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A Predictive Model of Occupational and Lifestyle Risk Factors and Pain Management Strategies for Participants in a Wellness Program Diagnosed with Chronic Low Back Pain

Balmatee Bidassie*, Le Zhang, Yuan Gao and Vincent G. Duffy

School of Industrial Engineering, Purdue University, West Lafayette, Indiana, USA

Abstract

Background: Chronic Low Back Pain is beyond a physical problem and depends on a person's psychological attitude which makes it a growing workplace concern. The objective of this paper is to understand occupational and lifestyle risk factors associated with Chronic Low Back Pain with a focus on prevention of related incidences in the workplace.

Methods: A predictive model (logistic regression) of occupational and lifestyle risk factors associated with Chronic Low Back Pain was developed by a retrospective study from 2006 to 2009 of employees who participated in a Health and Wellness program at a large Midwestern university.

Results: The model determined six risk factors (ongoing back pain, ongoing neck pain, know how to treat back pain at home, chronic insomnia, bodily pain, and slips, trips, and/or falls) with the most significant association with Chronic Low Back Pain.

Conclusion: Chronic Low Back Pain may be managed through workplace ergonomics and psychological approaches that stress at pain management, self-care at home, and reducing risk factors associated with slips, trips, and/or falls.

Keywords: Chronic low back pain; Occupation risk factors; Lifestyle risk factors; Pain management; Self-care at Home; Slips; Trips; and/or Falls; Pain management strategies

Abbreviations: CLBP: Chronic Low Back Pain; HRA: Health Risk Assessment; LB: Low Back; WC: Workers' Compensation, IRB: Institutional Review Board, SPSS: Statistical Package for Social Science, LTB: Lifting, twisting and/or bending, STF: Slips, trips and/or falls, SBS: Struck by something, BMI: Body mass index, OR: Odds ratio

Introduction

When the duration of low back pain tends to persist for more than 3 months, it is actually defined as Chronic Low Back Pain (CLBP) [1]. Ergonomics engineering suggestions [2–7] have been implemented in the workplace to address low back issues and injury prevention strategies which target the causes of low back injury, such as lifting, twisting and/or bending (LTB) [8] and slips, trips and/or falls (STF) [9], are well-developed in industrial domain. However, CLBP is still a major cause of medical expenses [10], absenteeism [11], and disability [12,13] in the workforce [14,15].

Previous studies [16,17] have evaluated occupational risk factors associated with CLBP [17–19] and defined occupational contributors for CLBP as neural tissue inflammation [20], ongoing nociception [21], injuries of ligaments [20], spondylitis [22], and less rest [23]. However, traditional occupation-based programs often fail to include lifestyle risk factors that might contribute to CLBP [16] and underestimate the predictive potential of lifestyle factors for future CLBP episodes [24]. According to Waddell [16], CLBP is not only a physical problem, but also depends on a person's attitude [12], beliefs [25], and psychological distress [19,26]. Thus, there is a need for robust models to manage the chronic disorder and disability [20,27], including a better understanding of the contribution of occupational and lifestyle risk factors [28].

In addition to occupational and medical risk factors, CLBP has lifestyle and psychosocial risk factors, such as age [18,23,29], weight [30], exercise [23,31], physical pathology and physical disability [32]. Contributors to CLBP are psychological activities [33], neuro-physiological factors [34], and fear of pain [35]. Although psychological risk factors have been used to predict CLBP [8], there is no clear understanding of whether certain psychological risk factors contribute to CLBP and how to use these risk factors in physical therapies [28]. Workplace interventions can aid in prevention through physical approaches [36,37] such as physical activity [38], exercise [39], lumbar support [40], and education and training approaches [41]. However, depression [42], psychological distress [19], and fear of disability [12,43] may also result in CLBP and cannot be managed by physical therapy alone. Thus, there is need for exploring high quality interventions to manage CLBP in workplace [44] from not only a physical aspect, but also a psychological concern.

Previous studies focused only on either occupational risk factors or lifestyle risk factors associated with CLBP [17,19], but failed to explore a chronic disease model for managing chronic back pain [27]. A better understanding of when and how chronic pain occurs and a predictive model for managing CLBP is needed for pain management strategies [45]. Thus, this study attempts to develop a predictive model with

***Corresponding author:** Balmatee Bidassie, Clinical Partnership in Healthcare Transformation, VA-Center for Applied Systems Engineering, School of Industrial Engineering, Purdue University, West Lafayette, Indiana, USA, Tel: 269-873-2514; E-mail: balmatee.Bidassie@va.gov

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insight into both occupational and lifestyle risk factors associated with CLBP in the workplace. The risk factors identified in this study may be used to guide the early-detection of CLBP and manage employees' pain. This research can be applied to develop pain management strategies based on known occupational and lifestyle risk factors to help companies achieve health and safety goals in workplace.

Methods

Study approach

A data mining, systematic, problem solving approach modeled by Bidassie [46] was used to analyze the association between occupational and lifestyle risk factors with CLBP (Figure 1).

