the secondary monitor to the side



A pipeline insulation used to prevent contact stress

C. Workstation or desk DIY potential fixes

1. Place a folded towel over the edge of table or desk to reduce the contact stress due to hard edge

2. Use a pipe insulation from a local hardware store, or pool noodle, which can be split down the seam and placed along the edge

Importance of Posture Change Throughout the Day

- Every 30 minutes, one should stand up and move around for 2 minutes (
- Maintain a fluid posture, switch between sitting and standing desk throughout the day
- Stretch during micro-breaks, restroom-use, coffee-break
- **Prevents prolonged sedentary position**
- **Prevents MSDs, diabetes, cardiovascular conditions, etc.**

10-15 seconds for each position

Do ergonomic interventions work?

Industrial Engineering
& Management Systems
Vol 20, No 2, June 2021, pp.109-118
ISSN 1598-7248 | EISSN 2234-6473 |
https://doi.org/10.7232/iems.2021.20.2.109

Effectiveness of Ergonomic Intervention in Work-related Postures and Musculoskeletal Disorders of Call Center Workers: A Case-control Study

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(Received: August 31, 2020 / Accepted: April 8, 2021)

Methods

→ case-control study

→ 32 call center workers 4-week ergonomic intervention

→ Ergonomic informational brochure

→ Postural and biomechanical assessments (RULA & REBA)

→ Pain or discomfort assessment

Table 1. Characteristics of study participants

Variable	Case	Control	*P*
Subject (N)	16	16	
Age (y) Mean ± SD	28.8 ± 5.7	32.1 ± 10.0	0.564
Sex (N)			
Male	4	4	0.077
Female	12	12	
BMI (kg/m^2), Mean ± SD	23.6 ± 3.4	24.1 ± 5.1	0.616
Smoking (N)			
Yes	5	4	0.118
No	11	12	
Work experience (month), Mean ± SD	39.2 ± 24.8	54.5 ± 23.7	0.196
Location (N)			
Manila	8	9	1.000
Cebu	8	7	

Mann-Whitney U test and McNemar's Exact test, *significant at $P \leq 0.05$

BMI Body mass index

Primary Outcome Measures

1. Rapid upper limb assessment (RULA)

2. Rapid entire body assessment (REBA)

Table 2. Rapid upper limb assessment (RULA) mean scores in pre and post intervention periods

Location	Variable	Case				*P*	Control				*P*	Case		Control		*P*
		Pre		Post			Pre		Post			Pre-Post		Pre-Post		
		Mean	SD	Mean	SD		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Manila	RULA score	4.3	1.4	1.9	0.8	0.018*	3.8	1.0	3.8	0.8	1.000	2.4	1.7	0.0	0.5	0.002*
	Score A	3.9	0.4	1.5	0.5	0.010*	3.6	0.5	3.7	0.5	0.317	2.4	0.7	-0.1	0.3	<0.001*
	Score B	4.1	2.2	1.5	0.9	0.016*	3.7	1.7	3.4	1.2	0.317	2.6	2.1	0.2	0.7	0.003*
Cebu	RULA score	3.0	0.8	1.6	0.5	0.008*	3.9	0.9	3.7	0.8	0.317	1.4	0.7	0.1	0.4	0.002*
	Score A	3.3	1.0	1.6	0.5	0.015*	3.3	1.0	3.4	0.5	0.564	1.4	0.7	-0.1	0.7	0.005*
	Score B	4.1	1.1	1.1	0.4	0.010*	4.1	1.1	4.1	1.1	1.000	1.9	1.4	0.0	0.0	<0.001*
Total	RULA score	3.6	1.3	1.8	0.7	0.001*	3.8	0.9	3.8	0.8	0.564	1.9	1.4	0.1	0.4	<0.001*
	Score A	3.4	0.7	1.6	0.5	0.001*	3.4	0.7	3.6	0.5	0.317	1.9	0.9	-0.1	0.5	<0.001*
	Score B	3.6	1.8	1.3	0.7	<0.001*	3.9	1.4	3.8	1.2	0.317	2.3	1.8	0.1	0.5	<0.001*

Wilcoxon signed rank test, *significant at $P \leq 0.05$

Both RULA and REBA Scores of experimental group improved after following interventions

Table 3. Rapid entire body assessment (REBA) mean scores in pre and post intervention periods

