

Job demands and worker health in machine-paced poultry inspection

by Barbara Wilkes, MS,¹ Lambert Stammerjohn, MSE,¹ Nina Lalic, MSPH²

WILKES B, STAMMERJOHN L, LALICH N. Job demands and worker health in machine-paced poultry inspection. *Scand j work environ health* 7 (1981): suppl 4, 12—19. A questionnaire survey was used to assess job stress, strain, and health complaints associated with machine-paced poultry inspection. Four groups of employees, with differing amounts of time on the inspection line, were compared: full-time inspectors, part-time inspectors, rotating relief inspectors, and a supervisory group. Results showed full-time inspectors to have generally the highest job stress and poorest work environment scores. Social support from supervisors was lowest for the full-time inspectors, while rotating relief inspectors had the least support from others at work. Measures of psychological and behavioral strain were highest for the full-time inspectors, usually followed by the rotating relief inspectors. Health complaints showing a difference by group involved the respiratory, skin, musculoskeletal, gastrointestinal, and visual systems. Full-time inspectors had the highest frequency rates for 17 symptoms, while rotating relief inspectors were highest for nine. Relative to workers in previously studied occupations, full-time inspectors were high on stresses and strains and low on social support. Recommendations for improvements were made based on a model relating stresses to health effects.

Key terms: environmental, ergonomic, psychosocial, stress, survey.

Machine-pacing has been associated with high stress and strain relative to other kinds of work (2), numerous adverse psychological effects (1, 3, 7, 8, 10, 12, 13), physiological changes including increased heart rate (6), elevated catecholamine excretion (4) and somatic complaints (4), and a low activity/long recovery period after work (5). An investigation was requested by the US Department of Agriculture (USDA) and the National Joint Council of Food Inspection Locals to identify stresses and health effects resulting from machine-

paced poultry inspection. This report presents selected findings.

A model for relating stress to disease is based on the work by Caplan et al (2). "Stress" is defined as any characteristic of the job that poses a threat to the individual, either demands that the person may not be able to meet or insufficient supplies to meet the person's needs. Stress buffers like social support modify the individual's responses to the work environment. "Strain" is a response to stress that deviates from one's normal state. Psychological strains are negative mood states such as boredom, anxiety, or job dissatisfaction. Behavioral strains include drinking, smoking, or taking drugs as ways of coping. Absenteeism and accidents can also be thought of as behavioral consequences of stress. Physiological strains are changes in the body such as high blood pressure or increased catecholamine excretion. Strains wear down the body and make it vulnerable to symptoms or disease. In summary, this model posits that job demands, as

¹ Applied Psychology and Ergonomics Branch, Division of Biomedical and Behavioral Science, National Institute for Occupational Safety and Health (NIOSH), Cincinnati, OH, United States.

² Statistical Services Branch, Division of Technical Services, National Institute for Occupational Safety and Health (NIOSH), Cincinnati, Ohio, United States.

Reprint requests: to: Ms B Wilkes, Mailstop C-24, National Institute for Occupational Safety and Health, 4676 Columbia Parkway, Cincinnati, OH 45226, USA.

modified by stress buffers, give rise to reactions of a psychological, behavioral, or physiological nature, which over time can lead to ill health.

Material and methods

Subjects

US poultry plants were stratified by size (with the exception of one stratum containing night shift operations), and sample plants were selected randomly from each stratum so that each stratum would yield a similar number of inspectors. All USDA employees in the selected plants were surveyed, including roughly 800 full-time inspectors (40 % of the total population) and 700 other employees. Initial and follow-up mailings to the sample group yielded a 42 % response rate. The respondents comprised four groups that could be compared in terms of the amount of time spent on the inspection line, namely: (i) high exposure — 418 full-time inspectors (72 % men); (ii) medium exposure — 57 part-time (1200 h/a) inspectors (88 % women); (iii) variable exposure — 40 rotating relief inspectors (90 % men); and (iv) low exposure — 60 persons who were either supervisors or veterinarians (97 % men).