There are four steps in Figure 1 which is represented as our systematic problem solving approach: 1) use a Health Risk Assessment (HRA) to collect data from individuals on occupational and lifestyle risk factors; 2) descriptive statistics were used to determine a general profile of employees who were diagnosed with CLBP (the percentage of each level in a factor) and bivariate analysis was performed to gain an understanding of the level of association between CLBP and each individual risk factors based on statistical significance ($p<0.05$); 3) develop a predictive model to identify risk factors to gain an insight into CLBP; 4) divide those risk factors into factors that can be manage based on known literature finding (providing the strategies based on their impact) and factors that may need more consideration for management strategies and wellness programs in the workplace.

In January 2006, the Human Resource Services of a Midwest university launched University WorkLife Programs focused on the prevention of illness and the reduction of health risk factors for faculty, staff, and their spouses [47]. This study utilized data mining for CLBP lifestyle risk factors from the Midwest university's wellness program HRA [48] to understand CLBP risk factors that should be considered in future workplace health and wellness programs. A typical HRA instrument obtains information on demographic characteristics, lifestyle, personal medical history, physiological, and family medical history from participants [49].

The health & lifestyle data for this study were collected from January 2006 to June 2009. Since, questions in the HRA questionnaire were pre-designed, occupational injury risk factors on workplace injury and illness data was collected from OSHA 300 Logs and approved Workers' Compensation (WC) claims. WC claims provide information on an employee who was injured at work or acquire an occupational disease to receive benefits including wage replacements, medical treatment, vocational rehabilitation and others [50]). This research was approved by the university's Institutional Review Board (IRB).

Study sample

Bidassie [46] described in detail the data collection method to ensure the non-traceability of data to the employees in this study. Each employee was assigned a unique identification (a CODE). From January 2006 through June 2009, there were 9,149 benefit-eligible, full time university employees who participated in the Wellness Program, of which 17.7% (n=1,619) reported that they were diagnosed by a doctor with CLBP.

Conceptual framework

The conceptual framework in this study applies the model documented by Bidassie [46] where "Potential effects" refer to physical

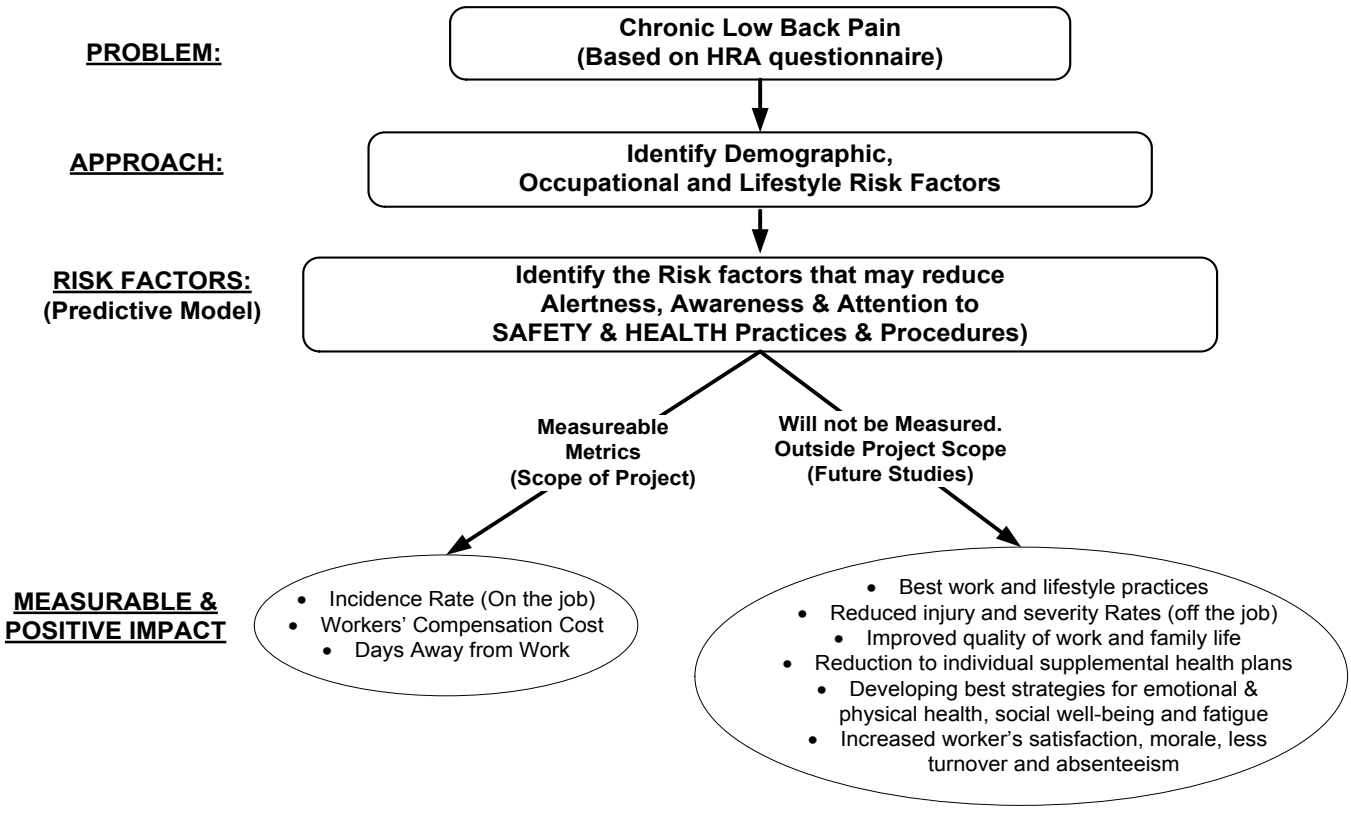

Figure 1: Systematic problem solving process.

