Work and Family Support Systems and the Prevalence of Lower Back Problems in a South African Steel Industry

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Abstract
Introduction Back complaints are a common in society.
Methods An analytical cross-sectional epidemiological study was carried out among 366 steel plant workers to examine the prevalence and association between lower back problems (LBP) and family and workplace related psychosocial risk factors.
Results Using inclusive and stringent definitions for LBP, point prevalence was 35.8% and 15.3%, respectively. Logistic regression analyses indicated significant adjusted odd ratios (OR) for negative perceptions of workplace support (2.32; CI 1.09–4.92), unexpected events (2.58; CI 1.19–5.59) and working under time pressures and deadlines (2.83; CI 1.24–6.48). A significant protective association was found for control over the order and pace of working tasks (OR 0.30; CI 0.14–0.63). A significant univariate association was further found between LBP and negative perceptions of family (1.97; CI 1.06–3.68) support.
Conclusion These findings suggest that workers who feel more in control on the job and who have good family and workplace support systems in tact are less likely to experience LBP. Supervisors are therefore encouraged to develop appropriate support and organizational systems which may be an inexpensive, but potentially beneficial, means of reducing worker stress and LBP.

Keywords Epidemiology - Back pain - Steel workers - Perceived risks - South Africa

Introduction

Many studies attest to the high frequency of back complaints in society [1–4]. About 70–80% of all people have back pain during their lifetime. The annual prevalence of back pain ranges from 15% to 45%, with point prevalence's averaging 30%. In the USA, back pain is the most common cause of activity limitation in people younger than 45 years, the second most frequent reason for visits to the physician, the fifth-ranking cause of admission to hospital, and the third most common reason for surgical procedures [1, 2, 5]. Similar findings around the world indicate a relevant and universal problem. In the UK, lost productivity and resulting economic costs due to lower back problems (LBP) was estimated to be in the region of £12 billion in 1998. Indirect costs, due to lost productivity and informal care costs, by far comprise the largest proportion of these costs [6, 7]. It is calculated that 30,000 South Africans suffer daily from back and neck problems and 10% of them will become chronic cases [8]. Compensation costs for LBP in South Africa resulted in the equivalent of approximately 20 million US $ in 2000 [9].

Individual, psychosocial and lifestyle factors, together with work-place exposures have been implicated in the onset of LBP symptoms [7, 10]. Both work- and nonwork-related psychosocial factors, have been associated with back disorders [11–15]. From the early 1990s, work-related psychosocial factors have increasingly been considered as risk factors for LBP [4, 16–19]. It has been suggested that various organizational and social factors in the workplace may be related to increased stress and subsequent adverse health outcomes. Those with little control over their work, high demands from the work place and little social support from colleagues or supervisors are also believed to be at an increased risk of developing poor health outcomes like LBP [7]. According to a review of epidemiological evidence for work-related musculoskeletal disorders edited by Bernard [20] for the US National Institute for Occupational Safety and Health, these conditions fall within three separate domains, namely: (1) factors associated with the job and work environment, (2) factors outside the work environment, and (3) characteristics of the individual worker. Work satisfaction and the measure of family support are psychosocial factors often mentioned in literature, [21–24] and commonly measured by the family and work APGAR (Adaptation, Partnership, Growth, Affection, and Resolve) questionnaires. The original work APGAR was based on the hypothesis that the components of interpersonal relationships at the workplace are similar to those of the family [25]. In the landmark study of the Boeing aircraft plant, Bigos et al. [16, 26] found low work satisfaction (measured by the modified work APGAR to be associated with the reporting of back injury in 3,020 aircraft employees. Family support (measured by the family APGAR) did however not significantly predict the recording of back pain. Hoogendoorn et al. [12] in their systematic review of studies of rigorous design on psychosocial factors at work and private life as risk factors for LBP, reported similar findings and concluded that strong evidence was found for an association of poor social support in the workplace and low job satisfaction with back pain. They however found that there is insufficient evidence of an effect of psychosocial factors in private life.

A point of concern is that although literature on the epidemiology of LBP is accumulating, for the most part studies are restricted to high-income countries, which comprise less than 15% of the world's population. Little is known about the epidemiology of LBP in the rest of the world [27]. Research is thus imminent to understand the complex association between LBP and psychosocial factors within the industrial workplace. The unexplored African industrial setting lends itself to possible authentic research in this regard, especially in the labor-intensive sector.

The purpose of this study is to report on the prevalence of LBP among workers in a South African steel industry, and to determine the association between LBP and family and workplace related psychosocial risk factors. This study forms part of a bigger research project to assist the South African industry in more successful management of LBP, by better understanding the complex associations between occupational exposures, personal and psychosocial factors and work-related LBP.

