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THE DESIGN OF SUPERMARKET WORKSTATIONS TO REDUCE THE INCIDENCE OF MUSCULO-SKELETAL DISCOMFORT

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INTRODUCTION

Statistics provided by the Department of Social Security in Great Britain show that the number of days of certified incapacity because of musculo-skeletal diseases rose from 34.2 million days in 1971/2 to 78.2 million in 1986/7. This alarming rise is costly both to the employee and the employer. This paper describes how one large-supermarket store examined the extent of the problem experienced by their staff and what measures the management took to alleviate the situation.

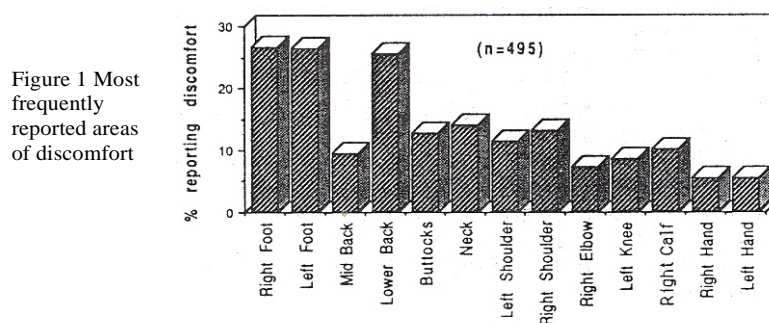
The great majority of studies concerning supermarket workers have examined only the cashiers' workstations (e.g. Wilson and Grey, 1984; Thorne and Russell, 1987; Krueger et al, 1988; Strasser 1990) often because of the introduction of laser scanning systems. The cashiers were typically found to report discomfort in the neck, shoulders, arms and back. A recent study by Ryan (1989) examined supermarket employees in a range of job areas and concluded that the cashiers experienced an excess prevalence of musculo-skeletal symptoms compared to other employees, particularly in the lower back and lower limbs. The discomfort in the lower limbs was associated with standing (whereas the other studies cited examined seated cashiers) and there appeared to be a threshold effect of about 50% of time spent standing for lower limb symptoms to appear. Earlier work by Buckle et al (1986) compared the incidence of musculo-skeletal disorders within female occupational groups including supermarket workers in general. It was pointed out that the supermarket workers showed only slightly lower prevalence rates of back pain than nurses who are known to be a group particularly at risk.

METHOD

A questionnaire was designed to collect subjective judgements of musculo-skeletal discomfort (on up to 3 occasions during the working day) and related information such as the work area (18 areas), the main tasks performed and the number of hours worked today and per week. Discomfort was assessed using a rating scale (0 - no discomfort, 1 - slight discomfort, 2 moderate discomfort, 3 - considerable discomfort) with reference to body area diagrams identifying 30 body areas. 2650 questionnaires were sent to all employees of 24 branches throughout England. 590 fully completed questionnaires were returned but 14% of the sample reported body discomfort for reasons other than work and they were omitted from further analysis. This reduced the effective sample size to 495.

RESULTS

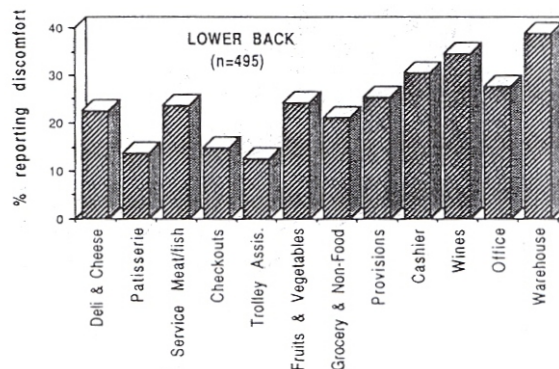
Over half of the employees reported discomfort due to work. Figure 1 shows that the most frequently reported areas for the whole sample were the lower back (26%) and the feet (27%).



Lower back discomfort was experienced by both standing and seated employees (see Figure 2) whereas foot discomfort was consistently related to the time spent standing (only the cashiers and office staff worked whilst seated). Employees working in 4 of the work areas were found to suffer the greatest amount of discomfort in the largest number of body areas; These were the cashier's workstation

(lower back 31 %, neck 25%, shoulders 24%, buttocks 22%), the delicatessen service counter (feet 27%, right shoulder 27%, lower back 23%, right elbow 23%), the fruits and vegetables section (feet 37%, lower back 24%) and the warehouse (lower back 39%, feet 33%); The warehouse staff were involved in very physical work involving frequent lifting, pulling, pushing and carrying of cases of stock. The fruits and vegetables section also involved some dynamic work when collecting goods from storage areas and filling the shelves. However, staff working at the cashier workstations and delicatessen and cheese counters reported discomfort in a large number of body areas even though they were not lifting loads as heavy as the other two areas above. These problems were related to working at poorly designed workstations for long periods of time.