and emotional variables (fatigue, stress, physical health, and emotional health/depression) and "Occupational and Lifestyle Risk Factors" refers to demographics, occupational and lifestyle risk factors. Association between these variables and CLBP were investigated. According to Bidassie [46], various occupational and lifestyle risk factors—such as lifestyle, stressors, and job tasks/security [51]—may aggravate disorders such as CLBP [12,21] and other bodily pain depending on an individual's physical condition [52]. Impairment (real or perceived) triggered by risk factors tend to result in employee having difficulty to function effectively in the workplace and limit social activities beyond the workplace [46].

Framework for statistical analyses

Dependent (response) variable: To create two groupings, the dependent variable (binary variable) was derived from the participant's response to the question in the HRA "Has a doctor ever said that you have chronic low back pain?" The participants whose responses were **Y=1** (Participant **reported** chronic low back pain as a health condition based on doctor's evaluation) were classified as the experiment group, and the participants whose responses were **Y=0** (Participant reported **no** chronic low back pain as a health condition based on doctor's evaluation) were classified as the control group.

Independent (predictor) risk factors: Independent risk factors included: demographic, occupational, Lifestyle risk and "potential effects" risk factors. Demographic risk factors included: age, gender (male, female), ethnicity (white, black, Hispanic, Asian, other), marital status (single, married, divorced, widowed, separated, other), and number of dependents.

Occupational risk factors data were derived from 1) OSHA 300 logs data including: job status (service, clerical, administrative, faculty, operation/technical staff), annual income, years of work experience, department, date of injury or onset of illness, location where incident occurred, description of injury or illness (including effected body part), cause of accident, type of injury (injury, illness, or fatality), eligibility of injury for WC, job transfers, missed or restricted workdays, and employee death [53]; and 2) Workers' Compensation data included: employment status (full-time vs. part-time), job status (service, clerical, administrative, faculty, operation/technical staff), years of work experience, cause of workplace injury (LTB, STF, or struck by something (SBS)), part of body effected, date of workplace injury, lost days, and WC paid [46].

Lifestyle risk factors and "potential effects" risk factors were collected from the Midwest University's wellness program HRA. Lifestyle risk factors included socio-demographics, occupational factors, alcohol use, smoking or tobacco use, sleeping habits, exercise, psychosocial factors, self-care, health history, and medication usage; "Potential Effects" risk factors included level of stress, dealing with stress, occupational and non-occupational stress, fatigue, depression, and the employee's rating of their physical health and emotional health.

Statistical analysis

The processes to reduce the number of risk factors to be included in the predictive model were conducted in two stages. In Stage 1, our team developed a general profile of employees with CLBP based on the percentage of each level in a risk factor (categorical variables). In Stage 2, we examined the relationship between CLBP and independent variables or risk factors (x's) by comparing pairs of means by two-sample t-test, and determining the relationship between CLBP and predictor risk factors with two or more categories by using Pearson Chi-square (x^2) tests. Statistical significance risk factors with an association with CLBP had a p-value<0.05. Risk factors with a high percentage in the descriptive analysis (Stage 1) or risk factors with a statistically significant association with CLBP (Stage 2) were the variables selected to be in the predictive model.

To determine a model for predicting the odds of risk factors associated with CLBP, twenty (20) predictive variables were entered using a backward stepwise logistic regression method. It required the observations to be independent and the independent variables (individual risk factors) be linearly related to the log of the dependent (CLBP).

$$\pi(Y=1X)=1n\left[\frac{p(Y=1/X)}{1-p(Y-1/X)}\right] \quad (1)$$

$$(OR=2.14) \quad (2)$$

In the equation (1) and (2), **E(Y)** is the log odds of the dependent variable (CLBP), β_0 is the constant, β terms are the logistic regression coefficients, and **X** is independent variables (individual risk factors). The odds ratio (OR) is the exponential of the regression coefficients e^{β} and each of them describes the size of the contribution of that risk factor. An OR greater than 1 indicates that the odds of CLBP increase when the predictor risk factor (independent variable) increases. An OR less than 1 indicates that the odds of CLBP decrease when the predictor risk factor increases [54]. The Hosmer-Lemeshow test [54], frequently used in risk prediction models, was used here to test for the goodness of fit for our logistic regression model. A probability level of $p<0.05$ was considered statistically significant. All statistical analysis was conducted using the Statistical Package for Social Science (SPSS) 16.0.1.