Methods

Subjects and Design

The design entailed an analytical cross-sectional epidemiological study among a group of 366 steel plant workers, performing various related tasks (Tables 1 and 2). These workers were all randomly selected from the only stainless steel plant in South Africa and represent all employment areas inside the plant (Table 2). The study sample represented 40% of the total operational workforce, and the response rate was 100% since all workers in this plant has at least a secondary educational certificate.

Table 1 Characteristics of the study population (*n* = 366)

Characteristics	*M* (±SD)
Age (year)	31.76 (7.80)
Work exposure (year)	6.73 (5.47)

Table 2 Employment areas of subjects

Plant area	Number of workers: *n* (%)
Raw materials and steel melting plant	55 (15)
Hot mills	81 (22)
Cold mills	33 (9)
Plate processing	36 (10)
Finishing lines	59 (16)
Maintenance	41 (11)
Various	61 (17)
Total	366 (100)

Measures and Instruments

Case Definition

The functional rating index (FRI) comprising 10 items developed and validated by Feise and Menke [28] to assess the extent to which LBP affects daily activities, was applied to determine stringent case definition. The FRI index score was achieved by simply summing up the equality weighted scores of 10 items relating to pain intensity, sleep, personal care, travel (driving etc.), work, recreation, frequency of pain, lifting, walking and standing, dividing by the total number of possible points, and multiplying by 100%; the higher the number, the higher the perceived dysfunction and pain. The FRI score was calculated as follows: (total score/40) × 100%. The FRI is known for its reliability, validity, and responsiveness and recently found preferable to the well-known 18-item Roland-Morris Disability Questionnaire for use in clinical trials and practice [29]. A FRI of ≥30% perceived disability was used in the analyses as a stringent definition for LBP, and the mere presence of back pain at the time, was used as an inclusive definition to record cases of LBP.

Work and Family Support

Information on potential psychosocial risk factors for LBP was assessed using the APGAR's (Adaptation, Partnership, Growth, Affection, and Resolve) questionnaires [16, 30, 31]. A modified Work APGAR (WAPGAR), which evolved from the family APGAR, and was refined by Bigos et al. [16] for the benchmark Boeing study, was used to examine the perceptions of support at the workplace. A measure of the family support system was obtained by the use of the Family APGAR (FAPGAR), which comprises a brief, five-item, family function questionnaire.

The standard scoring for the FAPGAR interprets high scores [7–10] as indicating high functionality and low scores (0–3) indicating severe dysfunctionality. We, however, for statistical modeling purposes amended the scoring inversely such that a score of 0–3 and 7–10 indicated high functionality and severe dysfunctionality, respectively. A score of ≥4 (moderate to severe dysfunctionality) was thus utilized as the criteria to classify exposure (confirm the risk factor). The modified WAPGAR was scored in the same manner, and used a score of 7 and higher as the classification of low social support and job satisfaction in the workplace.

Work Organization

Information on work organization was attained from part of the new Occupational Risk Factor Questionnaire (ORFQ), developed by Halpern et al. [32]. This new comprehensive questionnaire is easy to administer in a clinical setting, user-friendly, reliable and valid. The instrument obtained self-reported information on various job stressors associated with LBP, and collected information on a variety of categories of risk factors that may be associated with LBP. The questionnaire consists of 26 items. The first five questions on work organization (yes/no) scales, were used for this publication (Appendix 1). Using categorical (yes/no) scales, a yes answer was associated with risk in questions 2, 4 and 5 of the ORFQ. Questions 1 and 3 differed, however, and a no answer was associated with risk. For statistical purposes all questions were processed in the same manner, with positive odds being associated with risk in questions 2, 4 and 5; and negative odds being associated with risk in questions 1 and 3.

Procedures

The study was conducted in accordance with the declaration of Helsinki. The local Ethics committee approved the informed consent of all parties and the experimental design and procedures. To ensure reliability and representation, anonymity was assured and the questionnaires were administrated during guided explanatory sessions of 5–10 workers per session. The FRI is known for its reliability, validity, and responsiveness [28]. This was confirmed in the South African industrial population, with high internal consistency (Cronbach alpha values) being recorded (CA 0.91) in a pilot study. Good internal consistency was recorded for the ORFQ, WAPGAR and FAPGAR with Cronbach alpha values of 0.89, 0.78 and 0.84, respectively. Similarly high test–retest reliability (Frequency of differences <20%) for the FRI, ORFQ and two APGAR's was recorded in the pilot study.

