

Anti-fatigue Mats

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This report has been written on behalf of the Canterbury DHB Health and Safety team to answer the following questions:

1. What is the purpose of anti-fatigue mats?
2. What are the benefits (and drawbacks) of anti-fatigue mats?
3. What other factors should be reviewed when considering use of anti-fatigue mats?

Executive Summary

Anti-fatigue mats are used to provide cushioning on hard surfaces where people are standing for prolonged periods. It is claimed by manufacturers that fatigue is reduced by up to 50%. There is no scientific evidence that mats eliminate leg and back fatigue. There is a lack of consensus on the underlying physiological causes of discomfort and fatigue associated with prolonged standing which makes it difficult to recommend the most appropriate intervention; hence a multi-factorial approach is required. There appears to be a threshold value of between 30% and 50% of time spent standing during a working day above which there is a “pronounced risk for increased discomfort”. There needs to be an optimal mix of postures (standing, sitting and walking) to provide protection from discomfort.

There are many factors that contribute to discomfort, pain and injury (which may be a precursor to fatigue) that all need to be considered. Interventions that address only one factor in isolation will not be effective. The way the work is organised and the variety of tasks and working positions are particularly important factors to consider in prolonged standing tasks.

If anti-fatigue mats are used, the required design features of the mat should be clarified before purchasing. In some instances provision of matting may create new difficulties such as tripping and manual handling hazards.

Recommendations:

1. Anti-fatigue mats should not be used as an isolated intervention.
2. All contributory factors of discomfort, pain and injury should be considered. The content and organisation of prolonged standing tasks should be examined to identify ways to provide a variation between standing, walking and sitting tasks. The standing component should be no more than 30% to 50% of the working day.
3. If using anti-fatigue mats as an adjunct with other interventions, clarify what design features are important for that work area.

1. The purpose of anti-fatigue mats and design features

Anti-fatigue mats are designed to reduce fatigue caused by standing on hard surfaces for long periods.¹ Provision of a mat may improve comfort but will not entirely eliminate discomfort and fatigue. The way the work is organised and duration of time spent standing are important considerations in prolonged standing tasks. To successfully manage discomfort, a combination of all contributory factors must be addressed. In some instances provision of matting may create new difficulties such as tripping and manual handling hazards.

Anti-fatigue mats are generally used over existing flooring to provide cushioning for workers involved in prolonged standing tasks. Some manufacturers² claim that anti-fatigue mats are able to reduce the level of perceived fatigue and discomfort by as much as 50%.

The composition of the mats is variable depending on where and how it is to be used. There is a vast range of mats available, so careful evaluation of requirements should be made before making a purchasing decision. The primary component is rubber with additional PVC or synthetic materials however carpeting materials, vinyl and wood may also be used.

Manufacturers specify different warranties for their products. The matting may flatten with wear or the mat may break down on incompatible flooring and therefore not function as designed.

Mat features to consider:

1. Will it be used in a wet area or dry area? Is drainage (openings for flow through) required?
2. Is slip resistance important to prevent falls? Note that the non-slip properties may cause shoes to grab suddenly on the flooring causing the feet to slide forward inside the shoes.
3. Is it to be used in a 24-hour a day area? A higher density composition is more durable but may not provide sufficient cushioning.
4. Are wheeled items to be used in this area and on the mat? Wheels may sink in and be difficult to move.
5. How easy is the surface to clean? A closed surface is easier to clean. If grit is not removed there may be increase in wear.
6. What is the size/area requiring matting? Is a rolled length suitable or are interlocking tiles required?
7. How critical is a seamless surface? Uneven surfaces create tripping hazards.
8. Is a flat, textured or “bubbled” surface required? A “bubbled” surface provides more cushioning but is difficult to move wheeled equipment on.