Potential benefit

This predictive model will give better insight into the correlation between CLBP and associated risk factors and become essential in developing CLBP management strategies in the workplace. Potential benefits of pain management programs focusing on CLBP may include reduction in future workers' compensation cost [55], improvement of employees' productivity [56], reduction the medical costs, and reduction absenteeism and turnover [57]. This research may also provide a better insight for health and safety professionals to estimate the net costs of managing CLBP in the workplace from an economic aspect.

Results

Descriptive statistics for employees who reported CLBP

In total, 56 individual risk factors were investigated to determine their associations with CLBP. Ethnicity (Caucasian) and shift (day) were not mentioned in the results because they were the majority of the sample size based on the university population who answered the HRA. Table 1 includes the demographic risk factors of employees diagnosed with CLBP. They tend to be females and employees 40 years and older [42].

Table 2 summarizes occupational risk factors based on employees' status, work shift, income, previous low back injury, working experience, type of work (lifting), causes of previous low back injury, and potential lost days due to previous low back injury. Employees who were diagnosed with CLBP tend to be administrative or service staff, have an average work experience (n=1444) of 12.8 years (SD=9.5,

Demographics	Risk Factors	n	Percent
Gender	Female	926	57.2%
	Male	693	42.8%
Ethnicity	Caucasian	1180	72.9%
	Non-Caucasian	439	27.1%
Age (years)	30-40	256	15.8%
	40-50	483	29.8%
	50-60	588	36.3%
	60 years and older	95	5.9%

Table 1: Demographics.

Occupational Risk Factors	Risk Factors	n	Percent
Previous low back injury	Reported low back injury (based on OSHA and Workers Compensation Reports)	222	13.7%
Reported cause of low back injury (OSHA and Workers' Compensation)	Lifting/Twisting/bending(LTB)	137	8.5%
	Slip/trip/fall (STF)	69	4.3%
	Struck by something (SBS)	16	1.0%
Work Requires Lifting?	Regular lifting	462	28.5%
Lost days and restricted days	Health problem limited the kind of work	1231	76.0%
	Miss one or more days from job because of injury	388	24.0%
Employee status	Administrative staff	547	33.8%
	Service staff	436	26.9%
	Clerical staff	293	18.1%
	Faculty	294	18.2%
	Operations or technical staff	49	3.0%
Work shift	Daytime shift	1449	89.5%
	Evening shift	152	9.4%
Income	More than $52,000	435	26.9%
	Between $33,800 and $52,000	451	27.9%
	Less than $33,800	733	45.3%
Work experience	One year or less	156	9.6%
	1-5 years	316	19.5%
	5-10 years	298	18.4%
	10-15 years	177	10.9%
	15-20 years	213	13.2%
	20 years or more	284	17.5%

Table 2: Occupational risk factors.

median=10, min=1, max=55), and the average annual income (n=1607) was $44,717 (SD=$29,504, median=$35,942, min=$8,403, max=$269,721). According the salary statistics from the Midwest university, the employees who report their annually income is lower than $33,800 are considered low income group. In contrast, the employees who report their annually income is higher than $52,000 are considered high income group [47]. About 12.3% (n=199) reported that they had filed an OSHA log or WC claim from 1999-2008 for a low back injury. On average, a participant reported 4.45 low back injuries (SD=6.5), with an average of 4.74 caused from LTB (SD=7.2), an average of 2.7 caused from STF (SD=1.9), and an average of 2.3 caused from SBS (SD=0.86).

Table 3 provides descriptive lifestyle factors (also supported by the literature) of employees diagnosed with CLBP. People who were diagnose with CLBP tend to use alcohol, smoking or tobacco, tend to sleep less than 8 hours per night, tend get about 30 minutes or more of physical activity (moderate pace), and tend to somewhat seeking psychosocial support from friends and family [58-60,92].

Table 4 shows that they have knowledge of self-care and tend to use prescriptive and non-prescriptive medication to manage their pain [45]. Participants reported that they were able to treat an average of 6.5 health problems by themselves (SD=2, mode=8, median=8).

Table 5 summarizes the biometric factors that are important criteria for evaluating quality of life such as cholesterol measure, blood glucose level, blood pressure, body mass index (BMI), and perceived current health. On the average, employees diagnosed with CLBP tend to have the following biometrics greater than normal: blood pressure [61], cholesterol [62], and blood glucose level [63]. In addition, they tend to be overweight or obese [64].

Table 6 summarizes the stress of employees diagnosed with CLBP. Ninety-eight percent employees (n=1582) reported that they have had stress in their lives due to minor annoyance to fairly major pressures,

Lifestyle Risk factors	Risk Factors	n	Percent
Alcohol Use	Drink alcoholic beverages of any kind	899	55.5%
	Consume beer, wine, liquor and/or other alcohol	953	58.9%
	Drink alcohol one day a week or less	616	38.0%
	Drink alcohol two days a week or more	186	11.5%
	Normally have one drink on the days that people drink alcohol	480	29.6%
	Normally have two drinks on the days that people drink alcohol	309	19.1%
	Normally have three or more drinks	165	10.2%
Smoking or tobacco use	Reported smokers	228	14.1%
	Smoked cigarettes	178	11.0%
	Smoked less than a pack of cigarettes	118	7.3%
	Smoked one or more packs of cigarettes	60	3.7%
Sleeping habits	Slept less than eight hours per night	1253	77.4%
	Slept eight hours or more per night	366	22.6%
Exercise	30 minutes or more moderate physical activity	1392	86.0%
Psychosocial factors	Participated in social groups about 2-3 times a month to once a week or more	721	44.5%
	Had contact with close friends about 2-3 times a month to once a week or more	1181	72.9%
	Had contact with close relatives about 2-3 times a month to once a week or more	1304	80.5%

Table 3: Lifestyle factors.

