

Effects of an Electric Height-Adjustable Worksurface on Computer Worker Musculoskeletal Discomfort and Productivity

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Hedge, A. and Ray, E.J. (2004) Effects of an electronic height-adjustable worksurface on self-assessed musculoskeletal discomfort and productivity among computer workers, Proceedings of the Human Factors and Ergonomics Society 48th Annual Meeting, New Orleans, Sept. 20-24, HFES, Santa Monica, 1091-1095.

Acknowledgements

- LINAK (especially Ann Hall) for funding support.
- WorkRite (especially Steve Owles) for the worksurfaces and installation in the test facilities.
- Lodina Slawecki, Lynn Olson, Debbie Padilla and Anne Merrill (Intel)
- Ben Atkinson (CNA Insurance)
- Participants

Sit-Stand Workstations

- Benefits:
 - Varied work posture
 - Reduced upper body discomfort
 - Reduced foot swelling



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Sit-Stand Workstations: Above-desk Keyboard Trays

- Height and angle adjustable keyboard tray allows the user to sit or stand.
- For standing, the height of the screen and any documents also needs to be adjustable.

Sit-stand Workstations: Above-desk Keyboard Trays

(Dainoff, 2002)

- Studied sit-stand keyboard tray.
- Standers stood ~2.5 times per day
- Standing time averaged ~6 minutes
- Standers took fewer and shorter breaks
- Standers showed better productivity

Sit-Stand Benefits

(Roelofs & Straker, 2002, Ergonomics SA 14(2): 11-29)

- 30 Ss from 16 bank branch offices
- Ss full time bank-tellers
- Ss worked in turn in either:
 - Seated all day
 - Standing all day
 - Sit-stand
- Sit-stand involved alternating between high stool and standing at teller counter.
- Results showed significant benefit of sit-stand for reducing MS discomfort.

