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# Interaction between physical and psychosocial work risk factors for low back symptoms and its consequences amongst Indonesian coal mining workers

Baiduri Widanarko [a, b, *, 1], Stephen Legg [a], Jason Devereux [c, d], Mark Stevenson [e]

[a] Centre for Ergonomics, Occupational Safety and Health, School of Public Health, College of Health, Massey University, Palmerston North, New Zealand
[b] Department of Occupational Health and Safety, Faculty of Public Health, University of Indonesia, Depok 16424, Indonesia
[c] Lloyd's Register Consulting, London, UK
[d] Business Psychology Unit, University College London, London, UK
[e] EpiCentre, Institute of Veterinary, Animal and Biological Sciences, College of Sciences, Massey University, Palmerston North, New Zealand

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ABSTRACT

This study assessed the interaction between physical and psychosocial factors for low back symptoms (LBS) and its consequences (reduced activities and absenteeism) in a developing country. A sample of 1294 Indonesian coal mining workers reported occupational exposures, LBS and its consequences using a self-administered questionnaire. Respondents were placed into one of four combination exposure groups: high physical and high psychosocial (HPhyHPsy); high physical and low psychosocial (HPhyLPsy); low physical and high psychosocial (LPhyHPsy), and; low physical and low psychosocial (LPhyLPsy). The attributable proportion due to interaction between physical and psychosocial factors was examined. Individuals in the HPhyHPsy group were most likely to report LBS (OR 5.42, 95% CI 3.30–8.89), reduced activities (OR 4.89, 95% CI 3.09–7.74), and absenteeism (OR 4.96, 95% CI 3.05–8.06). Interactions between physical and psychosocial factors were present for LBS, reduced activities, and absenteeism; although for LBS and absenteeism the interactions were not significant. Current smokers were more likely to report LBS consequences. Permanent employment and night shift work increased the odds of LBS and its consequences. We conclude that interventions aimed at reducing LBS and its consequences should address both physical and psychosocial factors, with a focus on smokers, permanent employment and night shift work.



## 1. Introduction

Low back symptom (LBS) is an important health problem due to their serious worldwide economic and social impacts (National Research Council and Institute of Medicine (NRC & IOM), 2001). In a review using data collected between 1969 and 1998, the 12-month period prevalence of LBS from eight developed countries ranged between 22% and 65% (Walker, 2000). For the consequences of LBS, i.e. reduced activities and absenteeism, it ranges from 18% to 42% (Scuffham et al., 2010; Widanarko et al., 2012b) and from 9% to 14% (Ijzelenberg et al., 2004; Scuffham et al., 2010; Widanarko et al., 2012b), respectively. Since industrially developing countries (IDCs) may have a high proportion of workers engaged in heavy manual work, it might be expected that the prevalence of LBS and its consequences would be greater than for developed countries (Volinn, 1997). However, the prevalence of LBS in IDCs (32–75%) (Chen et al., 2005; Louw et al., 2007; Widanarko et al., 2013) and absenteeism (13%) (Widanarko et al., 2013) are similar to that in developed countries. The prevalence of reduced activities (10–16%) (Chen et al., 2005; Widanarko et al., 2013) in IDCs is lower than for developed countries, but it is hard to be confident that this difference is real because relatively few studies of LBS have been undertaken in IDCs (Volinn, 1997). In worldwide terms, the paucity of information about the magnitude of LBS and its consequences among IDCs is a concern, since more than 80% of the global workforce live and work in the industrially developing world (United

* Corresponding author. Centre for Ergonomics, Occupational Safety and Health, School of Public Health, College of Health, Massey University, Private Bag 11222, Palmerston North 4442, New Zealand. Tel.: +64 6 3569099x85859/+64 2102586099 (mobile).
*E-mail addresses:* baiduri@ui.ac.id, B.Widanarko@massey.ac.nz (B. Widanarko).
[1] Permanent address: Department of Occupational Health and Safety, C Building 1st Floor, Faculty of Public Health, University of Indonesia, Depok 16424, West Java, Indonesia. Tel.: +62 21 7863487; fax: +62 21 7874503.

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Nations et al., 2011). Hence, any study that investigates the burden of LBS in an IDC is important as it will, at the very least, provide baseline data for future comparison.

Risk factors for LBS and its consequences involve physical and psychosocial factors. Physical risk factors for LBS that have been identified in various occupational groups include awkward back posture (Hooftman et al., 2009; Ijzelenberg et al., 2004; Lotters et al., 2003), lifting (Aasa et al., 2005; Elders and Burdorf, 2001; Hooftman et al., 2009; Lotters et al., 2003) and whole body vibration (Linton, 1990; Lotters et al., 2003). Risk factors for reduced activity include awkward posture (Aasa et al., 2005) and lifting (Aasa et al., 2005; Widanarko et al., 2012b). For absenteeism, they include awkward posture (Hoogendoorn et al., 2002; Widanarko et al., 2012b), lifting (Hooftman et al., 2009; Hoogendoorn et al., 2002) and whole body vibration (Hartman et al., 2005).