¹ <http://www.ccohs.ca/oshanswers/ergonomics/mats.html> (downloaded 26/02/2007)

² <http://www.mul-t-mat.com/ergo.htm> (downloaded 8/05/2007)

9. What type of floor will the mat be used on? Some compounds may hasten the breakdown of the matting.
10. What thickness is required? A thicker mat provides more cushioning but the edges may need a ramp to reduce likelihood of tripping and make wheeled access easier.
11. Is the mat going to be picked up and moved? A heavier mat may be a manual handling hazard.
12. Is prevention of mat creep important? Mats may move from their original position when people walk on them.
13. Is flammability of the mat a consideration?
14. Is UV or chemical resistance a consideration?

These design features should be reviewed prior to purchasing matting. It is desirable to trial samples of anti-fatigue mats during this time.

2. The benefits (and drawbacks) of anti-fatigue mats

Manufacturers' claims

Manufacturers claim that the mats reduce physical fatigue³ by:

- Reducing pressure on the spine and strain on the back muscles resulting in less lower back pain.
- Stimulating circulation.
- Easing stiffness in neck and shoulders which causes headaches.
- Halving the amount of energy used up by supporting muscles in back and legs.
- Reducing arch and heel pain caused by flattening of the feet.
- Encouraging frequent changes in posture, preventing stiffness in joints and muscles.

Scientific Evidence

There is “no scientific evidence that mats relieve leg and back fatigue”⁴. Using a mat or wearing shoe insoles to modify the flooring made no significant differences in fatigue or discomfort⁵. Studies have examined subjective rating of fatigue and discomfort in controlled laboratory settings, measured leg volume changes, measured skin temperature readings and electromyographic muscle responses. The results have been mixed and sometimes conflicting.

³ <http://www.matworld.co.nz/TheFacts.phtml> (downloaded 8/05/2007)

⁴ Kim, J. Y.; Stuart-Buttle, C.; Marras, W. S. (1994) The effects of mats on back and leg fatigue. *Applied Ergonomics*. Pp. 29 – 34.

⁵ King, P. M. (2002) A comparison of the effects of floor mats and shoe in-soles on standing fatigue. *Applied Ergonomics*. Pp. 477 - 484.

There is a lack of consensus on the underlying physiological causes of discomfort and fatigue associated with prolonged standing which makes it difficult to recommend the most appropriate intervention. One hypothesis is that prolonged standing increases discomfort and overall body fatigue by reducing blood circulation which causes venous pooling and accumulated metabolites⁶. Anti-fatigue mats are engineered to make the body naturally and imperceptibly sway thereby encouraging lower leg muscle activity and activating the venous muscle pump. Shoe in-soles may be seen as “mobile mats” with a similar function. Other studies⁷ suggest that discomfort from prolonged standing arises from four main sources: (1) interference with venous return resulting in tissue hypoxia; (2) interference with venous return resulting in oedema; (3) intervertebral disc stress from excessive lordosis; (4) stretching of ligaments.

The duration of time spent standing is the critical factor. Workers standing for more than 4 hours a day reported a high incidence of low back pain⁸. There appears to be a threshold value between 30% to 50% of the time spent standing during a working day above which there is a “pronounced risk for increased discomfort”. There needs to be an optimal mix of postures⁹ (standing, sitting and walking). Workers who are able to adjust their posture at will are thought to be able to resist pain more effectively. Sitting for even a small part of the day provides some protection from discomfort.

Drawbacks

The cushioning effect of anti-fatigue mats may create new problems such as difficulty moving wheeled equipment over the mat and tripping hazards for users.

⁶ Zander, J. E.; King, P. M.; Ezenwa, B. N. (2004) Influence of flooring conditions on lower leg volume following prolonged standing. *International Journal of Industrial Ergonomics*. Pp. 279 – 288.

⁷ Messing, K; Kilbom, A. (2001) Standing and very slow walking: foot pain-pressure threshold, subjective pain experience and work activity. *Applied Ergonomics*. Pp. 81 - 90.

