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DOW JONES & COMPANY, INC.
DALLAS, TEXAS

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I. SUMMARY

On April 27, 1990, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Occupational Safety and Health Administration (OSHA) to conduct a health hazard evaluation at the Dow Jones & Company in Dallas, Texas. The request concerned lower extremity musculoskeletal problems among printers potentially related to poor ergonomic working conditions in the composing room. Specific health effects mentioned in the request included tumors between the metatarsal bones, hammertoes, ingrown nails, bunions, swelling associated with arthritic knees, and heel spurs. In response to this request, a medical and ergonomic investigation was conducted on June 26-27, 1990.

In October/November 1989, several changes occurred in the composing room environment. The carpet was removed and a tiled floor was installed. Stools used by printers during downtime were removed and sitting in the composing room was not allowed unless the employee was assigned a sitting job. In March/April 1990, as a result of management and union negotiations, mats were installed and sit-down breaks during downtime were permitted.

A questionnaire was administered to all 20 printers and 8 of 9 news production staff. Five (25%) of the printers and 1 (13%) news production staff person reported new onset of lower extremity discomfort following the change in composing room floor surface (relative risk [RR]=2.00, 95% confidence intervals [CI]: 0.27, 14.55). Twelve (60%) of the printers and 2 (25%) of the news production staff reported lower extremity discomfort (either new onset or aggravation of a pre-existing condition) following the change of floor (RR=2.40, 95% CI: 0.69, 8.40). Finally, 11 (55%) printers and 1 (13%) news production staff person reported current lower extremity discomfort (either new onset or aggravation of a pre-existing condition) (RR=4.40, 95% CI: 0.67, 28.71). Although the differences in prevalence of lower extremity musculoskeletal problems between the printers and news production staff were not statistically significant (possibly because of the small number of people in the study), more lower extremity problems were consistently reported by the printers than the news staff.

An ergonomic evaluation of the composing room was performed by analysis of photographs and videotaped work tasks. Static standing postures (which, when frequent or sustained, can be stressful and fatiguing to the musculoskeletal system) were observed among printers working at the make-up banks. Make-up banks did not accommodate the short-statured individual as evidenced by employees standing on tiptoe.

On the basis of the medical and ergonomic investigation, the NIOSH investigator conclude that an ergonomic hazard exists in the composing room among printers due to static standing postures. In addition, unadjustable workstations create an ergonomic hazard for short-statured workers. Recommendations are made in Section IX for modifying the work environment

KEYWORDS: SIC 2711 (Newspapers: Publishing, or Publishing and Printing), journeymen printers, composing room, standing workplace, lower extremity disorders, ergonomics

II. INTRODUCTION

On April 27, 1990, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Occupational Safety and Health Administration (OSHA) to conduct a health hazard evaluation at the Dow Jones & Company in Dallas, Texas. The request concerned lower extremity musculoskeletal problems among printers potentially related to poor ergonomic working conditions in the composing room. Specific health effects mentioned in the request included tumors between the metatarsal bones, hammertoes, ingrown nails, bunions, swelling associated with arthritic knees, and heel spurs.

NIOSH investigators conducted a site visit on June 26-27, 1990. The site visit consisted of an opening conference, a walk-through survey of the composing room, medical and ergonomic evaluations, and a closing conference.

III. BACKGROUND

The Dow Jones & Company began production of the Wall Street Journal (WSJ) in Dallas, Texas, in 1948 and moved to its current location in 1965. Two editions (a 2-star edition and a 3-star edition) of the WSJ for the Southwest United States are printed at the Dallas site, with a total production of approximately 95,000 copies per day. In 1972, the facility converted from hot metal printing to cold type. In 1974, approximately 50% of the data to compose the type were being entered at the facility by keyboard operators. During the period between 1985-87 the composing of type at this facility was phased out, and the approximately 12 keyboard operators (all female) were transferred to the make-up area to work as printers. Presently, all type comes directly from computers in New York City (NYC) and is received by typesetting machines in the composing room.

Once the type is received, it is photocopied, trimmed, waxed, and placed on a galley. The galleys holding the type are placed at the ready bank, where they are picked up by the printers and taken to the make-up banks to be used to compose a page. Each composite page, weighing approximately one pound, contains various combinations of news stories, photographs, and advertisements. After a composite page is assembled, a negative is made of it. The negative is sent to the plate-making department, and plates are subsequently sent to the printing department.