Psychosocial risk factors associated with LBS include high job strain (Ijzelenberg et al., 2004), high psychological demands (Aasa et al., 2005; Elders and Burdorf, 2001; Hooftman et al., 2009; Ijzelenberg et al., 2004), low decision latitude (Aasa et al., 2005; Ijzelenberg et al., 2004), low social support (Aasa et al., 2005; Hooftman et al., 2009), job dissatisfaction (Hooftman et al., 2009), high effort–reward imbalance (ERI) score (Rugulies and Krause, 2008) and high work stress (Widanarko et al., 2012a). Risk factors for reduced activities have been reported as high psychological demand (Aasa et al., 2005), low decision latitude (Aasa et al., 2005), low social support (Aasa et al., 2005) and high ERI score (Simon et al., 2008), whilst those for absenteeism include low job control (Hemingway et al., 1997), low social support (Hooftman et al., 2009; van den Heuvel et al., 2004) and job dissatisfaction (Hooftman et al., 2009; Hoogendoorn et al., 2002; van den Heuvel et al., 2004).

The relative role of physical and psychosocial factors in the aetiology of LBS and its consequences is complex. Davis and Heaney (2000) and Karsh (2006) proposed a model of the relationship between physical and psychosocial factors and LBS. These models suggest that both physical and psychosocial factors may independently influence LBS. The physical and psychosocial factors may also interact, giving rise to a probability of LBS being greater than the sum of the magnitude of the individual effects. Knol and VanderWeele (2012) recommend using relative excess risk due to interaction (RERI), attributable proportion (AP) and synergy index ($S$) to assess interaction for additive and multiplicative models. In the additive model, which is considered by Rothman (2012) to better reflect biologic interaction than the multiplicative model, RERI quantifies the extent to which the effect of the two factors together exceeds the effect of each considered individually. In contrast, AP, which has been used in many prior studies (e.g. Devereux et al., 2004, 1999, 2002; Lapointe et al., 2009; Tornqvist et al., 2001; Wahlstrom et al., 2004) measures the proportion of the joint effect of both exposures together that is due to the interaction (i.e. RERI divided by the relative risk of doubly exposed group). Although the synergy index (i.e. the ratio between combined effect and the sum of the individual effects) can also be used to assess interaction, it, however, is difficult to interpret if one or both of the exposures is preventive (Knol et al., 2011). For these reasons, the present study uses AP in an additive model to quantify the interaction.

To the best of our knowledge only eight studies have investigated the interaction between physical and psychosocial risk factors and LBS and its consequences (Devereux et al., 2004, 1999; Fernandes et al., 2009; Huang et al., 2003; Lapointe et al., 2009; Linton, 1990; Vandergrift et al., 2012; Waters et al., 2011). They have all shown that individuals exposed to both high physical and high psychosocial factors have the highest risk of LBS. Most of the studies that examined this interaction, as cited above, were conducted in developed countries and only one study (Fernandes et al., 2009) has examined this interaction in an IDC (Brazil).

With this background, the objective of the present study was to examine the interaction between physical and psychosocial exposures for LBS and its consequences (reduced activities and absenteeism). Since only one study has examined the interaction in an IDC, the present study was conducted in a coal mining company in Indonesia.

## 2. Methods

### 2.1. Respondents and questionnaire administration

With prior agreement and facilitation from the Safety, Health and Environmental manager of the company, invitations to participate in this cross-sectional study were delivered in person to 2150 coal mining workers involved in various occupations at three sites (two located in the province of East Borneo and one in the province of South Borneo). The activities, equipment and work environment between sites were very similar. Workers who had worked more than or equal to one year of work experience in the current position and had never previously had an accident involving the low back region were eligible for inclusion in the study. The workers were arranged to anonymously complete a self-administered questionnaire in groups of 20–25 under the supervision of two trained investigators, who were available to respond to queries and who, in advance, gave the groups a brief explanation about the questionnaire's content and the aims of the study. Company management were not present when the questionnaire was answered.

The first page of the questionnaire comprised an information sheet that had to be read prior to answering the questions. The information sheet clearly stated that completing and returning the questionnaire implied that respondents agreed to participate in the study. Since the questionnaire only sought information about demographic characteristics, occupation (and its related exposures), LBS and its consequences using self-reporting and was completed anonymously, a signed informed consent was not necessary. The study design was evaluated by peer review and judged to be low risk and was recorded on the Low Risk Database of the Massey University Human Ethics Committee.

### 2.2. Questionnaire

The questionnaire was used to obtain information on demographic characteristics (age, gender, education), smoking status (never smoked – defined as never smoked 100 cigarettes; former smoker – defined as having smoked $\geq$100 cigarettes but quit smoking during the year prior to the survey or longer ago, and; smoker – defined as having smoked $\geq$100 cigarettes and currently smoke (Albanes et al., 1987)), organisational factors (current employment status – permanent; non-permanent and shift work – no shift work; shift work without night shift; shift work with night shift), physical and psychosocial exposures, LBS and its consequences (reduced activities and absenteeism), and any accident(s) that involved the low back region. Since the original questions were all in English and the study was conducted in Indonesia(n), a cross-cultural adaptation of the questionnaire was undertaken, in accordance with guidelines for adaptation of health related subjective data collection tools (Beaton et al., 2000).

#### 2.2.1. Physical and psychosocial exposure assessments

Physical exposure questions asked respondents to estimate how much working time (not at all, 1–10%, 11–25%, 26–50%, 51–75%, and 76–100% of the time) during their work activities they were