Personal care	Risk Factors	n	Percent
Self-care	Know what steps to take to treat CLBP	1444	89.2%
	Knew what to do to treat a sprain	1186	73.3%
Medication usage	Used one or more non-prescription medication	782	48.3%
	Used one or more prescription medication	1109	68.5%
	Used one or more herbal remedies	284	17.5%

Table 4: Personal care factors.

Biometrics	Risk Factors	n	Percent
Cholesterol measure	Preferred total cholesterol measure between 0-199 mg/dL	947	58.5%
Blood glucose level	Reported glucose level between 70-150 mg	1503	92.8%
Blood Pressure	Higher than normal blood pressure	1207	74.6%
Body Mass Index	Overweight	505	31.2%
	Obese	706	43.6%

Table 5: Biometrics.

problems or difficulties. More than 40% of the participants reported that they had at least one of the two occupational stressors. In general, 50% reported feeling somewhat effective in dealing with the stressors in their lives [65].

According to Bidassie [46], impairment may cause difficulty for employees as they execute tasks, and may restrict an individual from participating in social activities and routine work within and beyond the workplace. Table 7 summarizes the potential effects and the perceived physical and emotional health of employees who were diagnosed with CLBP. They tend to be fatigued [66], have some level of depression [67], report other bodily pain [68] and tend to have a physical condition that limits their ability to get enough exercise [69]. Their physical health and emotional health tend to limit their ability to get exercise & participate in physical and social activities, and they experience some level of difficulty doing their daily work [70].

Logistic regression analysis

A logistic regression model was used to determine the socio-demographic, occupational and lifestyle risk factors associated with CLBP. The Hosmer-Lemeshow test [54] did not indicate any significant lack of fit $p < 0.05$. The final predictive model for CLBP consists of twenty risk factors containing seven occupational and lifestyle risk factors, two potential effects (stress and depression), nine human health factors (self-care at home and other chronic health conditions diagnosed by a doctor), and two physical impairments.

Figure 2 represents the final predictive model of occupational and lifestyle risk factors and Table 8 summarizes the odd ratios of these factors.

According to the predictive model in Table 8, employees diagnosed with CLBP tend to be male and can be any age ranging from 30 to 60 years old. Employees who were diagnosed with CLBP tend to also be diagnosed with other chronic health conditions. They were 2.17 times more likely to have also been diagnosed with chronic insomnia, 1.86 times more likely to also be diagnosed with chronic arthritis, and 1.58 times more likely to also be diagnosed with chronic migraine or severe headaches [42].

Employees who were diagnosed with CLBP were 2.14 times more likely to have reported that at least one low back injury was due to a STF and 1.86 times more likely to have had at least one low back injury due to LTB. They tend to be 2.16 times more likely to report overall bodily pain and 1.29 more likely to have moderate to very severe bodily pain. They tend to be 8.91 times more likely to have on-going back pain problem serious enough to interfere with their daily activities, and 1.47 times more likely to have neck pain serious enough to interfere with daily activities.

Stress	Risk Factors	n	Percent
Stress level	Having with too much to do has been a major source of stress	742	45.8%
	Had stress in lives due to minor annoyance to fairly major pressures, problems or difficulties	1582	97.7%
	Life was only slightly stressful or somewhat stressful	1094	67.6%
Dealing with stress	Somewhat effective in dealing with their stress	809	50.0%
	Quite or extremely effective in dealing with their stress	612	37.8%
Occupational stressors	Job responsibilities	706	43.6%
	Relationships at work	389	24.0%
Non-occupational stress	Death of a spouse, life partner or other loved one	196	12.1%
	Illness or injury of loved one	373	23.0%
	Personal illness or injury	492	30.4%
	Care of elderly parent, dealing with childcare	281	17.4%
	Family problems	464	28.7%
	Other sources of stress	243	15.0%

Table 6: Stress.

