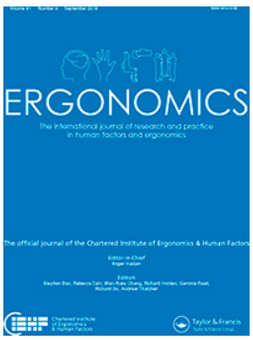

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Impact of added rest breaks on the productivity and well being of workers

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Keyword: Rest breaks

The impact of frequent short rest breaks on the productivity and well being of a group of 30 workers in a meat-processing plant was studied. Two rest break schedules were tested, both of which provided 36 min of extra break time over the regular break schedule (30-min lunch and two 15-min breaks). In the first experimental rest break schedule, workers were given 12 3-min breaks evenly distributed over the workday (3-min break for every 27 min of work). In the second schedule, workers were given four 9-min breaks evenly distributed over the workday (9-min break every 51 min of work). Outcome measures included production rate and discomfort and stress ratings. Results showed that neither of the two experimental rest break schedules had a negative effect on production, and the 9-min break schedule improved discomfort ratings for the lower extremities. The workers in the study mostly preferred the 9-min rest break schedule, indicating that workers in general might not as readily accept fragmentation of break time into short, frequent breaks.

1. Introduction

Work-related musculoskeletal disorders (WMSD) are on the rise and account for >60% of all occupational illnesses in the USA (BLS 1994). Annual compensable costs in the USA for these disorders are estimated to be $20 billion (BLS 1993).

Research investigations have indicated that conventional rest break schedules (mid-morning, lunch, mid-afternoon) are not fully effective in eliminating operator discomfort and performance deterioration (Zwahlen *et al*. 1984, Douwes *et al*. 1991, 1994). This suggests that job redesign strategies and alternative work/rest schedules may be effective in improving comfort, health and productivity. Though it may appear that taking a rest break is intuitive, studies have shown that workers will not always select an optimal rest break schedule, and performance may be improved significantly by using a systematic schedule for breaks (Janaro and Bechtold 1984, Janaro 1985). Several studies have called for more frequent and shorter breaks for light repetitive work (Laporte 1996, Mital and Kopardekar 1994). Other studies have suggested that care be taken to integrate the breaks with task demands

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because when breaks are too frequent, they may disrupt the work flow (Henning 1994, 1995a,b, Henning *et al*. 1996, 1997). Optimal rest break scheduling is a function of the task demands, cycle time and total duration of the task (Bechtold *et al*. 1984, Swanson *et al*. 1989, Sauter and Swanson, 1992, Fisher *et al*. 1993, Swanson and Sauter 1993, Sauter and Murphy, 1995). It is understandable that production management may be overwhelmed with the complexity of this issue. Often management is concerned that more rest breaks will reduce production. Others may be willing to invest in giving more break time to the workers, but are uncertain about how to divide the break time over the workday. The present study examined the comparative effect of two differing short rest break schedules on workers' comfort, stress and productivity.

2. Methodology

The study was conducted in a meat-processing plant in southwestern Ohio. The objective was to determine the impact of added short rest breaks on productivity and workers' well being. Participants in the study were workers from one of the plant's production lines. They received a total of 36 min extra rest break time beyond their usual 30-min lunch break and two 15-min breaks per day. The additional rest breaks consisted either of 12 3-min breaks (a break every 27 min of work) in one study condition or four 9-min breaks (a break every 51 min of work) in the other. The workday was divided into four work periods separated by either a 15-min break or by lunch. In the first experimental rest break schedule workers were given three 3-min breaks during each work period. In the second experimental break schedule, workers were given one 9-min break during each work period.

2.1. *The process*

The production line chosen for the study typically handled chicken filets. The study included only those workers who handled the prepared filets and the final products. The capacity of the production line varied from 1500 to 2000 lb/h (682–910 kg/h). Worker efficiency ranged from 80 to 85%, based on the existing company standards.

Prepared chicken filets were supplied to the beginning of the line. A group of workers, called the spreaders, took the chicken pieces from the container and spread them on a moving conveyer. The spread pieces then went through crust freezing, breading, cooking and total-freezing before being delivered to the pack-off line. Here, another group of workers, the packers, manually inspected, picked, counted and packed the product into boxes, and then weighed and palletized the boxes for shipping. A usual trip on the conveyer took about 45 min from start to finish. Thus, spreaders usually started work 30 min before the packers.

