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RESEARCH ARTICLE

PREVALENCE AND RISK FACTORS OF LOW BACK PAIN IN GARMENT INDUSTRY WORKERS OF NORTH INDIA

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ABSTRACT

Low back pain (LBP) is the commonest musculoskeletal disorder among industrial workers. The prevalence and risk factors of LBP in garment industry of North India have not been studied thus was the topic of interest. Data was collected from 1329 workers using pre tested questionnaire and clinical examination form. The subjects were divided in to 2 groups: workers with LBP (cases) and workers without LBP (control) based on presence or absence LBP at the time of examination. Multivariate logistic regression analysis was used to determine the risk factors. The point prevalence of LBP was found to be 34.91%. The 12 month prevalence and lifetime prevalence was 41.08% and 39.65% respectively. Workers with history of LBP in the past 12 months (OR= 16.41, 95% CI: 11.90-22.64, p=0.001), married workers (OR= 2.85, 95% CI: 1.83-4.44, p=0.001), those who perceived their work to be excessive (OR=1.42, 95% CI: 1.05-1.92, p=0.022) and those who did unsupervised yoga and gym workout were (OR= 1.37, 95% CI: 1.08-1.75, p=0.009) found to be risk factors for LBP. The prevalence of LBP in garment industry is comparable to that has been reported for industrial workers. There is difficulty in comparing results due to lack of similar studies in garment industry and needs further study.

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INTRODUCTION

Low back Pain (LBP) is a leading cause of activity limitation, work absenteeism and lost productivity throughout much of the industrialized world threatening function, mental health and quality of life (Rudy *et al*., 2007; Weiner and Nordin, 2010; Hoy *et al*., 2014) and inflicting substantial direct and indirect costs on health, social and economic systems (Woolf and Pfleger, 2003) The International Labour Organization (ILO) estimates that 40% of all costs related to work related injuries and diseases are due to musculoskeletal disorders (Rajgopal, 2003). Among these the LBP is the most common. Garment is one of the many labour intensive sectors that provide a gateway for developing countries to the global market. The readymade garment industry contributes to around 8% of India's exports, 7% of industrial output and is the largest employment generator after agriculture (Rao, Bangalore). There are around 70,000 apparel manufacturing units in the country providing employment to more than 3 million persons (Awashthi and Singh, 2003). Workers in garment manufacturing establishments are at considerably higher risk for developing problems such as physical and psychological ailments and repetitive strain injury owing to repetitive motions and fast work speeds (Brisson *et al*., 1992). Thus prevention of occupational LBP is a key research concern. The prevalence of LBP in the garment industry has been reported to range from as low as 8.75% to as high as 78.89% (Nag *et al*., 1992; Westgaard and Jansen, 1992; Zheng *et al*., 1994; Anannontsak and Puapan, 1996; Sarder *et al*., 2006; Parimalam *et al*., 2007; Nahar *et al*., 2010, Saha *et al* 2010; Bandhyopadhyay *et al*., 2012, Lombardo *et al*., 2012; Mehta, 2012; Padmini and Venmathi, 2012; Ahmed and Raihan, 2014; Najunda, 2014; Jahan *et al*., 2015). There are only few studies reporting LBP and other health related problems in garment industry in India. These studies have been conducted in the south western part of the country i.e. in Wardha (Tiwari *et al*., 2003), Tamilnadu (Sarder *et al*., 2006), Belgaum (Metgud *et al*., 2008) and Ahmedabad (Nag *et al*., 1992) and no study has been so far conducted in North India. The lack of documentation makes it difficult to identify and quantify the prevalence and risk factors of LBP among garment industry workers, thus is the need of the present study.

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MATERIALS AND METHODS

Study design: The study was a case control study on workers of the garment industries in Ludhiana district of Punjab (North

India). Workers who fulfilled the eligibility criteria were included in the study.

Eligibility criteria

The workers involved in cutting, stitching and finishing sections of garment industry, aged between 20 – 60 years, either male or female, having completed a period of 3 months in the job / occupation were included in the study. Workers involved in spinning, weaving and textile industry were not allowed to participate in the study.