Exposure

Poultry inspection refers to postmortem inspection of poultry carcasses for disease and defects. The chickens are suspended by the legs on rounded hooks and passed along a conveyor, the inspectors examining about 16–23 birds per minute. The inspection of each bird requires the following six major steps: (i) reaching for the carcass while making a general observation of the exterior, (ii) grasping the carcass and positioning it for viewing, (iii) viewing the interior for contamination and defects, (iv) inspecting the viscera for disease, (v) palpating the leg bone to detect flaws while rotating carcass, and (vi) repositioning the carcass. A rhythmic motion is achieved as the inspector simultaneously releases one carcass and reaches for the next. During this sequence, lasting about 3 s/bird, approximately 20 conditions are checked for. The inspector decides

whether to pass or condemn the bird. If the bird is condemned, the inspector removes the bird from the line. If it is passed but flawed, the inspector communicates instructions for trimming to the next worker on the line. The job demands constant attention and requires skilled judgements.

Plant environment conditions varied widely. Noise levels measured at ten plants ranged from 84 to 92 dB(A). This amount of noise poses a possible risk for hearing loss and, more demonstrably, masks communication; thus it restricts most social interaction. The illumination measured at selected work stations in three plants varied between 70 and 200 foot candles (65.03 and 185.8 lx, respectively). Plant temperature was sometimes uncomfortably warm or cold. Dampness and a noxious odor were common in these workplaces.

The majority of poultry plants operate on an 8-h day/5-d week basis, but significant amounts of overtime including 10- to 11-h workdays and 6-d workweeks do occur. Inspectors are normally confined to their work station except for 30 min of breaktime per day (periods arranged locally) and 30–45 min for lunch.

Walk-through observations suggested a number of ergonomic problems. For example, some of the inspectors' postures displayed excessive thoracic curvature, head inclined more than 20 degrees, and direction of vision consistently to one side. Some seated inspectors could not get their legs under the water trough (located beneath the chickens to carry away waste) and therefore had an uncomfortably long reach to the poultry. Some sat facing up or down the line, with their sides to the trough, an arrangement that would also increase strain. Possibly as a result of uncomfortable seating, most inspectors were observed standing, which would become very tiring on the back and legs in uninterrupted work periods of 1.5 to 2 h.

Survey instrument

The main areas tapped by the questionnaire were worker demographics, job stresses, social support, behavioral and psychological strains, and health status. These areas were intended for the collection of information relating stresses,

strains, and health effects within the exposure groups. The components of the questionnaire can be described as follows:

(a) A 33-item scale from Caplan et al (2) measured the following job stresses: underutilization of abilities, work load, variance in work load, job future ambiguity, lack of participation in decision making, role ambiguity, and role conflict. Data on other occupations are available for comparison on these scales.

(b) A work-environment scale (11) measured involvement in one's job, peer cohesion, staff support, autonomy, efficiency, work pressure, clarity, control by management, innovation, and physical comfort. The presence or absence of these factors also constituted job demands. A section of job-specific items tapped aspects of the poultry inspection task that could be related to strain and health complaints.

(c) Support from supervisors, co-workers, and family were measured with Caplan et al (2) scales. Social support scores were considered measures of buffer against strain.

(d) Measures of psychological strain, again borrowed from Caplan et al (2), included job dissatisfaction, workload dissatisfaction, boredom, and somatic complaints. In addition the 65-item Profile of Mood States (POMS) (9) was used to define the following psychological moods: tension-anxiety, dejection-depression, anger-hostility, vigor-activity, fatigue-inertia, and confusion-bewilderment. Scores on these strain scales served as outcome variables of job stress.

(e) Items reflecting behavioral strain included number of sick days, accident rate, amount of exercise off the job, alcohol consumption, and smoking rate. Physiological strain measures were not in the scope of this study.

(f) A 53-item symptom checklist measured health effects, the final outcome variables of stress and strain. Possible symptoms from ten body systems were listed.

Interested readers are urged to contact the authors for a more complete description of the questionnaire and the scales used.