2.2. *Work environment*

All jobs on the line were highly repetitive and monotonous. All workers at the plant were required to wear special coats, hairnets, earplugs, cotton gloves, thin plastic gloves and waterproof shoes. Before entering or re-entering the production area all employees were required to wear full gear, to wash their hands and to go through an antiseptic foot-bath. The trip from the working area to the rest area and back took on average 3 min. The noise level at the production line varied from 82 to 85 dB, and the temperature was $\sim 50^{\circ}$F.

2.3. *Subjects*

All workers on the line, except the machine operators and the line coordinator, participated in the study. The number of workers on the line varied daily from as few as 18 to as many as 32, depending on the type of product produced that day. A total of 35 subjects participated in the study, but not necessarily at the same time. All subjects worked full-time, consisting of 6 days a week and an average of 46.4 h week. Most of the workers were female (81%) and the mean age was 39 years (SD 10.77 years).

2.4. *Temporal structure of the experiment*

The 6-week experiment covered 32 workdays (only 21 days were included in the analysis). In the first week, baseline data were collected while the workers followed their regular rest break schedule (30-min lunch and two 15-min breaks). In the second and third weeks, workers were given an extra 3-min break every 27 min of work in addition to their lunch and 15-min breaks. During the fourth week, the workers resumed their regular rest break schedule (baseline 2). In weeks 5 and 6, workers were given extra 9-min breaks every 51 min of work. Outcome measurements were collected throughout the 6-week period.

2.5. *Productivity*

Using a video camera, production was monitored continuously. The data collection covered 32 days, but only 30 days were usable for the purpose of comparison. Production rates in pieces per minute were calculated by sampling for 1 min every 10 min, or more frequently depending on the variability noticed in the production rate.

It was essential to standardize the production data before attempting to compare treatments. Variability between workdays occurred because of different piece-weights for different products, changes in the method of loading the chicken pieces on the conveyer for different products, and variation in the number of workers.

The workday was divided into four 2-h periods, separated by either a 15-min break or by lunch. To investigate changes in the production rate over the workday, each production rate datum point was normalized by dividing it by the average production rate during the second period of the same day. In other words, a production rate of 70% in the fourth period would mean that the production in the fourth period declined 30% in comparison with what it had been during the second period of the same day. Production had two modes, on or off. Production would be off because of either a system failure or the workers' rest breaks. For the purpose of the analyses, production was considered to continue through the down time and breaks at a similar rate as during the adjacent 'on' times. The least squared-differences method was used to fit a straight line through each period, and each line was described by a constant and a slope.

A one-way repeated measures general linear ANOVA model was used to test for significant differences between the levels of the independent factor (rest break conditions). Dependent factors included average production rate over each of the 2-h periods of the workday, the intercept of the fitted line of each work period, the slope of the fitted lines, and a daily production total. When significant differences were indicated, a pairwise t-test tested differences in means.

2.6. *Daily discomfort ratings*

Subjects were asked to complete a discomfort questionnaire at the beginning and end of each workday. Subjects rated discomfort for the arms, neck, shoulders, back and

legs using a five-point scale, ranging from 1 (no discomfort) to 5 (extreme discomfort). The questionnaire also assessed fatigue, cheerfulness, tension and boredom.

A two-way repeated measures general linear ANOVA model tested for significant differences between the independent factors (rest break condition and time of the day). Dependent measures were the subjects' responses to each question on the questionnaire. When significant differences were indicated, a pairwise *t*-test tested differences in means.

2.7. *Weekly stress indicators*

At the end of each of the baseliines and experimental break conditions, subjects completed a stress questionnaire. It contained questions on experienced stomachache, ill health, trouble sleeping, general stress level and their opinions about the current rest break condition. Frequencies of aches were reported on a five-point scale ranging from 1 (never) to 5 (very often). Stress was reported using a four-point scale ranging from 1 (a lot of stress) to 4 (almost no stress at all).

A two-way repeated measures general linear ANOVA model was used to test for significant differences between the independent factors (rest break condition). Dependent measures were the subjects' responses to each question on the questionnaire. When significant differences were indicated, a pairwise *t*-test tested differences in means.