Sample size determination

A study on 20 – 45 years old work age adults in North India reported the prevalence of LBP to be 23.09% (Sharma *et al*, 2003). In view of paucity of data regarding prevalence of LBP in the population under study, for the purpose of estimating the minimum sample size required for the study, the prevalence of 23.0% is presumed. Hence, the minimum sample size required, with 10% of allowable error and 95% of confidence limit, using the formula given by Snedecor and Cochran (1967):

$$n = 4pq/L^2$$

where n = the minimum sample size
p = the presumed prevalence of the condition under study (23%)
q = (100 – p)
L = Allowable error, i.e., 10% of 'p' (i.e., 2.3)

Comes out to be 1339. Thus a minimum of 1339 subjects were recruited for the study. A total of 1358 workers were interviewed and examined out of which 29 refused to participate thus yielding a sample size of 1329 workers. The subjects were divided in to 2 groups: workers with LBP and workers without LBP based on presence or absence LBP at the time of examination with LBP defined as the "pain limited to the region between the lower margins of the 12th rib and the gluteal folds".

Data Collection

Data was collected using a pre tested questionnaire (Bindra *et al*., 2013) and clinical examination form designed for the study.

Statistical Analysis

Data was analyzed using SPSS (Version 16). Administered questionnaires were checked, sorted and coded serially. The data was entered, cleansed and analyzed using SPSS (version 16). Descriptive statistics were employed for the individual and socio demographic variables, clinical presentation, physical and psychological risk factors, health care utilization pattern and impact of LBP. Categorical variables were tested using the Chi square statistics. Analysis for risk factors was done using univariate (crude) and multivariate logistic regression analysis.

RESULTS

Prevalence of LBP

The point prevalence of LBP was found to be 34.91%. The 12 month prevalence and lifetime prevalence was 41.08% and 39.65% respectively.

Results of Univariate (crude) Analysis

Demographic risk factors

Age, gender, marital status, migration, work experience and working hours a day were found to be the risk factors for LBP on univariate analysis (Table 1). The prevalence of LBP was found to increase with age. As compared to the workers in the age group of 20-30 years, the workers in the age group of 30-40 years had 2.17 times, those in age group of 40-50 years had 1.94 times and 50-60 years had 2.19 times higher risk of having LBP. Female workers were found to have 1.63 times higher risk of current LBP as compared to male. Married workers had 3.61 times higher risk of having LBP as compared to those unmarried or single. Migrant workers had 1.42 times less risk of having LBP when compared to the non migrant workers. Workers with experience of more than 20 years had 1.70 times higher risk of having LBP. Work for longer hours was found to be a protective factor as those who worked for more than 10 hours a day had 1.66 times (1/0.60) less risk of LBP. Having children was found to be a protective factor for LBP as workers with 1-2 children had 1.31 times and those having more than 2 children had 1.36 times less risk of LBP.

Previous history of LBP

Workers who had a history of LBP in the past 12 months had 15.72 times (OR=15.72, 95%CI 11.87-20.84, $p<0.001$) and workers who had a history of LBP in lifetime had 2.31 times (OR=2.31, 95%CI 1.83-2.91, $p<0.001$) higher risk of having current LBP.

Back and Abdominal muscle strength and flexibility

The back and abdominal muscle strength and flexibility on Kraus Weber test (Kansal, 1996) were not found to be risk factors of LBP on univariate analysis.

Lower limb muscle length

The tightness of the hamstring (Feldman *et al*, 2001; Magee, 2002) iliopsoas and rectus femoris muscles (Harvey, 1998) was not found to be a risk factor on univariate analysis.

Trunk Muscle Endurance

Trunk muscle endurance (Ito *et al*., 1996) was found to be associated with LBP. Workers with trunk flexor endurance of 100-200 secs had 2.56 times (OR=0.39, 95%CI 0.16-0.95, $p=0.003$) reduced risk of having LBP. However trunk extensor endurance was not found to be a risk factor for LBP.

Physical risk factors at work

Physical factors such as frequent bending, lifting objects up to 5 kg, sustained sitting and sustained standing were not found to be risk factors for LBP. Lifting objects up to 25 kg was found to be significantly associated with LBP. Workers who had to lift objects up to 25 kg were at 1.27 times (OR=1.27, 95%CI 1.01-1.61, $p=0.04$) higher risk of having LBP.

Psychosocial risk factors at work

Psychosocial risk factors such as too much work, hard work and time constraint at work were found to be significantly associated with LBP.