⁸ Hansen, L.; Einkel, J.; Jorgensen, K. (1998) Significance of mat and shoe softness during prolonged work in upright position: based on measurements of low back muscle EMG, foot volume changes, discomfort and ground force reactions. *Applied Ergonomics*. Pp. 217 – 224.

⁹ Laperriere, E.; Ngomo, S.; Thibault, M.-C.; Messing, K. (2006) Indicators for choosing an optimal mix of major working postures. *Applied Ergonomics*. Pp. 349 - 357.

3. Other factors to consider

Fatigue versus discomfort

The name “anti-fatigue mat” implies that its use will prevent fatigue; however the primary goal should be to reduce discomfort. Fatigue is defined as “mental or physical exhaustion that stops a person from being able to function normally.”¹⁰ Fatigue is usually associated with long working hours or with high intensity mental or physical effort. Whereas discomfort is “the body’s way of telling you that you need to change something” before you cause injury or damage¹¹. To stay healthy and comfortable the body needs movement – jobs must be designed to allow adoption of a variety of positions and tasks as well as allowing adequate time for recovery. Discomfort can be a precursor to fatigue and is a useful indicator of a worker’s perception of the match between their capability and the demands of their work.

Discomfort, Pain and Injury Contributory Factors

There are many factors that contribute to discomfort, pain and injury. ACC have grouped these into seven categories (ACC, 2006). Depending on the person and the task, these categories all work uniquely together in different proportions. All factors must be considered – interventions that only address one factor in isolation will not be successful. Anti-fatigue matting provided as a single intervention to improve the physical environment will not eliminate feelings of discomfort that may lead to fatigue.

Contributory factors for Discomfort, Pain and Injury:

- a) Amount of repetition in a job or lack of ability to change position (task invariability).
- b) How the work is organised (work organisation). This includes the hours of work, breaks, peaks and troughs of workload, amount of control the individual has on the pacing and selection of tasks.
- c) The layout of the workplace and the positions the person works in e.g. reaching, bending and/or twisting actions.
- d) The working environment e.g. temperature, lighting, noise, vibration etc.
- e) The weight, size and shape of objects moved and how they are moved e.g. carrying, pushing, holding (load/forceful movements).
- f) Individual factors that are the unique characteristics of individual people. Age, gender, genetic makeup cannot be changed but nutrition, hydration, smoking and drug use, fitness and sleep involve individual lifestyle choices than can be altered.
- g) Psychosocial factors are the stressors individuals may be experiencing at home or work and their attitude to them. At work this may include how workloads and deadlines are perceived, the amount of support given by managers or colleagues, the workplace culture and the degree of job satisfaction.

¹⁰ Queensland Government, Department of Industrial Relations. *Fatigue Management Guide. Workplace Health and Safety Queensland.*

¹¹ Accident Compensation Corporation. (2006) *Preventing and Managing Discomfort, Pain and Injury.* Wellington, New Zealand.

While the individual and psychosocial factors may not directly arise from the work itself, these factors may significantly impact on the way a person is able to carry out the work. It benefits everyone if the workplace helps the individual to manage these issues.

When prolonged standing is causing discomfort, the way the work is organised and the variety of tasks and working positions are particularly important factors to consider.

Legal requirements

The Health and Safety in Employment Act, 1992 requires employers to take all practicable steps to provide a safe and healthy workplace for employees by identifying and controlling all hazards. Prolonged standing is hazardous because it may lead to discomfort, pain or injury.

Recommendations

1. Anti-fatigue mats should not be used as an isolated intervention. There is no scientific evidence that mats relieve leg and back fatigue.
2. All contributory factors of discomfort, pain and injury should be considered. The content and organisation of prolonged standing tasks should be examined to identify ways to provide a variation between standing, walking and sitting tasks. The standing component should be no more than 30% to 50% of the working day.
3. If using anti-fatigue mats as an adjunct with other interventions, clarify what design features are important for that work area (refer to Mat Features to Consider – page 3).