2.8. *Break schedule preferences*

At the end of the study, subjects were asked to rank the three types of rest break schedules studied in the experiment (the regular schedule, the 3-min break schedule, and the 9-min break schedule) according to which they liked most. A score of one was given to the best-liked break schedule, two for the second best-liked, and three for the least-liked.

3. Results

Only weeks 1, 3, 4 and 6 were included in the analysis. Weeks 2 and 5 were eliminated because they were considered as transition periods during which the subjects were becoming accustomed to the break schedules. Also, over the study period few workers quit their work and few others joint the study. To compare the effect of the two experimental break schedules on workers, only subjects who participated for 4 or more days each week of the study were included in the analysis.

3.1. *Subject-workplace profile*

In general, workers reported that they had little control over their work schedule and work-related factors and were only moderately satisfied with their jobs. Turnover was high (25% annually) and the average seniority was <2 years. However, workers also reported good relations with their co-workers and support from their supervisor.

3.2. *Production*

The production line is a sequence of machines. It is a single-point failure system, such that any problem with any of the machines will result in production delays. Although downtime varied from day to day, the two rest break conditions did not differ significantly in production delay due to system failure.

Analysis of variance showed that the three rest break conditions did not differ in production rate over the first three periods of the day. However, the average

production rate of the fourth period was significantly less than that of other periods in each day for all rest break conditions ($p < 0.01$). Figure 1 shows the average production rate of the fourth period for all rest break conditions. As it can be seen, production in the fourth work period ranged from 60 to 90% of the production accomplished in the other work periods, depending on the rest break condition.

Analysis of variance showed that the average production rate of the fourth period was significantly different between treatment levels ($F(3,12 = 22.49$, $p = 0.0$). The average production rate of the fourth period during the frequent rest break treatments was significantly higher than during the baseline weeks. No difference was found in the average production rate during the fourth work period for the two experimental conditions ($p > 0.05$).

A similar result was found when analysing the slope of the fitted line through the fourth period ($F(3,12) = 4.21$, $p = 0.03$). Production rate in the fourth work period deteriorated faster during the base line conditions. Significant difference was found between the 9-min rest break condition and baseline week 1. In other words, the slope of the fitted line through the fourth period during the 9-min break condition was less steep than during the fourth period of the first baseline. The difference in the slope of the fitted line was not significant between the 9-min breaks and the 3-min break conditions ($p > 0.05$).

Although overall production rate was higher when the additional rest breaks where used, after accounting for the 8% reduction in production time during the frequent break treatments, there was no significant difference in total production between any of the three treatment levels ($p > 0.05$).

3.3. *Daily discomfort*

The mean discomfort rating was low for all body parts. For example, the average discomfort rating for the left forearm at the end of the workday, across the study

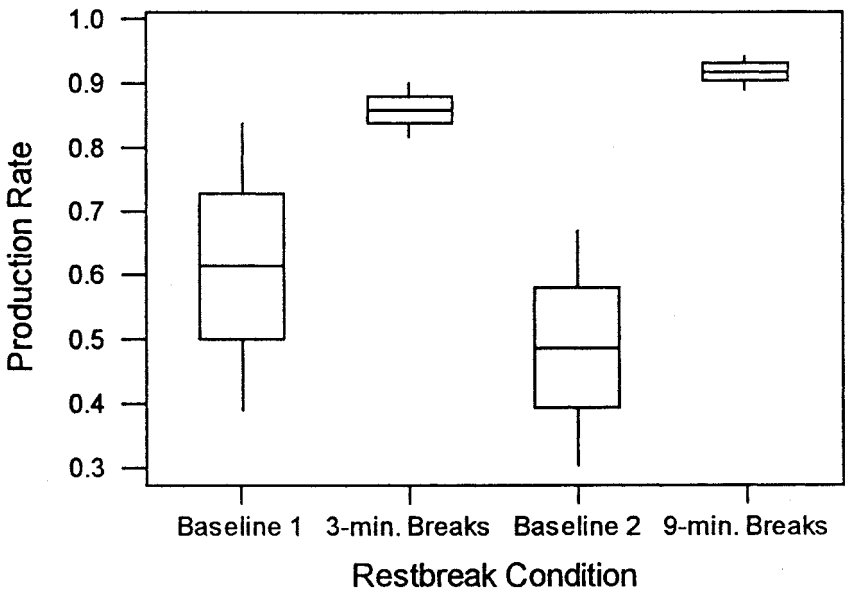

Figure 1. Average production rate in the fourth work period.

period, was 1.39, which corresponded to experiencing little to no discomfort. It was possible to detect significant increases across the working day in the discomfort rating for all the body parts except for eye soreness and stomach aches. Subjects on average experienced more discomfort by the end of the workday than they did at the beginning.