Table 1. Demographic Risk factors of LBP in the Garment Industry

Variables	Category	With LBP (N=464)	Without LBP (N=865)	Total (N=1329)	$\chi 2$ value	Odds Ratio (95% CI)	P
Age (years)	20-30	149	430	579	38.65***	Ref.	
	30-40	156	207	363		2.17 (1.64-2.87)	<0.001*
	40-50	111	165	276		1.94 (1.43-2.63)	<0.001*
	50-60	48	63	111		2.19 (1.44-3.34)	<0.001*
Gender	Male	320	678	998	14.31***	Ref.	
	Female	144	187	331		1.63 (1.26-2.10)	<0.001*
Marital status	Single	51	267	318	65.54***	Ref.	
	Married	413	598	1011		3.61 (2.61-5.00)	<0.001*
Level of Education	Illiterate	90	156	246	7.64**	Ref.	
	Less educated	155	355	510		0.75 (0.54-1.04)	0.08
	Educated	219	354	573		1.07 (0.78-1.46)	0.65
Migratory status	No	165	243	408		Ref.	
	Yes	299	622	921	7.91**	0.70 (0.55-0.90)	0.005*
Nature of Work	Cutting	48	90	138	1.81^{NS}	Ref.	
	Stitching	128	367	495		0.95 (0.63-1.41)	0.803
	Finishing	207	294	501		1.13 (0.76-1.68)	0.535
	Others	81	114	195		1.06 (0.67-1.67)	0.802
Work Experience (years)	0-10	332	666	995	7.48**	Ref	
	10-20	81	139	221		1.16 (0.86-1.58)	0.314
	More than 20	51	60	113		1.70 (1.14-2.53)	0.008*
Working hours/day	Less than 10	251	360	611	18.92***	Ref.	
	More than 10	213	505	718		0.60 (0.48-0.76)	<0.001*
Socioeconomic status	Upper	18	24	42	2.91^{NS}	Ref	
	Middle	203	415	618		0.65 (0.34-1.22)	0.186
	Lower	243	426	669		0.76 (0.40-1.43)	0.395
Number of Children	0	155	235	390	5.74*	Ref	
	1-2	154	308	462		0.75 (0.57-1.00)	0.053*
	More than 2	155	322	477		0.73 (0.55-0.96)	0.027*
BMI	Normal	266	550	816	9.17**	Ref	
	Underweight	62	128	190		1.14 (0.82-1.59)	0.404
	Overweight/Obese	136	187	323		0.95 (0.73-1.25)	0.765

P $\{\chi 2_{(1, 0.05)}\} \leq 3.84$* P $\{\chi 2_{(1, 0.01)}\} \leq 6.64$** **P** $\{\chi 2_{(1, 0.001)}\} \leq 10.83$*** NS: Non-significant

Table 2. Association of Psychosocial risk factors at work with LBP in both groups

Parameters of Mental stress	With LBP N=464	Without LBP N=865	Total N =1329	χ^2 value	Odds Ratio (95% CI)	P
Job Demand						
Excessive	256	554	810	9.99**	1.44 (1.15-1.82)	0.002*
Hard	266	562	818	7.51**	1.38 (1.09-1.73)	0.006*
Enjoy	381	729	1110	1.02^{NS}	0.85 (0.63-1.15)	0.311
Time Constraint	404	796	1200	8.45**	1.71 (1.18-2.47)	0.004*
Targets	260	466	726	0.569^{NS}	1.23 (0.98-1.54)	0.073
Dissatisfaction	220	389	609	0.726^{NS}	1.103 (0.88-1.38)	0.394
Job Perception						
Monotonous	461	862	1323	0.60^{NS}	0.53 (0.10-2.66)	0.445
Creative	143	295	438	1.47^{NS}	0.86 (0.67-1.09)	0.225
Learning	161	322	483	0.83^{NS}	0.89 (0.70-1.13)	0.361
Freedom	171	297	468	0.84^{NS}	1.11 (0.88-1.41)	0.360
Insecurity	36	66	102	0.007^{NS}	1.01 (0.66-1.55)	0.933
Peer Support						
Co worker	431	799	1230	0.118^{NS}	1.07 (0.57-1.07)	0.732
Supervisor	390	753	1143	2.25^{NS}	0.78 (0.57-1.07)	0.134
Lack opportunity						
Promotion	242	433	675	0.53^{NS}	1.08 (0.86-1.36)	0.466
Underemployed	260	457	717	1.25^{NS}	1.138 (0.90-1.42)	0.264

P $\{\chi 2_{(1, 0.05)}\} \leq 3.84$* P $\{\chi 2_{(1, 0.01)}\} \leq 6.64$** **P** $\{\chi 2_{(1, 0.001)}\} \leq 10.83$***, Ref category: no