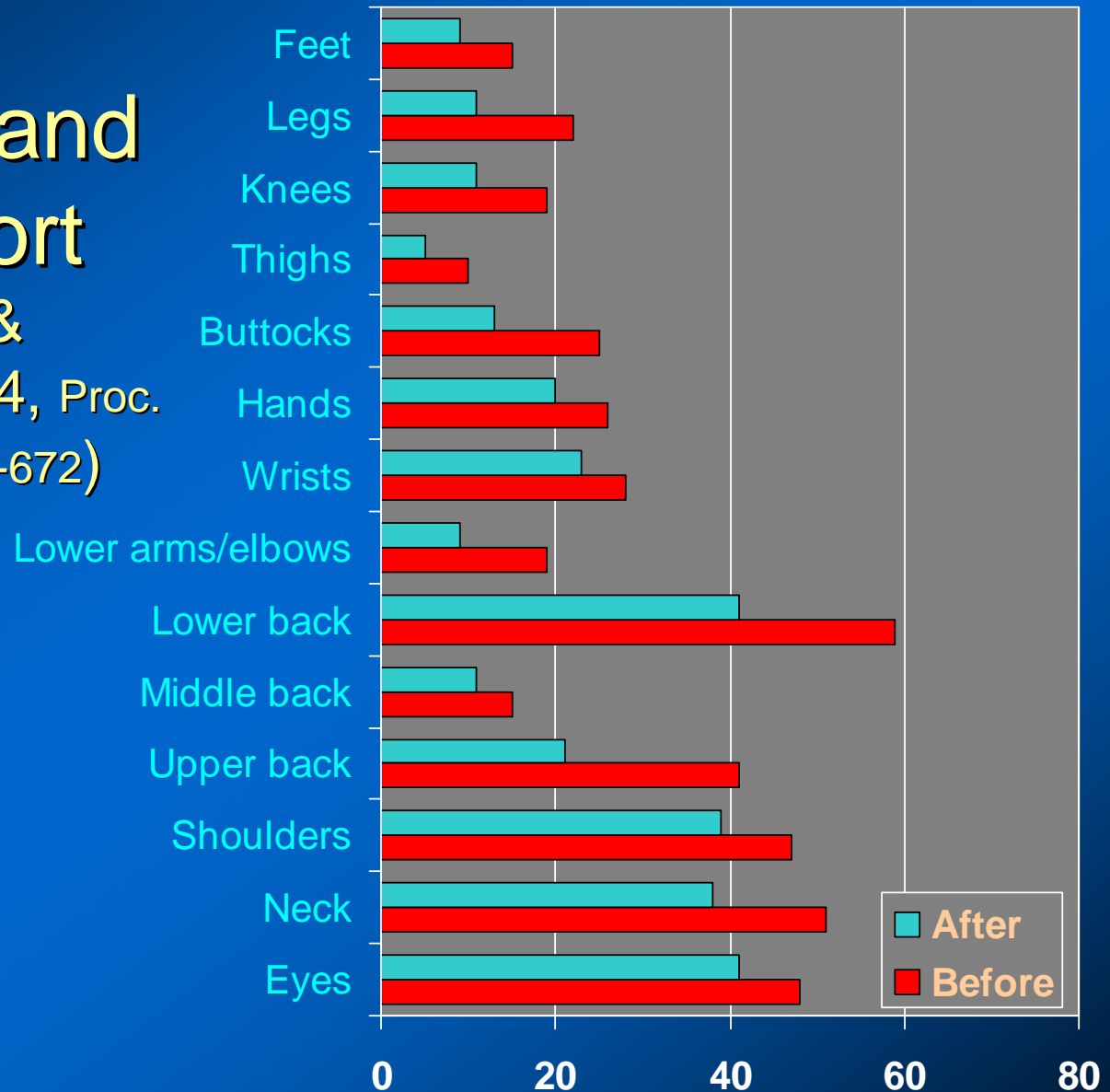
Sit-Stand: UPS Study

(Nerhood & Thompson, 1994, Proc. HFES 38th,1, 668-672)

- Conducted a before-and-after survey of UPS employees
- Results showed average 3.6 times per day adjustments to standing position
- Results showed average 23% times per day in standing position
- Results showed average 62% decrease in musculoskeletal discomfort complaints
- Feedback from employees on sit-stand was very positive

Sit-Stand and Discomfort

(Nerhood & Thompson, 1994, Proc. HFES 38th,1, 668-672)



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Electric Height-Adjustable Worksurfaces

- Keyboard/ mouse on a height-adjustable worksurface:
 - Postural effects:
 - Neck, back, wrists, legs
 - Adjustments:
 - Ease, time, controls
 - Equipment:
 - space (chair)
 - screen position
 - document position
 - Productivity

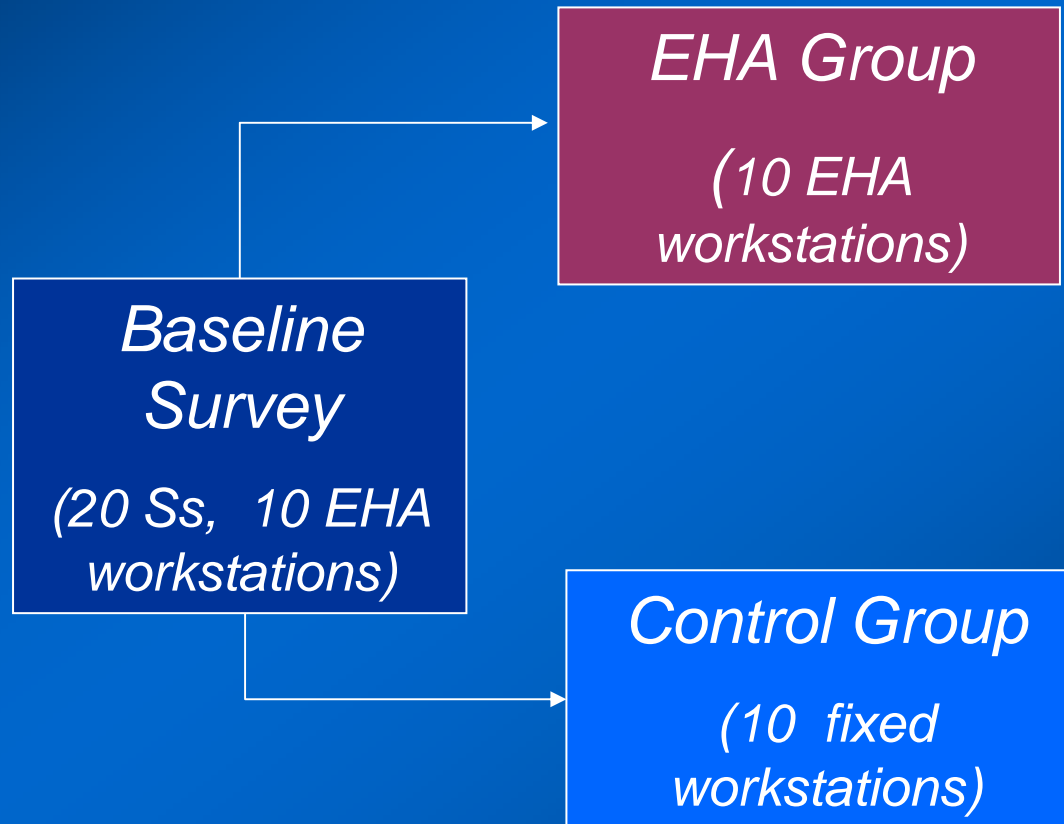
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CNA Research Design