With the exception of the legs and knees, there were no significant differences in the daily increase of discomfort between the rest break conditions. Significant interactions between time of the day and rest break conditions were found for the upper legs ($F(3,264) = 3.73, p = 0.01$), knees ($F(3,264) = 5.16$, $p < 0.01$) and lower legs ($F(3,264) = 4.11$, $p < 0.01$). Means and standard deviations (SD) of discomfort ratings in the lower leg, knees and upper legs are listed in table 1. Figure 2 shows the discomfort ratings of the lower legs across the treatment levels and at both the beginning and the end of the day.

Note that the white bar is the discomfort rating at the beginning of the day and the black bar is the discomfort rating at the end of the day. Pairwise comparison *t*-test indicated that the differences between the two baseline weeks and the 3-min break condition were not significant. The differences between the 9-min break condition and all other rest break conditions were significant ($p < 0.01$). As a result of the 9-min breaks, subjects experienced less discomfort in their lower legs than they had in the other levels of the treatment. Similar results were obtained for the upper legs and for the knees.

Among the mood items, significant differences were reported across the workday for tension and fatigue, but not for cheerfulness, boredom, and energy. Across the study period, the average rating of fatigue was higher by the end of the workday ($F(1,264) = 25.62, p < 0.01$), but there were no significant differences between the rest break schedules ($F(3,264) = 2.36$, $p = 0.08$). Similar results were found for the feelings of tension. In general subjects were (little) to (moderately) fatigued and tense, (moderately) cheerful, and a (little) energetic, but also a (little) bored.

Table 1. Mean and SD of discomfort ratings in the legs.

	Knees		Lower legs		Upper legs	
	Mean	SD	Mean	SD	Mean	SD
Break schedule						
1. (Baseline 1)	1.339	0.06060	1.474	0.07884	1.366	0.06822
2. (3-min breaks)	1.335	0.06190	1.436	0.08054	1.169	0.06969
3. (Baseline 2)	1.348	0.06373	1.561	0.08291	1.333	0.07174
4. (9-min breaks)	1.111	0.06530	1.271	0.08496	1.111	0.07351
Time of the Workday						
0 (Beginning)	1.074	0.04442	1.178	0.05780	1.096	0.05001
1 (Ending)	1.492	0.04454	1.693	0.05795	1.394	0.05014
Schedule * Time						
1 * 0	1.056	0.08629	1.083	0.11226	1.083	0.09713
1 * 1	1.622	0.08511	1.865	0.11074	1.649	0.09581
2 * 0	1.059	0.08879	1.206	0.11552	1.088	0.09995
2 * 1	1.611	0.08629	1.667	0.11226	1.250	0.09713
3 * 0	1.061	0.09012	1.182	0.11726	1.091	0.10145
3 * 1	1.636	0.09012	1.939	0.11726	1.576	0.10145
4 * 0	1.121	0.09012	1.242	0.11726	1.121	0.10145
4 * 1	1.100	0.09452	1.300	0.12298	1.100	0.10641

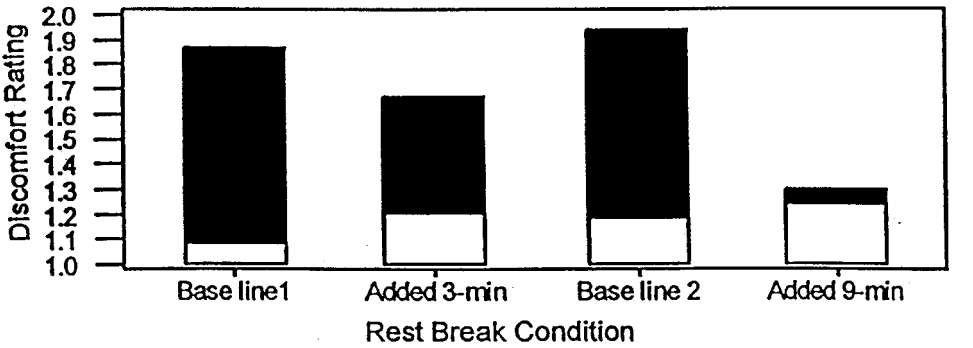

Figure 2. Discomfort ratings for the lower legs during all rest break conditions. White bars are discomfort at the beginning of the workday; black bars are the discomfort accumulated by the end of the workday.