The composing room includes 11 make-up banks for composing newspaper pages, the dump area where type is trimmed and waxed, ready banks where type ready for paste-up is placed, typesetter machines driven by computers in NYC, 2 cameras, and advertising and news production areas. There is also a small backroom used for photographic processing.

In October/November 1989, several changes occurred in the composing room environment. The carpet was removed and a tiled floor was installed. Stools, used by printers during downtime since approximately 1974, were removed. Subsequently, printers were prohibited from sitting in the composing room (unless they were assigned to a job, such as doing corrections on video display terminals in the advertising department, that required a sitting posture). Reportedly, the only time they were allowed to sit during the workshift was during their lunch time (a half hour break). The union filed a grievance regarding the need for mats, stools, and breaks. An agreement on these issues was reached between union and management representatives in March/April

1990. Subsequently, cushioned mats were installed at the make-up areas and other areas where static standing occurs. Sit-down breaks in the lunch room during downtime were also authorized.

IV. JOB DESCRIPTIONS

Printers are responsible for composing newspaper pages, making corrections, and performing photographic processing. There are 16 full-time and 4 substitute (fill-in for full-time employees) printers. Most of the printers are assigned to make up approximately 2-5 pages each.

News production staff (news staff) are responsible for proofreading, directing corrections, and supervising page make-up. There are 9 news production staff working in the composing room. Reportedly, news staff have more control over their work-rest schedule than printers.

Printers and news staff generally work five 7-hour shifts, Sunday through Thursday; a few work on Friday typesetting classified ads. The majority work the 3:30pm to 11:00pm shift.

V. METHODS

Medical

A NIOSH investigator administered to all 20 of the printers and 8 of the 9 news staff, a questionnaire that focused on lower extremity (LE) musculoskeletal problems potentially related to ergonomic hazards in the composing room. Seventeen of the 20 printers completed the questionnaire in person at the time of the site visit; the other 3 printers and all 8 of the news staff were interviewed by telephone at a later date.

Rates of LE discomfort among printers were compared to news staff. Both printers and news staff worked in the composing room before and after the composing room environment was changed.

Ergonomic

The ergonomic evaluation included evaluation of a videotape and photographs, taken by NIOSH personnel, of employees working in the composing room. The videotape and photographs of composing room employees taken by the OSHA investigator were also obtained and reviewed. Finally, a make-up bank was measured.

VI. EVALUATION CRITERIA

In many industries, workers are required to work while standing and walking. Lower extremity musculoskeletal disorders from forced long-term standing and walking has not been well researched in the occupational literature. According to Redfern and Chaffin, in 1983 the American Podiatric Association reported that 83 percent of industrial workers had foot or lower leg problems such as discomfort, pain, or orthopedic deformities.¹ It is generally acknowledged that the physiological demand on the worker is increased during standing tasks. Cardiovascular demand is increased (manifested as increased heart rate and diastolic blood pressure), as is demand for continuous static

contraction of the lower extremity and back muscles which maintain erect posture.² In the absence of leg movement, blood and other tissue fluids tend to accumulate in the legs, causing swelling and varicose veins (enlarged twisted veins most commonly observed in the lower extremity).² Fatigue and discomfort associated with standing tasks are attributable to insufficient return flow of the venous blood and static muscular effort.³

A few studies have examined the relationship between lower extremity musculoskeletal problems and prolonged standing postures.^{4,5} A study conducted in Switzerland found that saleswomen who stand during the entire workshift had significantly more complaints of pain in the legs, feet, and back compared to saleswomen who walk around.⁴ In another study, two-thirds of 315 saleswomen studied had signs or symptoms of varicosis.⁴ In addition, 28% of the saleswomen had pains in the legs, 50% had problems with their feet, 18% had low back pain, and 15% had knee problems.

In a United Kingdom study, the most common site of regularly occurring pain or discomfort among female department store and supermarket staff was the feet.⁵ In department store staff, pain or discomfort in the hips, legs, and knees was predominantly considered to be associated with either prolonged standing or general work fatigue, as was the case when discomfort in the feet was recorded. In supermarket staff, pain in the hips, legs, and knees was attributed to prolonged sitting or standing and cramped workstations. There were significant differences between department store and supermarket staff who reported foot discomfort and those who did not. Those who reported foot discomfort reported spending a greater time standing, walking, and kneeling, and less time sitting, than did those without foot discomfort. In addition, this study of women in the retail trade observed a dose-response relationship between "time on feet" during the working day and prevalence of regular pain or discomfort in the feet. The prevalence of pain or discomfort was 48.2% among those spending more than 30% of their working day on their feet, while for those spending less than 30% the prevalence was 7%. Similar findings were found by Grandjean, who concluded that prolonged standing in one place is a common cause of ailments affecting the legs and feet of saleswomen.³