- CNA site:
 - CNA insurance (20 Ss, 10 sit-stand workstations)
 - Two-phase design:
 - Baseline survey
 - Phase 1 survey (one-month post baseline)



CNA – Study design



Phase 1

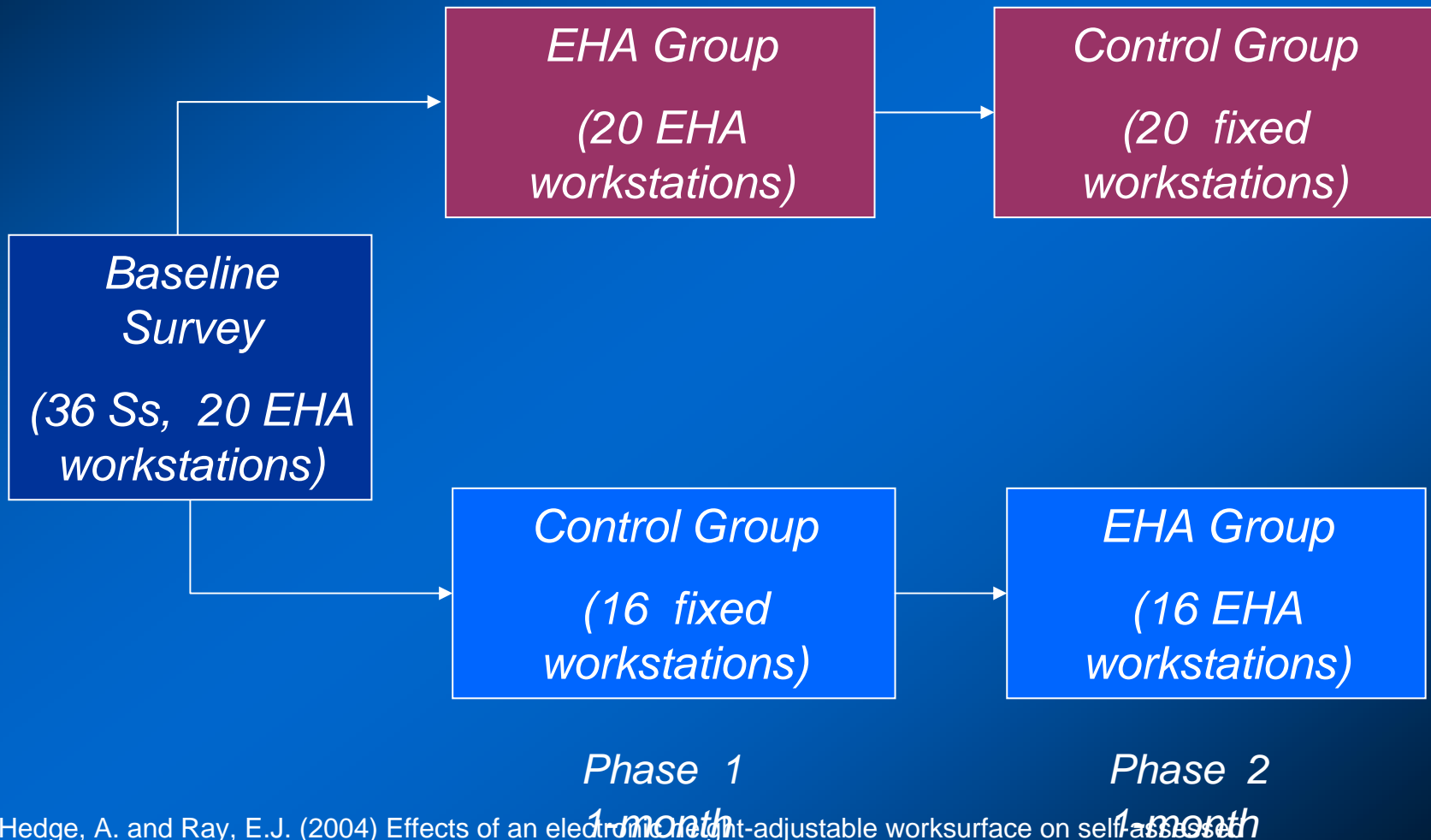
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The Intel logo is displayed in white lowercase letters on a blue square background.