Statistical Analyses

For the assessment of risk factors, crude odd ratios (OR) derived directly from 2 × 2 tabulations, while adjusted ORs followed from logistic regression analyses. To control for potential confounding factors, personal variables such as age, work exposure, sport and smoking were controlled for together with occupational exposure risk variables. The latter consisted of 20 variables from the constructs trunk posture (e.g. bending and or twisting), load features (e.g. bulk or grip), handling activities (e.g. pushing or pulling, carrying), body position (e.g. sitting, climbing), and environmental demands (e.g. vibration, slippery surfaces).

In the statistical analyses, testing was done at the 0.05 level of significance. The odds ratios described the magnitude of effect, while the confidence intervals described the precision of the estimate. Where appropriate, and where the data was of a ratio nature, standard descriptive statistics (means and standard deviations) were employed. Where appropriate, significant differences between sets of ratio data were evaluated using an independent *t*-test [33]. The statistical data analysis was performed using Stata Release 8, Stata Press, STATA CORPORATION, College Station, Texas, Copyright 1985–2003.

Results

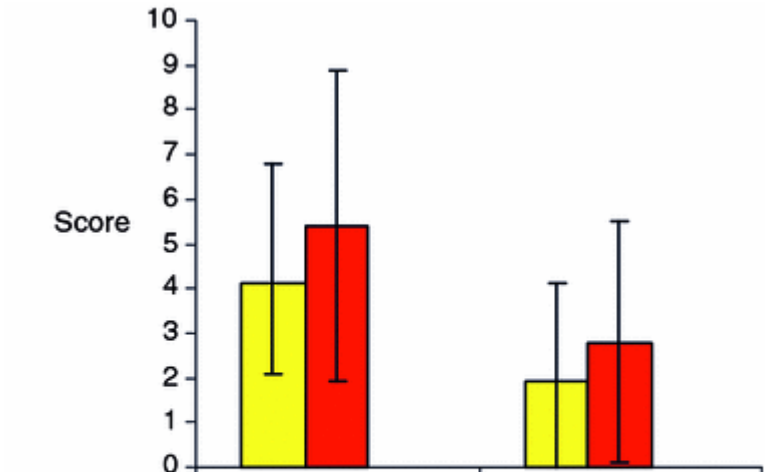
Analyses involving the family and workplace related psychosocial factors are based on the data obtained from 366 steel workers.

Prevalence

About 131 of the 366 (35.8%) workers had any form of LBP at the time of data capturing and 56 of the 366 (15.3%) workers had functional disability of at least 30% because of their LBP.

APGAR Scores

Mean APGAR scores were significantly higher ($P \leq 0.05$) in workers with the highest levels of disability, indicating that lower perceived ratings of family and workplace support systems are associated with higher levels of perceived disability (Fig. 1).



	WAPGAR	FAPGAR
FRI < 30%	4.1	1.9
FRI > 30 %	5.4	2.8
p - values	0.0154	0.0363

Fig. 1 Comparison of disability groups with respect to APGAR scores

Multivariate analyses, indicated significant ORs of 2.27 (CI 1.10–4.67) and 2.32 (CI 1.09–4.92) for negative perceptions of support at the workplace (Table 3).

For negative perceptions of the family support system, only univariate analyses indicated significant crude ORs of 1.81 (CI 1.02–3.24) and 1.97 (CI 1.06–3.68), with no significant associations found with multivariate analyses (Table 3).

Table 3 Summary of study findings

Variables	Univariate analyses crude ORs				Multivariate analyses adjusted ORs			
	Crude OR inclusive definition	CI 95%	Crude OR stringent (FRI) definition	CI 95%	OR inclusive definition	CI 95%	OR stringent (FRI) definition	CI 95%
Taking of unscheduled breaks[a]	0.85	0.58–1.43	0.68	0.38–1.23	0.71	0.37–1.40	0.69	0.31–1.43
Unexpected events	1.24	0.76–2.02	2.51	1.34–4.72*	1.0	0.54–1.86	2.58	1.19–5.59*
Control over order and pace of work[a]	0.42	0.24–0.74*	0.34	0.19–0.61*	0.37	0.18–0.73*	0.30	0.14–0.63*
Dependence on others	2.57	1.36–4.86*	2.46	1.00–6.01*	1.42	0.63–3.24	1.46	0.49–4.33
Time pressure and deadlines	3.42	1.71–6.83*	1.89	0.77–4.65	2.83	1.24–6.48*	1.25	0.43–3.59
Work APGAR	2.29	1.23–4.24*	2.22	1.19–4.13*	2.27	1.10–4.67*	2.32	1.09–4.92*
Family APGAR	1.81	1.02–3.24*	1.97	1.06–3.68*	1.53	0.76–3.11	1.89	0.89–4.01

*$p \leq 0.05$
[a] Odds less than 1.0 associated with risk

Work Organizational Data

According to univariate and multivariate analyses significant ORs of 2.51 (CI 1.34–4.72) and 2.58 (CI 1.19–5.59) were observed respectively, for the occurrence of unexpected events during a workday, among workers who had self-reported functional disability of at least 30% (Table 3).