Factors	Risk Factors	n	Percent
Fatigue	Felt tired during waking hours	1457	90.0%
Depression	Bothered by emotional problems	639	39.5%
	Felt down, depressed or hopeless	494	30.5%
	Felt depressed sometimes or most of the times	771	47.6%
	Bothered by a lack of interest or pleasure in doing things	449	27.7%
Perceived current health	Had bodily pain	1488	91.9%
	Did not have a physical condition that limited their ability to get enough exercise	1152	71.2%
Physical health status	Physical health problems limited usual physical activities	915	56.5%
	Physical health problems limited usual and physical activities very little to somewhat	731	45.2%
	Physical health provide difficulty in doing daily work	840	51.9%
	Physical health provide somewhat difficulty in doing daily work	717	44.3%
Emotional health status	Personal or emotional problems limited people from doing their usual work, school or other daily activities	639	39.5%
	Personal or emotional problems somewhat bothered people from doing their usual work, school or other daily activities	581	35.9%
	Personal or emotional problems bothered daily activities quit a lot	38	2.3%
	Could not do any daily activities	6	0.4%
Physical or emotional health status	Physical or emotional problems limited usual social activities with family or friends	903	55.8%
	Physical or emotional health somewhat limited usual social activities with family or friends	791	48.9%
	Physical or emotional health somewhat limited social activities quite a lot	83	5.1%
	Could not do any social activities	5	0.3%

Table 7: Potential effects and impairment factors.

The employees diagnosed with CLBP were 2.71 times more likely to treat back pain at home and 3.32 times more likely to have had their blood pressure checked during the last two years. They were 2.71 times more likely to report that a personal illness or injury had been a major source of stress for them, were 1.36 times more likely to have been diagnosed with chronic depression and tend to infrequently participate in organized social events. They were 1.45 times more likely to have a physical condition that limits their ability to get enough exercise and 1.21 times more likely to have physical health problems that limit their usual physical activities.

The impact of the OR e^{β} varied significantly for each risk factor. There were six of these risk factors appear to have the most impact $(OR \geq 2)$. From these six risk factors, three factors (blood pressure checked, treat back pain at home, insomnia) are about self-care at home, two factors (ongoing problem with back pain, bodily pain) are related to physical health, and the last factor says STF had an adverse effect on their CLBP. It was concluded that the risk factors that contributed most to the study of CLBP were: 1) the influence of ongoing back pain on daily activities $(OR = 8.91)$ 2) the blood pressure in the last two years $(OR = 3.32)$; 3) the knowledge of treating back pain at home $(OR = 2.71)$; 4) the chronic insomnia $(OR = 2.17)$; 5) the influence of