Intel Project

- Intel project:
 - Intel (36 Ss, 20 sit-stand workstations)
 - Three phase design:
 - Baseline survey
 - Phase 1 survey (one-month post baseline) – almost complete
 - Phase 2 survey (one-month post baseline) – to be completed

Intel – Study design



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Results: Work Patterns

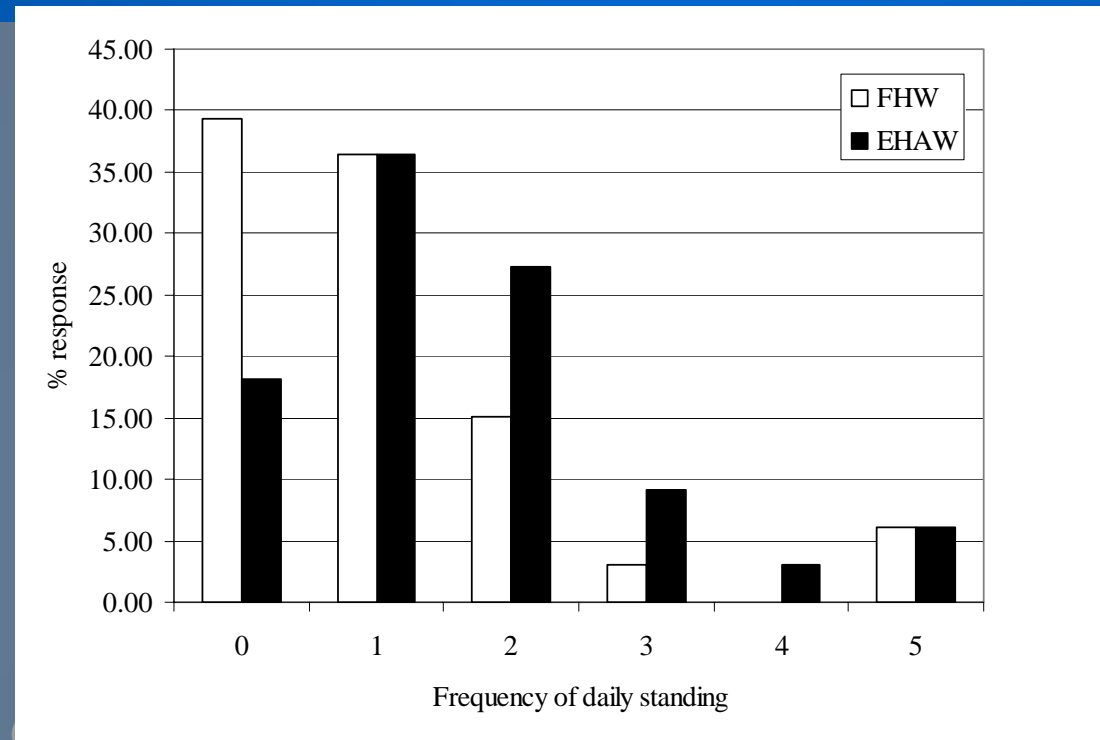
- Complete data available for 33 participants