Results

Data analysis showed the groups to have significantly different mean scores on five of seven job stress scales (table 1). Full-time inspectors scored the highest on underutilization of abilities and on work load. This combination of quantitative overload (too much work for the available time) and qualitative underload (not being able to fully utilize one's skills because of the speed) is a characteristic of machine-paced work that has been described well by Frankenhaeuser & Gardell (4).

The rotating relief inspectors were the most uncertain about their job future, while the supervisory group was the most secure. The relief inspectors, followed by the supervisory group, showed the most participation in decision making, and the part-time inspectors had the least. The supervisory group reported the least role ambiguity (table 1).

Although not shown in this report, the groups were also significantly different in all aspects of work environment except innovation. Full-time inspectors scored the worst on involvement in their job, peer cohesion, staff support, autonomy, physical comfort, and work pressure. The rotating relief inspectors scored next to worst on most of these measures. The part-time inspectors and the supervisory group indicated lower stress in their work environment scores, but both were high in control by management.

The groups were not significantly different in their perception of line speed, less than half being satisfied with the speed and over 40 % considering the line speed to be too fast. Too much overtime was a stress for almost half of the full-time inspectors (47 %) followed by the relief and supervisory groups (both 44 %).

The mean responses for the groups on social support were significantly different except for support from family and friends, for which there was no difference. Full-time inspectors had the least support from their supervisors, while part-time inspectors rated their supervisory support the highest. Rotating relief inspectors had the lowest support from others at work, while the supervisory group had the most (table 2).

The groups were significantly different on all four measures of psychological strain shown in table 3. The rotating relief inspectors were the most dissatisfied with their jobs, closely followed by the full-time inspectors. Dissatisfaction with work load, boredom, and an index of somatic complaints were all highest for the full-time inspectors. The part-time inspectors scored the lowest on all measures of psychological strain.

Differences between the groups on psychological strain were again apparent from measurements of the POMS (9) (not tabled). For two out of six mood states, the groups were significantly different: anger-hostility (at the 0.05 level) and fatigue-inertia (at the 0.005 level), full-time

inspectors scoring the highest and part-time inspectors the lowest in both cases.

Among the behavioral indicators, full-time inspectors took the most days off because of sickness, 50 % reporting in sick at least 1 d over the past month (preceding the survey). The full-time inspectors also took more aspirin than the other groups (range 59–76 % taking aspirin). Full-time inspectors reported more (at the 0.07 level) accidents off the job during the past six months than the other groups (range 0–7.3 %) and required more days off due to these accidents than the other groups. The supervisory group most often got “moderate” exercise off the job, but the other groups most often got “light” exercise. This last finding is in keeping with the

Table 1. Mean responses of groups on job stress scales (2).

Scales 1–5, except if marked	Full-time inspectors	Part-time inspectors	Rotating relief inspectors	Supervisory
Underutilization of abilities ***	3.51	2.92	2.81	2.61
Quantitative work load **	3.87	3.58	3.74	3.66
Variance in work load (1–4)	3.01	3.06	3.02	2.99
Job future ambiguity ***	3.68	3.33	3.75	2.84
Participation in decisions ***	2.59	2.44	3.22	3.17
Role conflict (1–4)	1.57	1.42	1.50	1.46
Role ambiguity **	2.04	1.85	1.79	1.61

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.005$ significant difference between poultry groups (with Kruskal-Wallis one-way rank analysis of variance test).

Table 2. Mean responses of groups on social support (2).

Scales (0–4)	Full-time inspectors	Part-time inspectors	Rotating relief inspectors	Supervisory
Support from supervisor **	2.58	2.98	2.84	2.79
Support from others at work ***	2.60	2.83	2.55	2.91
Support from family and friends	3.38	3.34	3.28	3.58

** $p < 0.01$; *** $p < 0.005$ (significant difference with the Kruskal-Wallis test).

Table 3. Mean responses of groups on measures of psychological strain (2).

