

UNIVERSITI TEKNOLOGI MARA

**MODIFICATION OF THE REVISED
NIOSH LIFTING EQUATION
(RNLE): A STUDY OF
CONTRIBUTING FACTORS TO
OCCUPATIONAL LOW BACK PAIN
IN MANUFACTURING
INDUSTRIES IN SOUTHERN
MALAYSIA**

NOOR ADILLAH BINTI DAWAD

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ABSTRACT

Occupational low back pain (LBP) is a complex pathophysiological condition within a biopsychosocial framework. In the manufacturing industry, manual material handling, especially lifting loads, poses significant ergonomic challenges and has become a key area of concern for occupational health. The Revised NIOSH Lifting Equation (RNLE) is widely used to assess the physical risks associated with these activities. This study aims to determine the prevalence of occupational LBP and identify the factors related to individual characteristics and ergonomic domains contributing to it. Additionally, this study proposes modifying the RNLE to create the Individual Lifting Equation (ILE), incorporating age, gender and body mass index (BMI) components for assessing risks associated with LBP. This cross-sectional study was conducted in three states in Malaysia, involving nine companies in the manufacturing industry and consisting of two phases. In Phase One, 772 participants from all job categories completed Malay-translated validated questionnaires which covered individual factors as well as domains of physical, cognitive, and organisational ergonomics. In Phase Two, an observational ergonomic risk assessment using the RNLE method was conducted among 165 manual lifting workers. Based on the results, the 1-year prevalence of LBP was 43% (n=334), which increased to 61% (n=470) over a lifetime. In the multivariable logistic regression model, both lifetime LBP and social support were identified as significant contributing factors to LBP, with odds ratios (ORs) of 45.54 (95% CI 25.62-80.94) and 1.81 (95% CI 1.16-2.83), respectively. Load and vertical location during lifting were significant predictors in the ILE model, with ORs of 1.09 (95% CI 1.01-1.18) and 1.01 (95% CI 1.01-1.02), respectively. At a Lifting Index (LI) cut-point of 2.0, all ILE models significantly predicted LBP. Among them, ILE Model 5, which includes age and BMI multipliers, had the highest ORs at 2.96 (95% CI 1.39-6.33), exceeding those of the core RNLE model. The model achieved an accuracy with a sensitivity of 1.00 and a specificity of 0.90. The diagnostic confidence was 73.8%. In conclusion, this study underscores the recurring pattern of LBP prevalence and identifies significant contributing factors within the individual and cognitive ergonomic domains. It also demonstrates that incorporating age and BMI multipliers into the ILE models at an LI cut-point of 2.0 yields slightly higher ORs compared to the core RNLE model, with high accuracy and diagnostic confidence suggesting that the RNLE could be modified to ILE.

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CHAPTER 1

INTRODUCTION

1.1 Research Background

Occupational diseases have been a crucial concern in the realm of labour rights, defined as any condition contracted due to exposure to risk factors deriving from work activity (ILO, 2010). The International Labour Organisation (ILO), an agency under the United Nations that sets international labour standards, plays a pivotal role in defining and updating the criteria for what constitutes an occupational disease. Historically, the ILO's list of recognised occupational diseases has evolved, mirroring the changes in industrial practices, technological advancements, and understanding of work-related health risks. The ILO occupational diseases include illnesses caused by chemical, physical, and biological agents as well as respiratory and skin diseases, musculoskeletal disorders (MSDs), occupational cancers, and even mental and behavioural disorders (ILO, 2010, 2022). These classifications are essential for guiding policy decisions and protecting workers' health across diverse industries.

Focusing specifically on MSDs such as low back pain (LBP), it is noteworthy that in 2020, LBP affected 619 million people worldwide. The global incidence of LBP is expected to rise 36% by 2050, with the most significant increases anticipated in Asia and Africa. This increase is largely driven by demographic changes, particularly population growth (Ferreira et al., 2023). These regions are experiencing population growth and industrial expansion in primate cities, driven by rapid urbanisation, economic transitions, and demographic shifts (Yamashita, 2017).

A previous study also showed that occupational LBP accounts for 37% of all MSDs (Punnett et al., 2005). Globally, the prevalence of occupational LBP varies widely, ranging from 4% to 79%, emphasising its significant public health issues (Abdullah & Dawal, 2020; Al-Salameen et al., 2019; Buchbinder et al., 2018; Wami et al., 2019). In Malaysia, similar trends are observed with MSDs, which are the second-most common occupational diseases after noise-induced hearing loss (DOSH, 2016). LBP, in particular, is frequently cited as a prevalent issue among specific body parts (S. M. Awaluddin et al., 2023).