	FHW	EHAW	Z	DF	P
% day using a mouse?	64.3	62.2			ns
% day using a keyboard?	57.6	59.5			ns
% day discussing work with colleagues in your cubicle?	19.7	13.8	-1.92	30	0.055
% day discussing work with colleagues in their cubicles or in meeting room	16.4	14.2			ns
% day standing at worksurface to do your work?	8.3	21.2	-3.202	31	0.001
% day sitting at worksurface to do your work?	87.7	71.4	-4.023	31	0.000

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Results: Daily Standing

- Average of 1.5 height adjustments past the mid-point per day.
- Mean daily adjustments and the self-rated frequency of adjustment were correlated ($r=0.47$, $p=0.028$: 1 tailed).
- More EHA standing in the 2-4 times per day range.



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Results: Mean Comfort Ratings

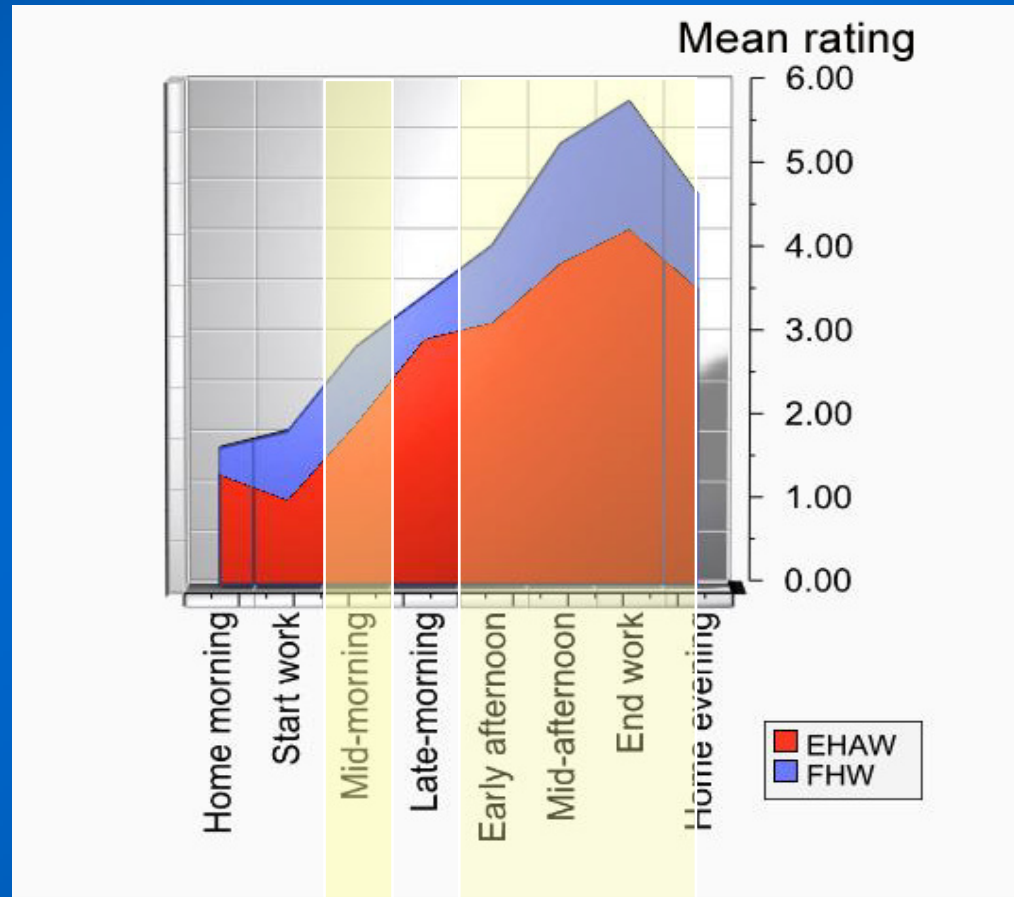
- Improvements in keyboard, mouse, chair, and workstation comfort ratings with EHAW

	FHW	EHAW	Z	df	P
Keyboard comfort	3.4	4.6	-2.90	30	0.004
Mouse comfort	3.2	4.2	-2.88	30	0.004
Chair comfort	3.2	4.4	-2.70	30	0.007
Workstation comfort	3.2	4.9	-3.92	31	0.000

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Results: Time-of-Day and Mean Discomfort Ratings

- Significantly lower discomfort ratings at the mid-morning and from early afternoon through the end of the workday with the EHAW.