Location	Variable	Case				P	Control				P	Case		Control		P
		Pre		Post			Pre		Post			Pre-Post		Pre-Post		
		Mean	SD	Mean	SD		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Manila	REBA score	9.0	1.8	3.1	1.1	0.012*	8.0	2.1	8.3	1.5	0.257	5.9	2.2	-0.3	0.9	<0.001*
	Score A	6.8	1.5	2.3	1.0	0.011*	6.1	1.5	6.2	1.1	0.655	4.1	2.6	-0.1	0.8	0.005*
	Score B	4.6	1.3	1.8	1.2	0.025*	3.6	1.6	3.8	1.8	0.317	2.4	2.4	-0.2	0.7	0.006*
Cebu	REBA score	9.1	1.5	2.9	1.0	0.012*	9.4	1.0	9.6	1.0	0.564	6.3	1.8	-0.1	0.7	0.001*
	Score A	6.1	1.5	2.4	1.1	0.011*	6.6	1.0	6.9	1.2	0.317	3.8	1.6	-0.3	0.8	0.001*
	Score B	6.3	0.7	1.6	0.9	0.011*	6.0	0.0	6.0	0.0	1.000	4.6	1.3	0.0	0.0	0.001*
Total	REBA score	9.1	1.6	6.1	3.3	0.012*	8.6	1.8	8.8	1.4	0.257	2.9	3.4	-0.2	0.7	0.002*
	Score A	6.3	1.7	4.2	2.3	0.017*	6.3	1.3	6.4	1.0	0.655	2.1	2.8	-0.1	0.6	0.023*
	Score B	5.4	1.3	4.3	2.3	0.040*	4.6	1.7	4.8	1.7	0.317	1.2	2.1	-0.1	0.5	0.013*

Wilcoxon signed ranks test, *significant at $P \leq 0.05$

Secondary Outcome Measure

Body part discomfort questionnaire

Subjective discomfort failed to improve after 4 weeks of ergonomic intervention

Table 4. BPDF, BPDS and BPDFS mean scores in pre and post intervention periods

Location	Variable	Case				*P*	Control				*P*	Case		Control		*P*
		Pre		Post			Pre		Post			Pre-Post		Pre-Post		
		Mean	SD	Mean	SD		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Manila	BPDF	6.63	4.44	3.88	1.73	0.344	3.33	2.29	5.56	3.81	0.205	2.75	5.01	-2.22	4.29	0.122
	BPDS	1.75	0.89	1.38	0.74	0.450	1.33	0.87	1.78	0.83	0.157	0.57	1.20	-0.56	0.86	0.128
	BPDFS	12.50	11.39	5.75	5.20	0.161	4.56	3.09	10.11	8.42	0.123	6.75	13.46	-5.56	8.89	0.054
Cebu	BPDF	4.88	2.64	3.88	1.89	0.482	4.86	3.58	5.86	4.22	0.267	1.00	3.30	-1.00	2.24	0.268
	BPDS	1.50	2.00	1.00	0.00	0.102	1.57	0.79	1.57	0.54	1.000	0.40	0.57	0.27	0.86	0.850
	BPDFS	7.25	4.17	4.13	2.17	0.123	7.57	6.55	8.43	6.97	0.496	3.13	5.33	-0.90	5.32	0.223
Total	BPDF	5.75	3.64	3.88	1.75	0.123	4.00	2.92	5.69	3.86	0.097	1.88	4.19	-1.69	3.50	0.028*
	BPDS	1.63	0.81	1.19	0.54	0.140	1.44	0.81	1.69	0.70	0.331	0.48	0.91	-0.19	-3.52	0.156
	BPDFS	9.88	8.72	4.94	3.94	0.052	5.88	4.97	9.38	7.62	0.111	4.94	10.06	0.93	7.69	0.017*

BPDF Body part discomfort frequency; BPDS Body part discomfort severity

BPDFS Body part discomfort frequency severity

Wilcoxon signed ranks test, *significant at $P \leq 0.05$

Key Takeaways

- MSDs is costly and may lead to permanent disability
- Due to the COVID-19 pandemic, office workers are given an option to permanently work from home
- Simple easy-to-follow ergonomic intervention can be done to improve home office set-up
- Postures improves when following proper office ergonomics
- Long-term ergonomic intervention is needed to prevent prevalence of body pain and discomfort related to MSDs

Thank you!

Q & A