3.4. *Weekly stress indicators*

At the end of each rest break condition, subjects were asked to answer a questionnaire about stress. Subjects on average reported that stomach problems or ill health affecting their work seldom bothered them. On average, subjects experienced trouble sleeping at night more frequently than they experienced stomach ache or ill health. Subjects in general estimated their stress to be relatively little to somewhat moderate. Workers' satisfaction with the rest break schedule and their opinion on how much rest the rest break schedules provided were significantly correlated ($p < 0.05$). The more rest they thought they were getting, the more they were satisfied with the rest break schedule. It was found that subjects did not perceive that the 3-min rest breaks provided more rest than the regular breaks they took in the baseline weeks. On the other hand, they felt that the 9-min rest breaks provided a significant increase in rest time ($F(3,83) = 6.77$, $p < 0.01$). Similarly, subjects were more satisfied with the 9-min break condition than they were with the other rest break conditions ($F(3,83) = 6.43$, $p < 0.01$). The difference between the baseline and the 3-min break condition was not significant. Figure 3 shows the subjects' ratings on how much rest the rest break schedules provided.

3.5. *Best liked break schedule*

The 9-min breaks were liked the most. Fourteen of 24 subjects ranked it first, six subjects ranked it second, and three subjects liked it the least. The 3-min breaks were ranked first by eight subjects, and got a score of two from 14 subjects. Only two subjects ranked the regular schedule as number one, while 18 subjects ranked it as the least liked break schedule.

4. Discussion

4.1. *Subjects and the work environment*

In general, workers reported little control over their work. This was obvious from the management practices. Workers did not know their work schedule sooner than lunchtime the day before and were not sure about which day they were scheduled off. Each worker had to read the schedule for all the production lines to find where he or she was supposed to be. In some cases, workers were forced to work on their day off

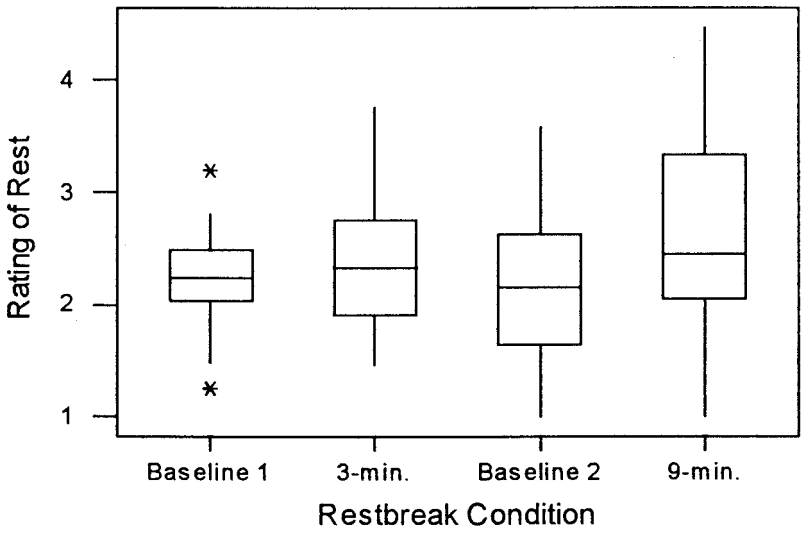

Figure 3. Subjects' ratings of how much rest each of the rest break schedules provided.

without notice. These practices were described by the manager of the plant as normal operating policies of the meat-processing business.

It was not easy for most workers to take a short personal break during work hours. A worker who had to leave for a restroom break, for example, would leave an empty spot on the conveyer, which would put more pressure on co-workers. It is estimated that the round trip to and from the rest area alone took around 3 min, including the time taken to wash hands and put on a clean work coat and gloves. Therefore, workers had enough time to attend to their physical needs during the 9-min break without losing work time, but not during the 3-min break. This meant that the group performance was less likely to be affected by a worker taking a restroom break during production.