Table 3. Association of Parameters of General Health with LBP in both groups

General Health Parameters	Category	With LBP (N =464)	Without LBP (N=865)	Total	χ^2 value	Odds Ratio (95% CI)	P
Perceived Health status	Poor	117	156	273	9.54**	Ref	0.002*
	Good	347	709	1056		0.65 (0.49-0.85)	
Regular exercise	No	380	757	1137	7.71**	Ref	
	Yes	84	108	192		1.55 (1.14-2.11)	0.006*
Type of exercise	None	380	757	1137	8.14**	Ref	
	Non specific	32	46	78		1.38 (0.86-2.21)	0.172
	Specific	52	62	114		1.67 (1.13-2.46)	0.010*
Smoking	Never	408	772	1180	0.527^{NS}	Ref	
	Ever	56	93	149		1.13 (0.80-1.62)	0.468
Tobacco chewing	Never	359	652	1011	0.660^{NS}	Ref	
	Ever	105	213	318		0.89 (0.68-1.16)	0.417
Alcohol Consumption	Never	345	654	999	0.254^{NS}	Ref	
	Ever	115	211	330		1.06 (0.82-1.38)	0.614

P $\{\chi 2_{(1, 0.05)}\} \leq 3.84$* P $\{\chi 2_{(1, 0.01)}\} \leq 6.64$** **P** $\{\chi 2_{(1, 0.001)}\} \leq 10.83$***

Table 4. Multivariate Analyses for risk factors of LBP in Garment Industry Workers of North India

Variables	B	S.E.	Wald	df	Sig.	Exp (B)	95% CI for Exp (B)	
							Lower	Upper
Age	0.01	0.10	0.01	1	0.91	1.01	0.83	1.22
Gender	0.19	0.18	1.06	1	0.30	1.21	0.84	1.74
Migrant	-0.07	0.16	0.20	1	0.65	0.92	0.67	1.28
Marital status	1.04	0.22	21.72	1	0.000*	2.85	1.83	4.44
Number of children	-0.07	0.06	1.48	1	0.22	0.92	0.82	1.40
Years in job	0.19	0.13	1.93	1	0.16	1.21	0.92	1.58
Hours/day	-0.14	0.15	0.81	1	0.36	0.86	0.63	1.18
12 month prevalence	2.79	0.16	290.68	1	0.000*	16.41	11.90	22.64
Lifetime prevalence	-0.30	0.16	3.35	1	0.06	0.73	0.53	1.02
Lifting objects up to 25 kg	0.14	0.15	0.88	1	0.34	1.15	0.85	1.57
Time constraint	0.27	0.24	1.28	1	0.25	1.32	0.81	2.13
Perceived Income Adequacy	-0.03	0.09	0.13	1	0.71	0.96	0.79	1.16
General health status	-0.14	0.17	0.68	1	0.40	0.86	0.60	1.22
Flexor endurance	0.30	0.19	2.48	1	0.11	1.36	0.92	1.99
What exercise	0.32	0.12	6.80	1	0.009*	1.37	1.08	1.75
Excessive	0.35	0.15	5.25	1	0.022*	1.42	1.05	1.92
Constant	-2.81	0.34	68.20	1	0.000	0.06		

2LL = 1186.85, Chi Square =532.63, df =16, P= 0.001
Pseudo R-Square Cox and Snell= 0.330, Nagelkereke = 0.455
% Correct = 65.1%, Overall percent = 79.7%

Workers who were asked to do too much (excessive) work had 1.44 times, workers who had to work very hard had 1.38 times and workers who did not get enough time to get their work done had 1.71 times higher risk of having LBP on univariate analysis (Table 2).

Perceived Income Adequacy

Perceived Income Adequacy was found to be significantly associated with LBP. Workers who perceived their income to be slightly inadequate had 1.29 times (OR=1.29, 95% CI 0.99-1.68, p=0.054) and those who perceived their income to be inadequate had 1.43 times (OR=1.43, 95%CI 1.05-1.96, p = 0.0230 higher risk of having LBP.

General Health Parameters

Perceived general health status and habit of regular exercise were found to be significantly associated with LBP (Table 3). Workers who perceived their general health status to be good had 1.53 times (1/0.65) less risk of LBP. Workers with the habit of regular exercise (those exercising at least 4-6 times a week) had 1.55 times higher risk of having LBP. Workers doing specific exercises in form of yoga or gym workout had 1.67 times higher risk of having LBP. Addiction of any kind (smoking, tobacco, alcohol) was not found to be associated with LBP in garment industry workers.