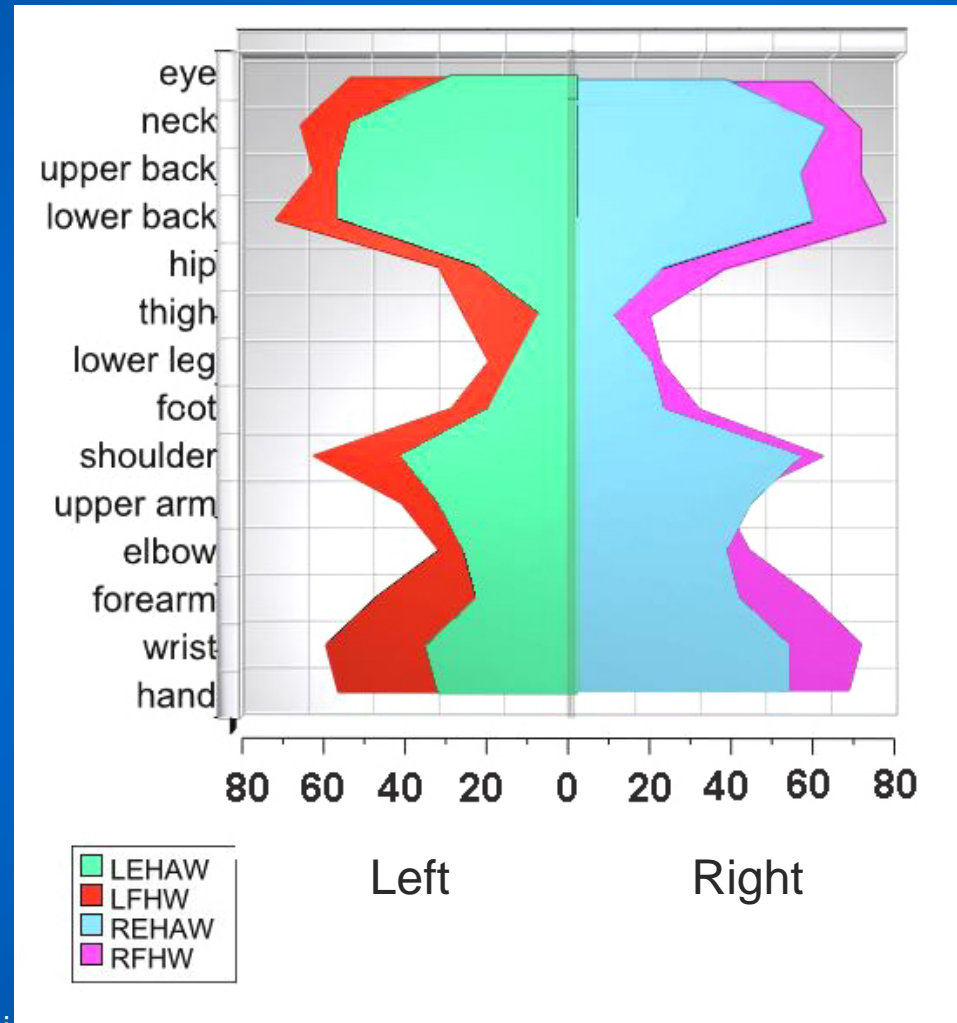
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Results: MSD Frequency