4.2. *Productivity*

Production lines similar to the production line in this study are described as quasi-machine-paced. At the meat-processing plant, production was not fully controlled by the machine because the spreaders had the option of putting fewer products on the conveyor than it could hold. On the other hand, spreaders could not put more products on the conveyor than the conveyor area allowed. Thus, the workers could not produce more than a certain limit even if they had wanted. Production output in such systems is also a function of the speed of the conveyor; the faster the conveyor, the higher the production output. This relationship is true up to a certain limit at which workers can no longer match the speed of the conveyor and their output drops (Murrell 1965: 375–385).

A similar relationship exists between fatigue and worker output. In general, workers will tolerate certain levels of fatigue and will protect their output from declining by investing more resources and working harder. This behavior will hold until fatigue reaches a level at which workers cannot work any harder; then their output will drop significantly. This investigation found that production during the

baseline weeks was almost the same throughout the first three periods of the day, but deteriorated significantly in the fourth period. Because the production rates during the first three periods were at the maximum output allowed by the conveyor system, the workers could maintain their output until fatigue reduced their production. By the fourth period, it is possible to speculate that the workers had reached a level of fatigue where they could not invest any more effort.

During the frequent rest break conditions, it was found that production improved significantly (25 – 30%) in the fourth period. This suggests that frequent rest breaks may prevent workers from reaching that level of fatigue where their output would deteriorate. During this study both frequent rest break conditions were equal in their effect on production.

4.3. *Hourly versus half-hourly breaks*

Both the 3-min and 9-min rest break schedules provided the same amount of break time over the workday (total of 36 min). However, in the weekly questionnaire, subjects indicated that the 9-min break schedule provided more rest and they were more satisfied with it than the 3-min or the regular break schedules. This perception was supported by the subjects' choice of the best break system. Fourteen of 24 subjects ranked the 9-min break system as number one, while the 3-min break system was ranked as the favourite by only eight subjects.

In previous research studies on rest breaks, it was noted that frequent breaks may cause task interruptions, which may cause production output to drop (Henning *et al.* 1993a,b, 1997). The more frequent the breaks are, the more chances there are for task interruptions. This finding favors the hourly 9-min break schedule over the half-hourly 3-min break schedule.

All jobs on the line shared common features. They were light, highly repetitive tasks and the worker had to stand all the time. Daily discomfort questionnaires indicated that although discomfort ratings increased significantly across the workday, experienced discomfort was low ('A little' discomfort by the end of the day for most body part ratings). With regard to the effect of more frequent rest breaks on discomfort, a significant reduction in discomfort (as compared with the baseline conditions) was found only for the 9-min rest break condition. Discomfort was significantly reduced for legs and knees in this condition. This is consistent with the subjects' choice of the 9-min break schedule, as the best liked.

No attempt was made to counter balance the order in which the rest break conditions were presented because only one production line was available for the study and there were not enough subjects/jobs to split them into two groups. Also, the production line was made available for 6 weeks only. It is unlikely that subjects liked the 9-min breaks more than the 3-min breaks because they were presented last, because discomfort ratings in the second baseline week went back up to what it was during the first baseline week.

4.4. *Activity during the rest breaks*

Subjects were told they could do whatever they liked during the short breaks, but were not to leave the production area. Seats were provided for all workers during the frequent rest break interventions, but not during the baseline weeks. Subjects were given the opportunity to sit, but were not required to do so. However, subjects appeared to prefer sitting through almost all of the frequent rest periods. While research in this area often recommends active breaks, in this study the

workers clearly preferred sitting, very likely because they stood throughout their work.

5. Conclusions

A major finding of this study was that taking hourly or half-hourly short breaks had no adverse effect on production. On the contrary, at the meat-processing plant, production rates improved in the later hours of the workday when workers were given frequent rest breaks. Also, significant improvements in the discomfort ratings in the leg area were found only when the longer hourly breaks were given. Fragmentation of the break time into shorter and more frequent resting periods tended to increase task interruptions, and was not as readily accepted by the majority of workers.

It can be concluded that the hourly breaks of 9-min are beneficial to the workers' well being in this study. This conclusion is consistent with the findings of some other rest break studies (Henning *et al.* 1989, Sauter and Swanson 1992). Thus, this study provides more evidence that taking time off for short breaks will not necessarily cause production to drop, and should encourage companies to experiment with frequent rest breaks. It can be concluded that hourly breaks were more beneficial for workers' well being in this study.

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