RESULTS OF MULTIVARIATE ANALYSIS

Eighteen independent variables were found to be significant risk factors for LBP on univariate analysis. Factors demonstrating very highly significant inter variable correlation (r= 0.80) were excluded on linear regression analysis. The multivariate logistic regression model was statistically significant at p< 0.001. The model explained 33% to 45.5% of the variance and correctly classified 65.1% of the cases (Table 4). Workers with history of LBP in the past 12 months were 16 times more likely to experience current LBP. Married workers were 3 times, those who perceived their work to be excessive were 1.42 times and those who did specific exercises were 1.37 times more likely to report LBP.

DISCUSSION

This study describes the prevalence and risk factors for self reported LBP among garment industry workers of North India.

The point prevalence of LBP was found to be 34.91%. The 12 month prevalence and lifetime prevalence was 41.08% and 39.65% respectively. Studies on workers of Indian garment industry are few and have reported LBP prevalence of 18%-68% (Nag *et al*., 1992; Parimalam *et al*., 2007; Saha *et al*., 2010; Padmini and Venmathi 2012; Bandyopadhyay *et al*., 2012; Mehta, 2012; Najunda, 2014). These studies have either reported musculoskeletal problems and health status of workers in the garment industry (Parimalam *et al*., 2007; Saha *et al*., 2010; Bandyopadhyay *et al*., 2012; Mehta (2012) or have focused on ergonomic evaluation and work stresses in the garment industry (Nag *et al*., 1992; Parimalam *et al*., 2006; Padmini and Venmathi 2012; Najunda (2014).

The prevalence of LBP in this study in particular is comparable to the prevalence of 34% in cutting and finishing section of small scale garment industry of Tamil Nadu (Parimalam *et al*., 2007), 41.03% (Saha *et al*., 2010) and 31.1% (Bandyopadhyay *et al*, 2012) in workers of small scale garment industry in Kolkata. The prevalence of LBP reported in this study is higher than that reported in garment industry workers of Bangalore (Najunda, 2014) and Jaipur Mehta (2012) and lower than that reported in garment industries of Tirupur (Padmini and Venmathi 2012) and Tamil Nadu (Parimalam *et al*, 2007). The differences in prevalence of LBP among garment industries may be ascribed to the methodological variations in terms of lack of uniformity in defining LBP, differences in sample size, population under study and age or gender differences. Despite of the methodological variations, many environmental and personal factors might have influenced the onset and course of LBP. The risk factors of LBP in garment industry is only sparsely documented, rather risk factors associated with musculoskeletal complaints have been documented. Aging is a well known immutable risk factor of LBP as degenerative changes in the spine and the disc are one of the major causes of LBP (Lawrence *et al*., 2003). Nearly 50% of the workers in the garment industry were found to be young (age group of 20-30 years). Increase in age almost doubled the risk of having LBP on crude analysis with higher prevalence in age group of 30-40 and 50-60 years. The findings of the study are in agreement to previous studies in the garment industry that reported that majority of the workers in the garment industry are relatively young (Sarder *et al*., 2006; Saha *et al*., 2010; De Silva *et al*.,

2013; Najunda, 2014; Jahan *et al*., 2015). In a study on garment industry Sri Lanka, workers in the age category of 35 years had 3.5 times greater odds of musculoskeletal problems as those of 20-24 year old (Lombardo *et al*., 2012). Some authors have reported that the risk of developing LBP increases with advancing age (Tiwari *et al*., 2003; Bejia *et al*., 2005; Fabunmi *et al*, 2005; Parimalam *et al*., 2007) however other studies have reported no such associations (Westgaard and Jansen, 1992; Nagasu *et al*., 2007).