It is generally acknowledged that the harder and less "giving" the floor surface, the more stress is placed on the body. According to Konz, carpet is considered to be the best type of floor surface because it provides resilience; metal gratings are the worst since they not only have little resilience but also have minimum surface area, thus acting as knives.² A study by Redfern and Chaffin examining the effects of different floor surfaces, including concrete, seven types of mats, and a visco-elastic shoe insert found that the concrete floor and the hard mat consistently had the highest discomfort ratings.¹ The lowest ratings were shared by the 3/8" thick rubber mat, the tri-laminate mat, and the shoe insert. Although this study was limited by a small study population, it found significant levels of fatigue and discomfort in different areas of the body among workers who are required to stand for prolonged periods of time. The feet had the highest discomfort rating, followed by the ankle. How effective a type of floor is in relieving fatigue associated with prolonged standing appears to be a function of its hardness. However, a floor surface can be too soft. This is evidenced by the uneven mat, perceived to be the softest, yet receiving relatively high tiredness ratings.

VII. RESULTS AND DISCUSSION

Medical

Demographic and Work History Characteristics

Demographic and work history characteristics of the printers and news staff are presented in Table 1. On the average, printers were older than the news staff, by 19 years. The number of years worked at the WSJ by printers and news staff was similar. Proportionally, the number of females to males was greater among the news staff than among the printers. Self-reported heights for printers and news staff were similar.

Lower Extremity Discomfort

Five (25%) of the printers and 1 (13%) news staff person reported new onset lower extremity discomfort following the change in composing room floor surface. Perhaps because of the small number of people in the study, this difference (relative risk [RR]=2.00, 95% confidence intervals [CI]: 0.27, 14.55) was not statistically significant. New onset LE problems included tiredness, burning and/or pain of the feet, cramps in the lower legs, and arthritis of the knee.

Twelve (60%) of the printers and 2 (25%) of the news staff reported lower extremity discomfort (either new onset or aggravation of a pre-existing condition) following the change of floor (RR=2.40, 95% CI: 0.69, 8.40). Again, this difference was not statistically significant.

Finally, 11 (55%) printers and 1 (13%) news staff person reported current lower extremity discomfort/pain (either new onset or an aggravation of a pre-existing condition) (RR=4.40, 95% CI: 0.67, 28.71). LE problems include tiredness and pain in the feet and lower legs, pain and swelling in the knee, and hip pain. Two employees were diagnosed with arthritis of the knee soon after the change in floor. One employee reported a history of hammertoes and ingrown toenails, one reported bunions on both feet, and another reported a history of a tumor removed from the foot. All of the printers and the news staff person with current LE discomfort/pain reported that their level of discomfort/pain decreased with introduction of the cushioned mats. Printers reported that the sit-down breaks during downtime also reduced LE discomfort/pain during the workshift. Many also reported that wearing shoes with cushioned soles reduced their level of discomfort.

Ergonomic

The current floor surface is a Roppe square-design rubber tile with foot cushions positioned in front of workstations associated with static standing (i.e., the dump area, ready bank, and make-up banks). The foot cushions are marketed as "anti-fatigue matting" and are open-celled mats composed of 3/32" thick top tile on a 3/8" thick foam rubber base. These mats have beveled edges on all four sides (eliminating a potential trip hazard). Several employees reported that the mats have a tendency to move over the day. Reportedly, maintenance workers are supposed to re-position the mats daily, but it was not being done consistently. A few areas where static standing occurs lacked cushioned mats. These areas include the dump area, the camera area, the opaque room, and the area where paper positives are made. The Roppe rubber tile design is reported

to have a static coefficient of friction of 0.73, which indicates slip resistance. A slip resistance of not less than 0.50 has been traditionally recognized as not hazardous. The Roppe rubber tile has a tensile strength of 950 pounds per square inch, which indicates rupture resistance, elasticity, and resilience. This flooring surface replaced an industrial-grade woven-loop carpet with a 3/8" foam pad.