In univariate analyses significant crude ORs of 2.57 (CI 1.36–4.86) and 2.46 (CI 1.00–6.01) were observed for worker dependence on others. No significant associations were however found in multivariate analyses (Table 3).

With univariate and multivariate analyses significant ORs for working under time pressures and deadlines were 3.42 (CI 1.71–6.83) and 2.83 (CI 1.24–6.48), respectively among workers who had the mere presence of back pain at the time (Table 3).

In multivariate analyses ORs for taking unscheduled breaks were 0.71 (CI 0.37–1.40) and 0.69 (CI 0.31–1.43), respectively which, although not significant, indicates the possible protective nature of taking unscheduled breaks (Table 3).

In multivariate analyses ORs for control over the order and pace of tasks were 0.37 (CI 0.18–0.73) and 0.30 (CI 0.14–0.63), indicating the significant ($P \leq 0.05$) protective nature of this variable (Table 3).

The results therefore indicated significant associations between LBP and perceptions of workplace and family support, in all the univariate analyses performed, with workplace support also significantly associated with multivariate logistic regression analyses. For the work organization factors analyzed by the ORFQ 1–5, significant associations in multivariate logistic regression analyses, were found in unexpected events and exposure to time pressure and deadlines. Control over the order and pace of tasks indicated a significant protective association towards LBP.

Discussion

This is one of the first published studies that the authors are aware of, examining family and workplace related psychosocial risk factors in the South African Industrial population. One of the strong points of this study where that both psychosocial and occupational characteristics were investigated in the same worker groups, and analyzed in logistic regressions to control for the confounding effects. These variables may covary, which raises the possibility of confounding if both types of risk factors are not accounted for in risk models [11]. This however was controlled for in this specific study.

Prevalence

Comparing prevalence and incidence rates of LBP with literature is subject to interpretation because of the various definitions of LBP. It is however interesting to note that while 35.8% of the workers indicated to have some form of LBP at the time of data capturing, only 15.3% of the workers seem to have more serious LBP, which in fact limit their daily activities. These findings are in accordance with point prevalence rates between 12% and 35% reported in literature [3, 34]. This again stresses the importance of considering the uniformity of definitions of outcome in evaluating LBP.

Workplace Support

Results indicated significant associations between LBP and perceptions of workplace support (WAPGAR), for these workers in all analyses performed (ORs 2.22–2.32). These findings are inconsistent with some international studies which after adjustment for possible confounders, did not find any associations between LBP and job dissatisfaction, [35, 36] but confirms the findings of others which found LBP to be associated with poor job satisfaction in multivariate logistic regression analyses [37, 38]. Bigos et al. [16] found a positive association between job dissatisfaction and workers at Boeing filing compensation claims for back injury. In their study, subjects who stated that they “hardly ever” enjoyed their job tasks were 2.5 times more likely to report a back injury than those who “almost always” enjoyed their job tasks. In our study, performing sub question multivariate analyses, indicated similar results with a high-adjusted OR of 3.02 (CI 1.90–4.79) for the question on enjoyment of job tasks. In their review Burdorf and Sorock [39] found odds ratios ranging from 1.39 to 2.40 for job satisfaction and odds ratios ranging from 1.30 to 2.08 for “mental job stress”. Hoogendoorn et al. [12] in their review found the magnitude of the risk estimates (RR/OR) ranged from 1.70 to 3.00 for job satisfaction and risk estimates ranged from 1.30 to 1.90 for social support in the workplace. These ranges of risk estimates are very similar to some of the risk estimates found in this study. In another South African study, work satisfaction increased, albeit not significantly, after an exercise intervention program in power station workers, suffering from self-identified chronic LBP (De Beer Unpublished).