Figure 2
Incidence of reported discomfort in the lower back for various work areas



CAD ANALYSIS AND RE-DESIGN

In seeking to reduce the incidence of discomfort the management decided to model the current cashier and delicatessen workstations using SAMMIE (an ergonomics 3D man modelling CAD system - see Porter et al 1990). The SAMMIE system helped to identify several causative factors in both workstations and detailed design recommendations were made including the following:-

Cashier workstation

Constrained sitting posture maintained for long periods of time. Shoulders require significant amount of abduction as the counter thickness is too great (110 mm).

Action: provide a sit/stand workstation by raising the counter height and providing an adjustable foot platform. This offers an additional benefit to the cashiers as the customers will no longer be looking down on them. A further recommendation was made to provide mirror image workstations back to back as this would allow cashiers to alternate from shift to shift and so help avoid the build up of localised discomfort. Poor postures related to fit, reach and vision were identified for a variety of equipment designs layouts and an optimal layout was chosen. A full size prototype of the new workstation has been constructed and user trials will take place in the near future.

Delicatessen counter

Reaching to shelves in the cabinet often requires stressful and uncomfortable postures (see Figure 3). Small female staff need to stand on tip toe whilst perching on the counter and using one hand to balance themselves. Taller staff are often forced to crouch down and brace their knees on the front edge of the counter. The shelves at the front of the cabinet are too low and extend too far forward. The spooning of items from the container in the cabinet to the customer's packaging is often performed at full stretch which accounts, in part, for the incidence of discomfort in the right shoulder and elbow. The counter height is too low for cutting and wrapping tasks as all staff need to stoop. Also the sink and rear worksurface areas and storage refrigerators are too low.

Action: Improve reach within cabinet by raising the height of the shelves and reducing the depth of the cabinet. The length of the cabinet could be extended to provide a similar display area to the present design. Alternatively, if this is not possible, replace the counter running along the rear of the cabinet with several 300 x 400 mm platforms for the cutting and wrapping tasks. This would allow the staff to get closer to the shelves in between the platforms. Extra flexibility would be provided if these platforms were mounted on runners so that they can be moved aside to allow easy reach to areas which were directly behind. The rear wall of the cabinet should be as thin as possible and

should feature a soft and curved top edge to facilitate leaning over to the front shelves. Reach tests were performed for female operators (5,10,20,50 and 95th percentiles) adopting a variety of postures appropriate for frequent reach to items of moderate weight and infrequent reach to light items. These reach areas were used to help design the shelving in a new cabinet design which is currently underway.

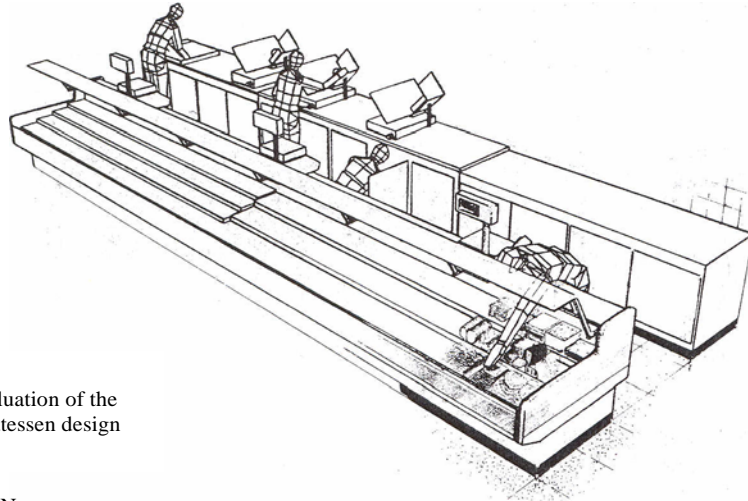


Figure 3
SAMMIE evaluation of the
existing delicatessen design

CONCLUSION

Discomfort surveys followed by the simulation of users, their tasks, equipment and workstations using SAMMIE enables a thorough examination of the causes of reported discomfort. The interactive facilities of SAMMIE permit the designer to explore modifications or conceptual design to alleviate the identified problem areas.

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