Scales 1–5, except if marked	Full-time inspectors	Part-time inspectors	Rotating relief inspectors	Supervisory
Job dissatisfaction ***	2.52	1.75	2.57	2.42
Work load dissatisfaction ***	2.43	1.83	2.25	2.25
Boredom ***	3.03	2.01	2.78	2.53
Somatic complaints ** (1–3)	1.38	1.25	1.31	1.28

** $p < 0.01$; *** $p < 0.005$ (significant difference with the Kruskal-Wallis test).

suggestion by Gardell (5) that the amount of work stress affects the use of one's time off the job.

Alcohol consumption patterns differed between the groups, perhaps being confounded by differences in the sex composition of the groups. In addition, many respondents left these items blank. Cigarette smoking rates did not differ.

Twenty-six out of 53 health complaints showed a significant effect between the exposure groups (table 4). The musculoskeletal, gastrointestinal, and visual systems were primarily involved. Full-time inspectors had the highest frequency rates on 17 symptoms, while the rotating relief inspectors were highest on nine.

Thirteen musculoskeletal symptoms were identified as problems. The gastrointestinal complaints comprised a nervous syndrome probably related to the

level of work pressure. The high visual demands of the job were reflected in the visual complaints. The skin rash, "chicken itch," was a reaction to handling the birds.

These data show that the health consequences of the job were the most severe for the full-time inspectors, followed by the relief inspectors, a finding which conforms with their high stress and strain scores. Table 5 compares the full-time inspectors with low, middle, and high-scoring occupations as measured previously on the same stress and strain scales (2). The poultry inspectors had close to as much work as the group of physicians but were without the positive aspects (future security, use of one's skills). The inspectors showed more variance in work load than the middle job (forklift drivers), and at the same time had less participation in

Table 4. Health complaints showing a significant * effect between groups.

Health complaint	Full-time inspectors (%)	Part-time inspectors (%)	Rotating relief inspectors (%)	Supervisory (%)
<i>General</i>				
Colds	72	64	58	51
Cough	33	16	29	17
Fever	50	36	37	24
Skin rash, itch	46	32	37	27
<i>Musculoskeletal</i>				
Pain down arm	28	28	8	14
Leg cramps	52	40	56	33
Neck pressure	48	41	42	20
Difficulty standing	71	56	77	47
Sore shoulders	71	56	62	37
Strained neck	52	56	57	30
Neck pain into shoulder	47	39	34	25
Cramps hands	31	22	21	15
Sore wrists	35	33	11	20
Painful joints	52	29	40	41
Back pain	68	52	73	49
Stiffness	61	35	66	48
Fatigue, exhaustion	53	44	58	36
<i>Gastrointestinal</i>				
Acid indigestion	62	55	72	46
Gas	59	55	62	34
Nausea	23	15	8	8
Bloated feeling	53	44	62	30
Stomach pains	45	35	33	25
<i>Visual</i>				
Eye strain	56	47	50	35
Itching eyes, tearing	52	27	38	40
Headaches	73	73	67	53
Severe headaches	53	48	36	35

* $p < 0.05$ with the chi-square test for homogeneity.

decision making. This finding, low participation in decisions affecting one's job, reflects the policy in many poultry plants of not allowing the inspectors to slow down the line for poor quality poultry lots, or for any reason. Role ambiguity for poultry inspectors was about average, and role conflict was lower than average.

Social support as a stress buffer was very low for the poultry inspectors, particularly from others at work. The psychological strains measured higher for the poultry inspectors than for most of the comparison occupations, as shown in table 5.

A series of Pearson correlations was

Table 5. Comparison of mean scores of full-time inspectors ^a and other occupations (2) on stress, social support and strain scales.