Male workers comprised 2/3rds of the sample in the study but females were found to have 1.63 times higher risk of LBP. The greater number of male subjects in this study are comparable to that observed in other garment industries of India (Saha *et al*., 2010; Bandyopadhyay *et al*., 2012) but is contrary to the pattern observed in garment industries of Bangladesh (Jahan *et al*., 2015) and Sri Lanka (Lombardo *et al*., 2012) where female workers contribute to the major work force in the garment industry. Studies in garment industries of Bangladesh (Jahan *et al*., 2015) and China (Zheng *et al*., 1994) have reported higher prevalence of LBP in male workers whereas another study in Indian garment industry has reported a high prevalence of LBP in females (Saha *et al*., 2010). The higher prevalence of LBP in females has been corroborated by another group of researchers (Lau *et al*., 1995; Unruh, 1996; Stam *et al*., 2004; Nagasu *et al*., 2007) the reason proffered was that female gender presents some anatomic functional characteristics (smaller stature, smaller muscle and bone masses, frail joints and less adapted to strenuous physical efforts as well as having a higher proportion of fat) (Silva *et al*., 2004; Capaldo, 2005; Siqueira *et al*., 2005) and others related to the nervous system which can collaborate to the emergence and increase of pain intensity (Sarlani and Greenspan, 2002; Quinton and Greenspan, 2007). Some studies have found higher prevalence of LBP in men than women (Fabunmi *et al*., 2005; Punnett, 2005; Sidhu *et al*., 2012; Kumar *et al*., 2013). The reason proffered was that men usually engage in occupations associated with heavy physical workload and whole body vibration compared with women (Punnett, 2005). On the other hand, no association between gender and musculoskeletal disorders was found by Bodhare *et al*., 2011 in construction workers in Karimnagar, Andhra Pradesh. Thus the opinions as to whether gender is a risk factor for LBP are varied and warrant further study.

Two thirds of the workers in the study were migrant. Being migrant posed to be a protective factor (migrant workers had 1.42 (1/0.70) times less risk) for current LBP. Behisi *et al*, 2013 and Khaled *et al*, 2013 identified nationality as risk factors for back pain, and a particularly high risk was seen among non migrant workers. Nationality may be important because of cultural difference between groups, but also because of differences in benefits available. More than 2/3rds of the workers in the study were married and found to have 3.61 times higher risk of having LBP. On multivariate analysis, marital status emerged out to be a significant risk factor for LBP. This finding is in agreement to that of the study on garment workers in Bangladesh (Jahan *et al*., 2015) in which marital status (p=0.017) was found to be a significant risk factor for LBP. The reason for the increased risk of LBP in married individuals is not clear (Kiecolt-Glaser and Newton, 2001). Married individuals generally demonstrate improved overall health compared with other marital groups and typically are considered to have more psychosocial and economic support, which should have a protective effect (Kiecolt-Glaser and Newton, 2001; Hughes and Waite, 2009; Dupre *et al*., 2009) but the higher prevalence of LBP in married individuals may be linked to physiological mechanisms after marriage or psychosocial aspect of LBP. Almost equal proportion (35%) of the married workers in the garment industry had 1-2 or more than 2 children. Having more than one child was found to be a protective factor for LBP on crude analysis which is contrary to the findings of Silman *et al* in 2015 who reported that there was a linear trend of increasing risk with increasing number of children in married individuals of both sexes and concluded that LBP is related more to child rearing than to child bearing. Our results for number of children as a risk factor on crude analysis are unusual and opposite to the common belief and are not comparable due to lack of related studies on the topic thus needs further study.

Two thirds of the workers of the garment industry had a work experience of less than 10 years which is similar to some other reports of garment industry (Sarder *et al*., 2006; Mehta, 2012; De Silva *et al*., 2013). Workers with an experience of more than 20 years had almost twice (OR=1.70) the risk of LBP with reference to the workers who had 0-10 years of experience. The increase in the risk of LBP with years of experience in garment industry has been corroborated by another group of researchers (Parimalam *et al*., 2007; Saha *et al*., 2010; Bandyopadhyay *et al*., 2012). The relation between years working in the same sector and the prevalence of low back pain is justified as a function of daily body requirements to perform professional activities. Such requests probably bring cumulative injuries to locomotor system mechanics and contribute to the appearance of pain complaints (Cecin *et al*., 1991). Nearly half (54.02%) of the workers in the garment industry worked for more than 10 hours a day. Working for more than 10 hours a day seemed to be a protective factor for LBP on crude analysis which is opposite to the common belief, but lost its significance on multivariate analysis. This finding is contrary to the popular belief that long working hours resulted in a number of illnesses and musculoskeletal pain (Begum *et al*, 2010; Saha *et al*., 2010; Bandyopadhyay *et al*, 2012). Such results may have occurred due to certain factors such as extra wages for lengthy working hours and it may be that workers who were not previously afflicted with LBP opted for working for more than 10 hours a day but needs further study. The recurrence rate of LBP is so high that it seems to be a part of its natural history (Andersson, 1999). On multivariate analysis, history of LBP in the past 12 months emerged as the most significant risk factor for LBP. Workers with history of LBP in the past 12 months were 16 times more likely to experience current LBP. The findings of our study are in agreement to some previous studies on LBP (Tomita *et al*, 2010; Ogunbode *et al*., 2013) and reveal that though LBP has a self limiting course, the initial complaint may resolve but the person remains exposed to further chances of LBP.