- There was a significant but small change in the frequency of 4 MSD symptoms (none vs. monthly/weekly/daily) :
 - left eye (51.5% vs 30.3%: $Z(33)=-2.06$, $p=0.04$)
 - right hip (34.3% vs 18.2%: $Z(32)=-2.46$, $p=0.014$)
 - right hand (66.7% vs 51.5%: $Z(33)=-2.36$, $p=0.018$)
 - slight increase for the right upper arm (36.4% vs 48.5%: $Z(33)=-2.74$, $p=0.01$)

Results: MSD Severity

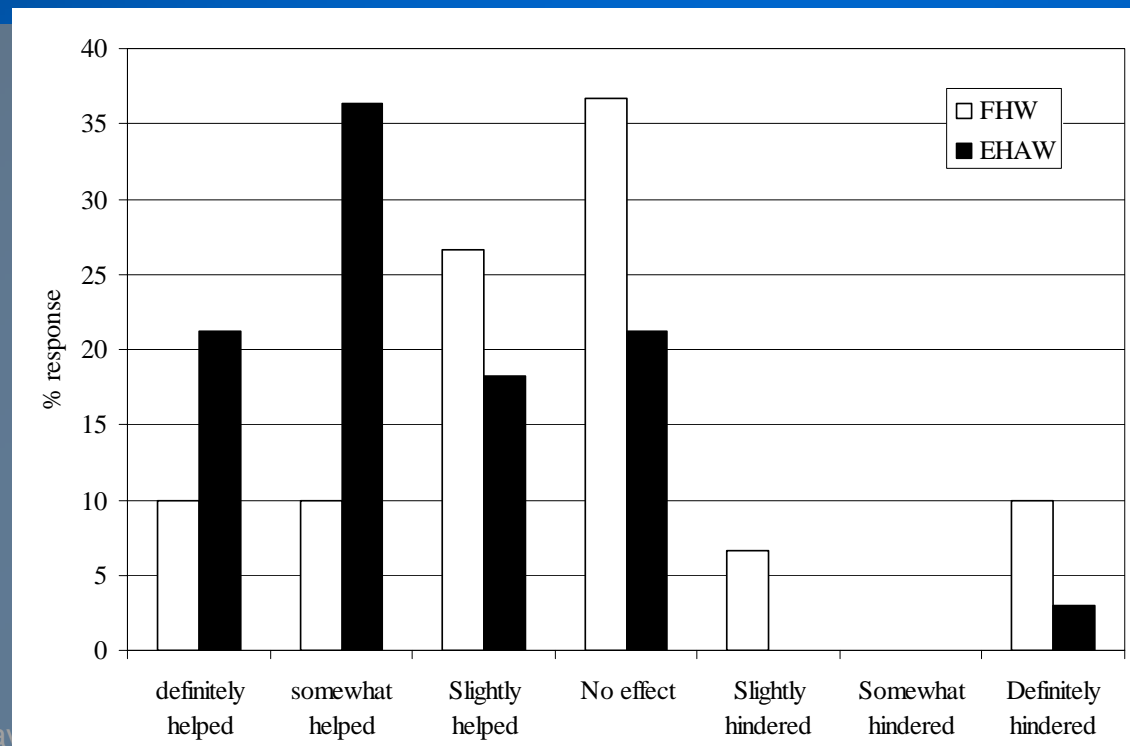
- Severity of MSDs aggregated (none vs. mild + moderate + severe)
- Significant decreases in severity for:
 - left eye, right neck, left and right upper back, left and right lower back, left thigh, left and right shoulders, right upper arm, left and right elbows, left and right forearms, left and right wrists and left and right hands
- Average 27.5% decrease across all body parts



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Results: Productivity & Preference