Family Support

Significant associations between family support and LBP were found in univariate analyses, with crude odds ranging between 1.81 and 1.97. Although still positive, there were no

significant associations with multivariate analyses. Limited data are available on family perceptions and support, with a few studies investigating low social support and poor social relationships outside the working situation as possible contributing factors in development of LBP. Davis and Heaney [11] only found positive associations between poor social relationships and LBP in 20% of their studies reviewed. The majority of workers in our study worked in shifts, which puts additional demands on their family life. Long hours often takes up valuable family time, which all in turn may lead to less support from the workers family, which will add additional stress, which in turn may be associated with LBP. The important supporting role that the family plays in the total wellness of a worker must not be underestimated. Many workers however come from dysfunctional families, which may lead to increase stress. In the specific South African situation, cultural differences play a significant role in the perception of family values, which may also influence the responses on perceived family support, as measured by the APGAR.

Work Organization

Significant findings for work organizational factors indicated a trend where workers who perceived to be working under stressful situations, specifically referring to time pressure and unexpected events were more prone to LBP. The opposite was true for workers who perceived to be working under more controlled conditions, where they had control over the order and pace of their tasks. These findings are supported by earlier work of Hoekstra et al. [40] Sauter, [41] and more recent by Byrns et al. [42]. Control over ones job, have been inversely associated with back disorders [40]. Unexpected events can easily lead to a feeling of distress and losing control over ones task. The nature of factory work more often than not is characterized by routine and certainty. Unexpected events normally disturb this situation. Unexpected events however occur on an irregular basis, due to machine breakdown, which is also prevalent in this specific steel plant. Similar to unexpected events, time pressures often contribute to feelings of distress. In today's society, time pressures and deadlines are not uncommon, and are often the culprits, which heightens, stress levels. Productivity objectives and goals often oblige workers to meet certain criteria, and time-deadlines. This is common practice in today's competitive industrial world, and also experience in the factory under study. It may however, be the perceived pressure that plays the biggest role in the development of stress. Some workers for instance cope better with these deadlines than others. Dependence on others also indicated positive associations with LBP, which confirms the findings on control over the order and pace of task, which indicated the opposite. Workers who are normally more dependent on their co-workers, are also more likely to have less control over their own working tasks, and may also experience more unexpected events.

Byrns et al. [42] found that workers with high scores in perceived job control also tend to have high scores in social support from their supervisors. These findings suggest that workers, who perceive that their supervisors support them, feel more in control on the job. This means that encouraging supervisors to be supportive of workers may be an inexpensive but potentially beneficial means of reducing worker stress. Also taking into consideration the significant protective association between LBP and control over the order and pace of tasks indicated for the steel workers in this study, the phenomena of social support relationship to job control needs to be studied further. Williams et al. [43] found that satisfaction with one's job might protect against the development of chronic pain and disability after acute onset back pain and, alternatively, dissatisfaction may heighten risk of chronicity.

Until fairly recently, biomechanical demands and psychosocial work characteristics were rarely investigated as risk factors for LBP within the same study, as was recommended by Hoogendoorn et al. [12] and Davis and Heaney [11] in their respective reviews on psychosocial risk factors for LBP. As mentioned earlier, this was however one of the strong points of our study where both characteristics were investigated, and analyzed in logistic regressions to control for the confounding effects. The findings on family support and dependence on others among the steel workers were in accordance with findings seen in literature: Significant associations with univariate analyses, but after adjusting for positive confounders, become insignificant. This is due to the covariation between psychosocial and

biomechanical factors, where both may independently contribute to the etiology and progression of LBP [11].

Given the wide range of factors appearing to influence industrial LBP, research in this area remains a daunting task. Epidemiological studies are absolutely necessary in the understanding of industrial LBP. Another question that remains to be answered is whether the same mix or variety of risk factors influences LBP in different parts in the world? Can one compare the data of a steel factory in South Africa with a motor manufacturing company in the UK? Most probably not. Therefore the importance of regional and industrial specific studies cannot be overemphasized, and is critical in the quest for seeking for preventative measures to decrease LBP in industry. A limitation in this study is the cross-sectional character, which does not permit causal inferences regarding the associations found. The authors however decided to perform a cross-sectional study rather than a more elaborate design, where the possibility of poor follow-up data might be a real threat in this industrial setting. It is however recommended that prospective studies will follow in the South African industrial population so that the temporal relationship between exposure and outcome can be established. This study provides evidence that the factors associated with low back problems in the present study are similar to those observed in many countries throughout the world.

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Appendix 1

Work organizational questions from ORFQ

Can you usually take breaks in your job in addition to the scheduled breaks?	Yes	No
Do you often find that you cannot work because of unexpected events, such as machine break down or material not delivered?	Yes	No
Can you usually control the order and pace of your tasks?	Yes	No
Is the order and pace of your tasks usually dependent on others (machines, computers, customers etc.)?	Yes	No
Do you usually work under time pressure and deadlines?	Yes	No

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