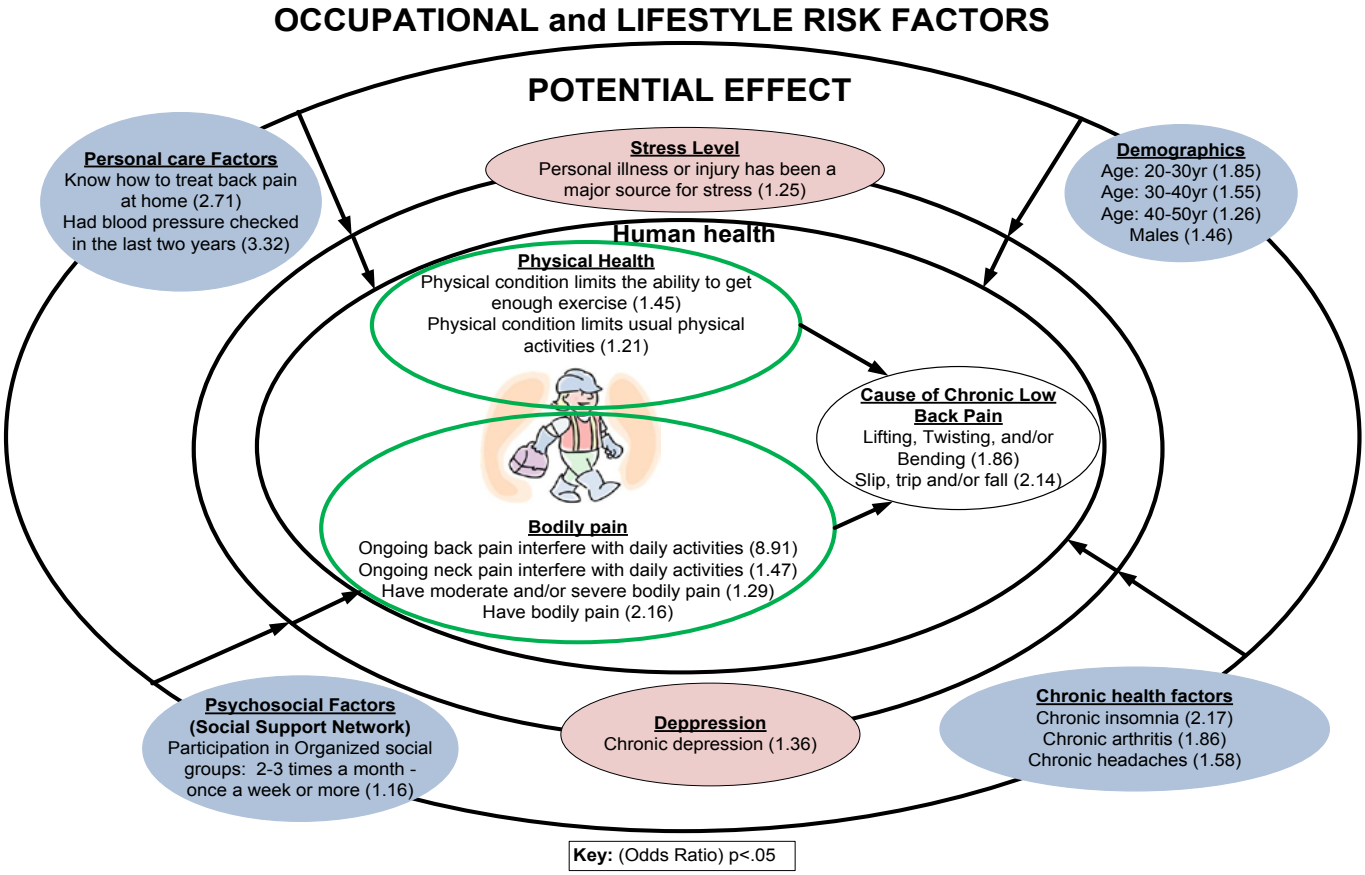

Figure 2: Predictive model (chronic low back pain in a Midwest university).

bodily pain on daily activities ($OR = 2.16$); and 6) the influence of STF for lower back injury ($OR = 2.14$).

Discussion

Applying the model proposed by Bidassie [46], we found that CLBP cannot be explained with a simple one-to-one relationship, but rather the relationship of occupational and lifestyle risk factors to the wellness and safety of the entire human system. Based on the possible relationships between occupational and lifestyle risk factors and the potential effects associated with CLBP as revealed in this study, people diagnosed by a doctor with CLBP were more likely to have low back pain in the past, may have had a previous low back injury caused from LTB and/or STF [71]. They tend to take steps at home to treat CLBP [72]; have chronic health conditions such as chronic insomnia, arthritis, high blood pressure, high cholesterol, or heart disease [73]; have much bodily pain and more than one ongoing problem (wrist pain, tingling or numbness, neck pain and eye strain) that interferes with their daily activity [74]; have more daily stressors such as personal illness or injury, family problems, financial problems [75]; experience more emotional problems [42] such as anxiety, depression or irritability [76]; have a physical condition that limits their ability to get enough exercise and complete physical activities [77].

The risk factors (Table 8) identified in this study proposed that employees with CLBP may potentially have reduced alertness and attention to safety & health which may be intensified by fatigue, stress, depression and anxiety. This is consistent with previous researches which have systematically examined the relationship between occupational and lifestyle risk factors and potential effects associated with CLBP [27,28,67]. However, many of the risk factor relationships shown by the OR in this study have not been widely reported as associated with CLBP in the literature, such as self-care at home [25]. Future studies may derive results that can corroborate the findings of this study.

The logistic regression model identified 20 risk factors, which are significantly associated with CLPB, had OR greater than 1. Within those risk factors, we targeted six risk factors which appeared to have the most significant impact ($OR \geq 2$) and divided them into three groups: self-care at home, bodily pain management, and management strategies to reduce STF. The three risk factors connected to self-care at home are routine checking of one's blood pressure ($OR = 3.32$), treating back pain at home ($OR = 2.71$), and insomnia ($OR = 2.17$). The participants who reported having their blood pressure checked in the past two years and who knew how to treat back pain at home are less likely to have CLBP. In contrast, the participants who reported having a diagnosis of insomnia were more likely to have CLBP.

Suggestions for management strategies may include encouraging employees to check their blood pressure regularly, training employees in the basic treatment of back pain at home, and providing education and interventions aimed at improving sleep quality and insomnia-related disorders. As blood pressure has a sensitive relationship with chronic pain [61,78] and physiological stress [79,80], home blood pressure monitoring is considered an effective of a way to prevent

Predictors Variables for CLBP	B	Exp(B)=OR	95%C.I. for Exp(B)		P<value
			Lower	Upper	
Constant	-6.890	0.00			0.000
Demographics					
Age group: 30-40yrs	0.616	1.85	1.607	2.093	0.000
Age group: 40-50yrs	0.438	1.55	1.354	1.746	0.000
Age group: 50-60yrs	0.231	1.26	1.099	1.421	0.005
Gender: Male	0.380	1.46	1.319	1.601	0.000
Doctor Diagnose Chronic health condition					
Insomnia	0.775	2.17	1.760	2.580	0.000
Arthritis	0.623	1.86	1.691	2.029	0.000
Migraine or severe headaches	0.458	1.58	1.384	1.776	0.000
Occupational and Lifestyle Risk Factors					
Completed a WC from 1999-2009 for lower back injury (STF)	0.763	2.14	1.705	2.575	0.001
Completed a WC from 1999-2009 for lower back injury (LTB)	0.623	1.86	1.552	2.168	0.000
Physical Health					
Have much bodily pain	0.770	2.16	1.948	2.372	0.000
Moderate to very severe bodily pain	0.256	1.29	1.112	1.468	0.005
Ongoing problem with back pain serious enough to interfere with daily activities	2.187	8.91	8.749	9.071	0.000
Ongoing problem with neck pain serious enough to interfere with daily activities	0.382	1.47	1.223	1.717	0.002
Self-care at Home					
Had blood pressure checked in the last 2 years	1.199	3.32	2.338	4.302	0.017
Know what steps to take at home to treat back pain	0.995	2.71	2.520	2.900	0.000
Stress, Depression, Social					
In the past year, personal illness or injury has been a major source of stress for you	0.220	1.25	1.076	1.424	0.014
Doctor: Chronic health condition depression	0.305	1.36	1.182	1.538	0.001
Participate in organized social groups: 1 per week to 2-3 per month or more	0.147	1.16	1.025	1.295	0.033
Physical Impairment					
Have a physical condition that limits ability to get enough exercise	0.370	1.45	1.256	1.644	0.000
Physical health problems limit usual physical activities	0.190	1.21	1.053	1.367	0.018