Jobs involving lifting or moving weights of 25 kg or more have been found to have strongest occupational associations with LBP particularly when the LBP was unremitting. The explanation proffered was that the subjects whose jobs entailed heavy lifting had a lower threshold for reporting symptoms, because the symptoms interfered more with their work (Walsch *et al*., 1989). On crude analysis the workers who had to lift objects up to 25 kg were at 1.27 (OR=1.27) times higher risk of having LBP but lost its significance on multivariate analysis. Work activities like lifting, pulling and pushing,

bending and sitting were highly associated with low back pain in employees in a clothes factory in Bangkok (Anannontsak and Puapan 1996). Lifting heavy loads has been found to be a risk factor for LBP in Chinese (Yun *et al*., 2012) and Nepalese workers (Paudyal *et al*., 2013). The perception of intensified workload, monotonous and repetitive work, limited job control and clarity and low social support might be associated with occurrence of musculoskeletal disorders (Putz-Anderson *et al*., 1997). At the same time, the person's ability to recover may be determined by things such as motivation, ambitions, social support, attitude at work and family dynamics (Yilmaz and Dedeli, 2012). Workers who were asked to do too much work had 1.44 times, those had to work very hard had 1.38 times those who did not get enough time to get their work done had 1.71 times higher risk of having LBP on crude analysis. On multivariate analysis, the workers who perceived their work to be excessive were at 1.42 times higher risk of having LBP. The results regarding the role of psychosocial factors on LBP are not consistent across studies. None of the studies in garment industry have reported the statistical association between psychosocial factors at work and LBP. For LBP, it has been hypothesized that exposure to sub optimal psychosocial factors may lead to altered spinal loading due to increased muscle tension. This then probably affects the nutrition of intervertebral discs, nerve roots and other spinal tissues (Bongers *et al*., 1993; Bergenudd and Johnell, 1991). Further raised plasma cortisol levels following high psychosocial demands may leave muscles vulnerable to mechanical loads (Theorell *et al*., 1993). The consequences and prognosis of LBP could also be influenced by psychosocial factors. For example, pain that under optimal circumstances would be tolerated by the workers may in a stressful psychosocial environment lead to injury reporting due to decreased pain tolerance (Burton, 1997).

The monthly income may indicate improved access to health care resources among higher earners. Close to 40% of the workers in the garment industry perceived their income to be inadequate. On crude analyses, the workers who perceived their income to be slightly inadequate had 1.29 times (OR=1.29) and those who perceived their income to be inadequate had 1.43 times (OR=1.43) higher risk of having LBP. However lost its significance on multivariate analysis. Work stress and depression were found to be intensified by factors such as poor pay in garment industry workers of Fiji (Chand, 2006). Less salary/ low or irregular wages have been found to be the reasons of job dissatisfaction among garment industry workers (Begum *et al*., 2010; Najunda, 2014) but these studies were descriptive in nature, hence no statistical association has been reported. On the basis of anatomic position and function of the abdominal muscles, it has been speculated that abdominal muscle weakness produces an anterior pelvic tilt and lumbar hyperlordosis resulting in LBP (Nourbakhsh *et al*., 2002; McNeill *et al*., 1980; Nachemson and Lindh, 1969). In contrast to these findings, some investigators have found that there is no association between angle of pelvic inclination, size of lumbar lordosis and abdominal muscle strength (Walker *et al*., 1987; Youdas *et al*., 1996) and few other studies have shown no differences in abdominal strength in asymptomatic individuals and those with LBP (Shirado *et al*., 1995; Thorstensson and Arvidson, 1982). Majority of the workers of garment industry had weakness of upper and middle abdominal and lower back muscles but back extensor, abdominal muscle strength and flexibility were not found to be significant risk factors for LBP. The association of back and abdominal strength and flexibility has not been studied in garment industries, thus necessitates further studies.

