

**THE PREVALENCE OF FATIGUE AND THE
EFFECTIVENESS OF FATIGUE RISK
MANAGEMENT INTERVENTION ON SAFETY
PERFORMANCE AMONG SHIFT WORKERS
IN ELECTRONICS MANUFACTURING
INDUSTRY IN MALAYSIA**

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DOCTOR OF PHILOSOPHY

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Doctor of Philosophy.

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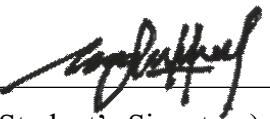
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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.



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DEDICATION

Dedicated to my late father, Abu Hanifah Mat Tahir, and my mother, Che Mani Buang.

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ABSTRAK

Pekerja syif mudah terdedah kepada kelesuan di tempat kerja kerana mereka bekerja dalam masa yang agak panjang sehingga menjangkaui masa tidur normal mereka. Kelesuan di tempat kerja boleh menyebabkan prestasi dan kualiti kerja menurun dan meningkatkan insiden di tempat kerja. Kajian ini dijalankan bagi meneliti kesan bekerja syif ke atas kelesuan pekerja, menilai faktor risiko berkaitan, dan mengenal pasti kesannya terhadap prestasi keselamatan dalam kalangan pekerja syif dalam industri perkilangan elektronik tertentu di Malaysia. Intervensi pengurusan risiko kelesuan juga dibangunkan dan diuji bagi melihat kesannya dalam mengurangkan kadar kelesuan dan meningkatkan prestasi keselamatan dalam kalangan pekerja syif. Kajian ini menggunakan pendekatan berbilang kaedah yang terbahagi kepada tiga fasa. Fasa pertama melibatkan kajian keratan rentas bagi melihat tahap kelesuan dan faktor risiko berkaitan menggunakan set soal selidik. Inventori Kelesuan Multidimensi (MFI), Skor Kemengantukan Karolinska (KSS), Soal Selidik Sikap Keselamatan (SAQ), dan Skala Neal dan Griffin (NGS), telah digunakan bagi menentukan tahap kelesuan, tahap kemengantukan, budaya keselamatan, dan prestasi keselamatan dalam kalangan responden. Fasa kedua memfokuskan pembangunan program intervensi pengurusan risiko kelesuan yang sah melalui temu bual separa tersusun, pemerhatian di tempat kerja, dan semakan dokumen. Fasa ketiga melibatkan reka bentuk kuasi-eksperimen, (pra dan pasca ujian kumpulan kawalan tidak dirawat) bagi menguji kesan intervensi terhadap responden. Kajian ini mendapati pekerja syif dalam industri perkilangan tertentu mengalami gejala kelesuan biasa (54.1%), kelesuan fizikal (33.1%), kelesuan mental (27.9%), kurang aktiviti (22.8%) dan kurang motivasi (19.9%) dalam waktu kerja. Faktor seperti jantina, umur, tahap pendidikan, pendapatan bulanan, pengalaman bekerja, Indeks Jisim Tubuh (BMI), tidur pada hari tidak bekerja, tidur sekejap, dan kualiti tidur menjadi kaitan penting terhadap gejala kelesuan dalam kalangan responden dengan kadar nisbah ganjil (OR) antara 0.162 hingga 6.588. Analisis permodelan persamaan struktur menunjukkan hubungan negatif signifikan ($b = -.30$, S.E. = .06, $p \leq .001$) di antara kelesuan dan prestasi keselamatan pekerja. Hasil dapatan tersebut telah digunakan sebagai asas dalam pembangunan, pengesahsahihan dan pelaksanaan program intervensi dalam kajian ini, merangkumi rangka kerja latihan kesedaran berkaitan kelesuan, garis panduan pengurusan risiko kelesuan, modul latihan kesedaran berkaitan kelesuan, modul senaman duduk, dan bahan-bahan promosi kesedaran. Program intervensi ini telah terbukti berkesan dalam mengurangkan tahap kelesuan (12.0% hingga 21.6%) di samping meningkatkan prestasi keselamatan (9.2% hingga 10.7%) dalam kalangan pekerja syif. Kajian ini mendapati pekerja syif yang mengalami kelesuan biasanya mempunyai tahap prestasi keselamatan yang rendah dan lebih mudah terbabit dalam insiden di tempat kerja. Walau bagaimanapun, pemahaman yang baik tentang punca berlakunya gejala kelesuan di tempat kerja, digandingkan dengan komitmen serta kerjasama yang baik antara majikan dan pekerja dapat membantu dalam merancang serta melaksanakan strategi intervensi yang sewajarnya bagi mengurus risiko kelesuan akut dan kronik dengan sebaiknya.

ABSTRACT

Shift workers are exposed to fatigue at work because they tend to work longer hours and beyond their normal sleeping hours. Workplace fatigue can lead to decreased performance and quality of work and increased incidents at work. This study is conducted to examine the impact of shift work on workers' fatigue, to assess the associated risk factors, and to identify its implication on safety performance among shift workers in selected electronics manufacturing industries in Malaysia. A fatigue risk management intervention was also developed and tested to observe its impact in reducing fatigue and improving safety performance among the shift workers. This study used a mixed-method approach that is divided into three phases. The first phase involved a cross-sectional study to look at fatigue levels and related risk factors using a set of questionnaires. Multidimensional Fatigue Inventory (MFI), Karolinska Sleepiness Score (KSS), Safety Attitude Questionnaire (SAQ), and Neal and Griffin Scale (NGS) were each used to determine fatigue, sleepiness, safety culture, and safety performance among the respondents respectively. The second phase focused on the development of a valid fatigue risk management intervention program using semi-structured interviews, workplace observations, and document reviews. The third phase used a quasi-experimental design (untreated control group pre-test post-test) to test the impact of the intervention on the respondents. This study revealed that shift workers in the selected electronics manufacturing industries experienced general fatigue (54.1%), physical fatigue (33.1%), mental fatigue (27.9%), reduced activity (22.8%), and reduced motivation (19.9%) during working hours. Factors such as gender, age, education level, monthly income, working experience, body mass index, sleeping on off-day, naptime, and quality of sleep were found to be significantly associated with fatigue among the respondents with an odd ratio (OR) range between 0.162 to 6.588. Structural equation modelling analysis indicated a significant negative relationship ($b = -.30$, S.E. = .06, $p \leq .001$) between fatigue and safety performance. The findings were used as a basis for the development, validation, and implementation of an intervention program in this study, which consists of a fatigue awareness training framework, fatigue risk management guideline, fatigue awareness training module, sitting exercise module, and awareness promotion materials. The intervention program has proven to be effective in reducing fatigue prevalence (12.0% to 21.6%) and further improve safety performance (9.2% to 10.7%) among the shift workers. This study suggests that shift workers who experience fatigue tend to have lower levels of safety performance and are more likely to be involved in incidents at work. However, a good understanding of the nature of fatigue occurrence in the workplace paired with a good commitment and cooperation between employers and employees could help to plan and to implement appropriate intervention strategies to properly manage the risk of acute and chronic fatigue.

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