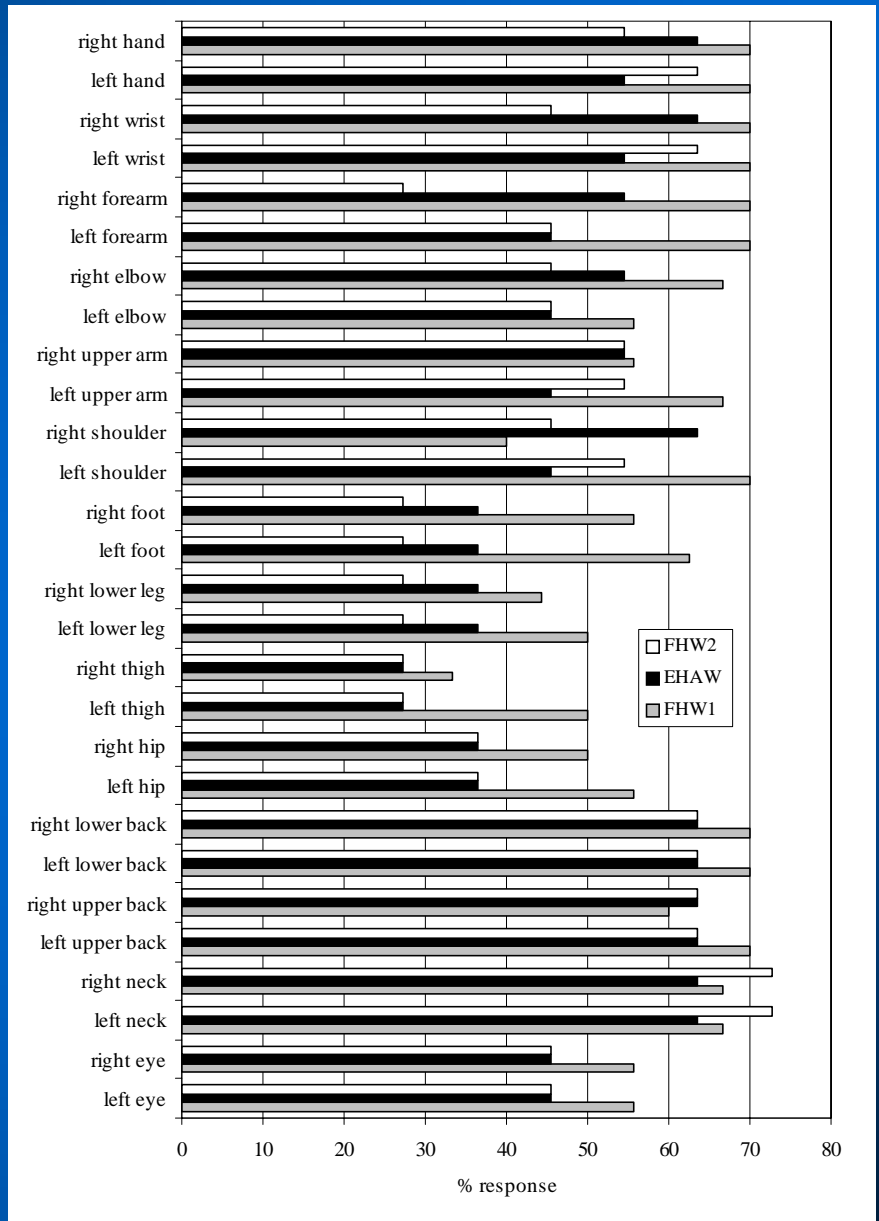
- Productivity ratings (somewhat/definitely helped) higher for the EHAW(57.5% vs. 20.0%: $Z(30) = -3.23$, $p=0.001$).
- Most participants (82.4%) preferred the EHAW and 64.7% indicated a definite preference for this arrangement.



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Results: Placebo Effect

- 11 Ss participated in the crossover design (FHW1-EHAW-FHW2)
- MSD symptoms decreased in the right forearm ($Z(10) = -2.06$, $p=0.039$) and right wrist ($Z(10) = -2.07$, $p=0.038$) between FHW1 and EHAW conditions, but no other significant differences in MSDs.
- No significant differences in MSDs between the EHAW and FHW2, though for several body segments the trend was in the expected direction (an increase with the FHW).



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Research Conclusions

- Results indicate that EHAW may offer several benefits:
 - Improved comfort at the workstation
 - Reduced discomfort over the course of the workday, especially later in the day
 - Reduced severity of musculoskeletal discomfort , especially in the neck, and low back
 - Improve self-rated productivity
- Results suggest that EHAW may not affect MSD frequency, but a longer-term study is required to investigate this.
- Results show that users respond favorably to the EHAW
- Detailed report available at
<http://ergo.human.cornell.edu/CUEHADownRep0904.html>