Table 8: Summary of logistic regression (predictive model).

cardiovascular disease and encourage patients to take a deeper involvement in their long term pain management [81]. To treat back pain at home, employees should be trained with information on using over-the-counter pain medicine and nonsteroidal anti-inflammatory drugs, releasing pain with heat or ice, and doing manual therapy and exercise for long-term care [82,83]. To alleviate symptoms of insomnia and sleep-related disorder, various treatments or programs designed to increase employees awareness of the factors associated with sleep problems may be utilized so that employees can take a long-term approach to the management of chronic insomnia. These may include interventions, such as sleep-restriction therapy, selected antidepressant medications, and psychological interventions such as mindfulness. Sleep restriction and selected antidepressant medications have been found to diminish the burden of chronic insomnia and prevent major depression [84,85]. Furthermore, several studies have recently provided evidence to support mindfulness-based treatment programs as being effective in treating clinical levels of insomnia [86–88] and alleviate sleep-related problems that often go along with other physical and psychological illnesses [89,90]. These findings may have significant implications on those that experience as CLBP and associated sleep disturbance.

Participants who reported having significant bodily pain ($OR = 2.16$) and ongoing problems with back pain serious enough to interfere with daily activities ($OR = 8.91$) are another group at high risk for CLBP. Thus, we propose pain management as a strategy to ease the adverse effect of CLBP. In March 2000, the Faculty of Occupational Medicine launched the Occupational Guideline for the Management of Low Back Pain at work, which provided a detailed understanding of how to manage back pain and bodily pain in different phases [16]. Most diagnosed pain can be managed by physical therapy (laser therapy, lumbar support thermotherapy, etc.) [28, 91, 92], exercise/physical activity therapy (aerobic exercise and yoga [31,93]), and manual therapy (massage) [94]) [95]. In order to help employees understand back pain, employees should be educated on the pre-symptoms of bodily pain. Thus, biomedical education and educational prevention programs are essential to prevent and manage future pain in workplace [41].

STF ($OR = 2.14$), or any significant accident, ae associated with CLBP which may result from a poor working environment and weak equipment [96]. In addition, employees over 50 years old are more likely to fall or slip from ladders, scaffolding and roofs [96]. Thus, the management strategy for STF should focus not only on applying human factor standards to develop a healthier working environments and equipment, but also protecting groups at a greater risk from activities likely to cause STF [97].

Since the HRA questionnaire [46] is pre-designed, some useful data for analysis were not available: such as disability, history of spinal surgery, and work posture [98]. If this study was replicated in an environment where the demographics (ethnicity, age, and work shift) were more diverse, it is hypothesized that while the occupational and lifestyle risk factors may vary, the similar risk factors will support the preventative and management strategies proposed in this study would be applicable.

Conclusion

This study addressed the relationship of occupational and lifestyle

risk factors related to CLBP in the workplace and suggested CLBP management strategies. Our study confirms the findings that past occupational low back injury increase the odds for future CLBP and disability [99]. It is important to address management of risk factors that can have an impact on lifestyle or psychological factors [100] into the treatments [101].

In addition to implementing fitness programs and facilities, cessation programs, and obesity programs in the workplace, employers should also offer lifestyle support to train staff with strategies for self-care at home [102], pain management [103,104], and how to minimize the risk of STF [105] with its association with CLBP. Physical therapies, such as lumbar support, exercise, massage, and yoga used in the treatments of CLBP have been seen to be effective, however, this study demonstrates the importance of applying the knowledge of stress and pain management from both physical and psychological perspectives. Previous research has demonstrated correlations between sleep disturbance and increased levels of stress and chronic pain, thus supporting the argument for the need for evaluation of stress-reducing interventions as one way of improving impairment [106]. As a result of the association between stress and CLBP identified in this study, we recommend that employers consider providing on-site psychologists to help employees address stress that comes from occupational and lifestyle factors. The use of mind-body interventions for the purpose of preventing low back injury is an area of active research.

Findings in this study neither permit causative conclusions, nor do they provide any evidence that modifying risk factors effectively prevents CLBP. However, the findings can be used to improve workplace ergonomics and well-being programs and promote the focus on the occupational and lifestyle risk factors associated with CLBP. In order to get a comprehensive understanding of the controllable risk factors associated with CLBP, we recommend future studies on preventative strategies and pain management strategies with a focus on addressing the occupational and lifestyle risk factors associated with physical pain, self-care at home, and STF.

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