It is thought that decreased back muscle endurance causes muscular fatigue and overloads soft tissue and passive structures of the lumbar spine resulting in LBP (Marras *et al*., 1987; Wilder *et al*., 1996). At the same time some authors have reported that good isometric extensor strength does not seem to protect from future LBP or back injury (Kujala *et al*., 1996; Mooney *et al*., 1996). Workers with trunk flexor endurance of 100-200 secs had 2.56 times (1/0.39) reduced risk of having current LBP. However trunk muscle endurance was not associated with LBP on multivariate analysis. One reason for lack of association of trunk endurance with LBP in this study could be that static tests for measuring trunk performance were used but the usual daily movements are dynamic (Parnianpour *et al*., 1988). Hamstring tightness is one of the most common findings in patients with LBP. It is thought that due to attachments of hamstrings to the ischial tubersoity, hamstring tightness generates posterior pelvic tilt and decreases lordosis which can result in LBP (Nourbaksh and Arab, 2002). Hellsing, 1988 on the other hand reported no association between hamstring tightness and LBP. Some studies have shown decreased iliopsoas muscle length (Ashmen *et al*., 1996; Mellin, 1988) in patients with LBP. As iliopsoas attaches to the pelvis and lumbar spine, some have assumed that the tightness of this muscle causes increased lumbar lordosis and weakness of this muscle causes decreased lumbar lordosis which in turn can lead to LBP (Calliet, 1981; Kisner and Colby, 1990). Recent studies have found no association between length of the iliopsoas muscle and size of lumbar curve and LBP (Gautier *et al*., 1999; Youdas *et al*., 1996). Muscle length was not found to be a risk factor for LBP on crude analysis. The findings can be explained in the light of fact that almost similar number of workers with and without LBP had lower limb muscle tightness.

Studies have shown that the worst is people health perception, the higher is the occurrence of morbidities (Siqueira *et al*., 2008). Nearly 80% of the workers in the garment industry perceived their general health status to be good. Workers who perceived their general health status to be good had 1.53 times (1/0.65) less risk of LBP. In a study on sea food factory workers, Tomita *et al*., 2010 reported that the workers who did not consider them to be healthy were three times more likely to have LBP. Physical exercise has consistent evidence for primary prevention of low back pain compared to no activity (Heneweer *et al*., 2011). 14.44% of the garment industry workers had a habit of exercising daily out of which majority opted for yoga and gym workout. Workers with the habit of regular exercise had 1.55 times higher risk of having LBP. On multivariate analysis, the workers who did specific exercises in the form of yoga and gym work out were 1.37 times higher risk of having LBP than the workers who did not exercise. Lack of physical exercise has often been linked to increased risk of having LBP (Nagasu *et al*., 2007; Miranda *et al*., 2008). Contrary to the expectation, the workers who did regular exercise were at risk of LBP. It was observed that majority of the workers who had a habit of regular exercise carried out unsupervised yoga and gym workout exercises predisposing them to LBP. Although exercise is one of the few evidence-based treatments for chronic LBP, the optimal way to implement this treatment is unknown (Maher, 2004). Maher *et al*. (1999) in a systematic review located a limited number of head-to-head comparisons of various exercise programs. One

of the conclusions of the review was that the supervised programs were more effective than unsupervised and influenced treatment efficacy. Therefore unsupervised yoga and gym workout may have predisposed the workers for LBP but warrants further study. 11.21% workers had a habit of smoking, 23.92% chewed tobacco and 24.83% were addicted to alcohol. Substance abuse of any kind was not associated with LBP. Addiction to either tobacco/alcohol or both has been found in garment industry workers (Saha *et al*., 2010; Bandhopadhyay *et al*., 2012) but musculoskeletal morbidity was not found to be related to substance abuse (Saha *et al*., 2010). History of LBP in the past 12 months, excessive work, unsupervised exercises in the form of yoga and gym workout, marital status have been identified as risk factors in the present study. The results for some risk factors of LBP (number of children, and working hours a day) on univariate analysis are against popular belief and lost their significance on multivariate analysis. The explanation proffered for the same is inherent in the design of case control studies in terms of selection bias, information bias and difficulty in establishing a cause effect relationship. The healthy worker effect bias also provides some of the explanation for the results of the study. It was also difficult to compare the results of this study with other studies owing to the lack of studies on LBP in the garment industry and the methodological differences encountered in the past studies. Another limitation of the study is that the data collected via interview schedule was limited to subjective perception of the respondents and self reported LBP thus it might have been influenced by the awareness and expression of the subjects under study.

Conclusion

The prevalence of LBP in garment industry was found to be 34.91%. History of LBP, being married, unsupervised yoga and gym workout and excessive work were found to be the risk factors for LBP. There are a multitude of risk factors of LBP. The association of physical fitness levels and LBP, anthropometric indices, ergonomic evaluation in terms of evaluation of the equipments used and design of the workstation and tools, medical co morbidities remains unexplored and can be taken up in future studies.

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