The 11 make-up banks are made of wood and are not adjustable. Each 2-sided table accommodates 6 pages of the WSJ, 3 on each side. The work surface has an approximate 30 degree slant. The distance from the ledge, where the plastic page carrier rests, to the floor ranges from approximately 36 to 37 inches. The height from the top of a bank to the floor is approximately 50 to 51 inches. Extending across the top of each bank is a piece of glass where papers are clipped; this adds approximately 10 inches to the height of the workstation.

Although the make-up banks are not adjustable, it was reported that it is possible to raise the page by the use of blocks placed in the trough of the make-up bank. Two blocks are required to raise each page approximately 4 inches diagonally and 2 inches vertically. Reportedly, one of the tallest employees occasionally uses them. One of the shortest employees prefers a particular make-up bank because it is slightly shorter than the others.

A review of the videotapes and photographs revealed potential ergonomic hazards. Printers work at a standing work station. The tasks performed by printers have both dynamic (i.e., walking) and static (i.e., standing in one place) components. The major task involving static standing postures is making up the pages at the banks, especially when the pages are being made up initially for the 2-star edition. Generally, static standing postures were maintained for approximately 5-10 minutes and were interrupted by walks to other areas of the composing room, such as the ready bank and camera. In addition, short-statured printers were observed standing on their tiptoes in order to work on the top of the page.

In addition, employees were noted to be leaning on the front edge and sides of the make-up banks, resting on their elbows and other body parts. The front edge and sides of the make-up banks can act as a contact hazard because of their small surface area.

VIII. CONCLUSIONS

This investigation was limited by the small number of persons evaluated. Although differences in prevalence of lower extremity musculoskeletal problems between the printers and news staff were not statistically significant, more lower extremity problems were consistently reported by the printers than the news staff.

Static standing postures were observed among printers working at the make-up banks. Make-up banks did not accommodate the short-statured individual, as evidenced by employees standing on tiptoes. Static postures, when frequent or sustained, can be stressful and fatiguing to the musculoskeletal system and thus should be avoided.

IX. RECOMMENDATIONS

In operations where a standing workplace is used for a majority of the shift, it is desirable to avoid static postures requiring continuous muscle contraction. The following recommendations are offered to minimize static standing requirements:

1. Provide the option for sitting or standing at make-up banks. Work on large-size products or drawings lends itself well to a sit/stand operation; provision for sitting considerably reduces static loading on the legs and backs of workers as they lean over large drawings or negatives.⁶
2. Install foot rests 4-6 inches above the floor to allow workers to rest one leg while standing. Workers should alternate legs often. Foot rests are believed to alleviate back stress as well as minimize foot fatigue. Foot rests are needed even if sit/stand provisions are made.
3. The front edge and the sides of the make-up banks should be padded to allow workers to lean against the bank while working. (It may be necessary to bolt the banks to the floor for stability.) Padded edges also eliminate the potential contact hazard associated with leaning on a small surface area.
4. Cushioned mats should be installed at the dump area, the camera area, the opaque room, and the area where paper positives are made, as well as in other areas where static standing occurs. Mats should be re-positioned prior to each workshift, or some type of semipermanent adhesive backing (e.g., velcro) should be used to keep the mats in place.
5. The dimensions of the make-up bank conform to those recommended by Woodson.⁷ However, make-up banks adjustable within a range of 10-15% (4-6 inches in height) could better accommodate short-statured workers. It may be possible to provide sufficient adjustability by providing pull-out, lock-in-place work platforms, 4-6 inches high, for short-statured workers to stand on. Platforms should be covered with a mat to provide cushioning and improve comfort during use.
6. Shoes with well-cushioned insoles and insoles should be provided to improve comfort.
7. Dow Jones should continue to permit employees to sit during slack time.

X. REFERENCES

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Table 1

Dow Jones & Company
 Dallas, Texas
 HETA 90-251

Demographic and Work History Characteristics

Characteristics	20 Printers	8 News Staff
Gender:		
Females	11	6
Males	9	2
Age (mean, sd ¹):		
Females	50 (4)	31 (8)
Males	55 (4)	42 (13)
All	52 (5)	33 (10)
# Years worked at WSJ (mean, sd):		
Females	9 (2)	8 (7)
Males	18 (14)	17 (19)
All	13 (10)	10 (10)
Height in inches (mean, sd):		
Females	64 (2)	64 (2)
Males	69 (3)	69 (1)
All	66 (4)	65 (3)
Range	60 - 72	60 - 70

¹sd = standard deviation