	Low	Middle	High
Stress			
Underutilization of abilities (1—5)	1.30 (physicians)	2.42 (programmers)	3.51 4.43 (assemblers, machine-paced)
Quantitative work load (1—5)	3.09 (continuous flow operators)	3.50 (ATC — small airport)	3.87 4.14 (physicians)
Variance in work load (1—4)	2.43 (assemblers, machine-paced)	2.81 3.01 (forklift drivers)	3.51 (ATC — small airport)
Job future ambiguity (1—5)	1.82 (physicians)	2.70 (programmers)	3.61 3.68 (machine tenders)
Participation in decisions (1—5)	2.06 (machine tenders)	2.59 2.97 (continuous flow operators)	3.79 (administrative professors)
Role ambiguity (1—5)	1.31 (ATC — small airport)	2.04 2.06 (assemblers, not machine-paced)	2.41 (programmers)
Role conflict (1—4)	1.36 (ATC — small airport)	1.57 1.75 (assemblers, machine-paced)	2.01 (train dispatcher)
Social support			
Immediate supervisor (0—4)	2.40 2.58 (assemblers, machine-paced — relief)	3.04 (scientists)	3.29 (continuous flow operators)
Others at work (0—4)	2.60 2.63 (machine tenders)	3.03 (accountants)	3.50 (administrative professors)
Home (0—4)	3.20 (assemblers, not machine-paced)	3.38 3.44 (train dispatchers)	3.76 (administrative professors)
Strain			
Job dissatisfaction (about 1—5)	2.79 (physicians)	3.19 3.38 (electronics technicians)	4.02 (machine tenders)
Workload dissatisfaction (1—5)	1.66 (couriers)	2.13 2.43 (electronics technicians)	2.90 (machine tenders)
Boredom (1—5)	1.34 (physicians)	1.83 3.03 (couriers)	3.37 (assemblers, machine-paced)
Somatic complaints index (1—3)	1.16 (couriers)	1.28 1.38 (accountants)	1.51 (assemblers, machine-paced)

^a Inspectors' means in italics.

used to ascertain the relative contribution of particular stresses to strains and health complaints. Lack of involvement in one's job and underutilization of one's abilities were the major factors contributing to the job dissatisfaction of the full-time inspectors ($r = 0.51$ and 0.49 , respectively). Social support from one's immediate supervisor was an important buffer. The symptoms most related to job dissatisfaction involved muscular tension; for stiffness, difficulty standing, sore shoulders, hand cramps, and stiff or sore wrists the correlations with job dissatisfaction were above 0.25 .

Lack of involvement and underutilization also appeared as major contributors to boredom ($r = 0.56$ and 0.52). Symptom manifestations of boredom were acid indigestion ($r = 0.28$), difficulty standing ($r = 0.30$), and sore shoulders ($r = 0.30$).

Role conflict ($r = 0.29$), lack of clarity ($r = 0.28$), and work pressure ($r = 0.26$) were the stresses that correlated the best with anger-hostility. Itching eyes or tearing and eyestrain were the highest symptom correlates of anger ($r = 0.37$ and 0.36 , respectively).

Discussion

The stress-strain-health effects model is a positive step toward quantifying the impact of various job demands, and it offers an empirical basis for making recommendations to improve work conditions. General guidelines like the following can be used by the USDA and the inspectors' union to implement changes.

A far-reaching change would be to increase worker influence and control over the work process. This change would include participation in decisions about rotation, inspection method, and line speed. Utilization and involvement would be increased, with the probable effects of increasing job satisfaction and decreasing musculoskeletal symptoms.

Supervisors should adopt a more cooperative, less authoritarian attitude toward inspectors. Supervisory support consistently emerged as an important stress buffer.

No unwanted overtime should be imposed. As the data show, a worker's health is increasingly at risk as the amount of time on the inspection line increases. The adverse psychological and health effects of exposure are probably worsened when work extends into one's personal time, where it further interferes with one's ability to carry out other activities or responsibilities.

More comfortable and acceptable environmental conditions should be sought. Noise levels should be at or below the 85 dB(A) that is recommended by the National Institute for Occupational Safety and Health as the 8-h time-weighted average. Properly fitting ear protectors should be provided. Lighting of the work area should keep eye strain and related visual symptoms at a minimum. Workroom temperature should be comfortable and uniform.

Breaks should be of sufficient frequency and duration to provide relief from visual and muscular fatigue. The overall cost to the worker, both psychologically and physically, can be reduced by breaks. In addition, breaks should be arranged so as to permit social interaction among workers, and thus provide a stress buffer not possible on the inspection line.

Further work should be done, with inspector involvement, towards defining the biomechanical demands imposed by the inspection job and means for their alleviation through workplace redesign.

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