Clinicians' views on factors that trigger a sudden onset of low back pain

Daniel Steffens · Chris G. Maher · Manuela L. Ferreira ·
Mark J. Hancock · Timothy Glass · Jane Latimer

Received: 8 August 2013 / Revised: 24 November 2013 / Accepted: 24 November 2013 / Published online: 8 December 2013
© Springer-Verlag Berlin Heidelberg 2013

Abstract

Purpose Little is known about what triggers an episode of low back pain (LBP) in those presenting to primary care. Previous studies of risk factors have focused on specific occupational settings and work conditions. No study has asked primary care clinicians to consider what triggers an episode of sudden-onset LBP in patients presenting to them for care. The purpose of this study, therefore, was to describe the short- and long-term factors that primary care clinicians consider important in triggering a sudden episode of acute LBP.

Methods One hundred and thirty-one primary care clinicians who were recruiting patients with LBP to a large observational study were invited to participate. A questionnaire was designed to obtain information about the clinician's characteristics, profession and clinical experience. We also asked clinicians to nominate the five short- and five long-term exposure factors, most likely to trigger a

sudden episode of acute LBP, based on their experience. Descriptive statistics and frequency distributions were used to describe clinician's characteristics and the frequencies of the main risk factor categories were reported.

Results Based on the views of 103 primary care clinicians, biomechanical risk factors appear to be the most important short-term triggers (endorsed by 89.3 % of clinicians) and long-term triggers (endorsed by 54.2 % of clinicians) for a sudden episode of acute LBP. Individual risk factors were endorsed by 39 % of clinicians as important long-term triggers, while only 6.4 % of clinicians considered them important short-term triggers. Other risk factors, such as psychological/psychosocial and genetic factors, were not commonly endorsed as risk factors for an episode of LBP by primary care clinicians.

Conclusions This study shows that primary care clinicians believe that biomechanical risk factors are the most important short-term triggers, while biomechanical and individual risk factors are the most important long-term triggers for a sudden onset of LBP. However, other risk factors, such as psychological/psychosocial and genetic, were not commonly endorsed as risk factors for an episode of LBP by primary care clinicians. Results of this study are based on primary care clinicians' views and further investigation is needed to test the validity of these suggested risk factors.

Keywords Low back pain · Primary care · Risk factors · Observational · Epidemiology

D. Steffens · C. G. Maher · M. L. Ferreira · J. Latimer
Musculoskeletal Division, The George Institute for Global Health, Sydney Medical School, The University of Sydney, Level 13, 321 Kent Street, Sydney, NSW 2000, Australia

D. Steffens (✉)
Musculoskeletal Division, The George Institute for Global Health, Sydney Medical School, The University of Sydney, Missenden Road, PO Box M201, Sydney, NSW 2050, Australia
e-mail: dsteffens@georgeinstitute.org.au

M. J. Hancock
Discipline of Physiotherapy, Faculty of Human Sciences, Macquarie University, 2 Technology Place, Macquarie Park, Sydney, NSW 2113, Australia

T. Glass
Warwick Medical School, University of Warwick, Coventry CV4 7AL, UK

Introduction

Low back pain (LBP) is the most common musculoskeletal condition affecting approximately 80 % of the adult

population at least once during their lifetime [1, 2]. LBP troubles are the fifth most frequent reason for a visit to a primary health care clinician in the USA and the seventh most frequent reason in Australia [3, 4]. In Australia back pain is the health condition that carries the greatest burden when considering lives lived with disability [5]. The global burden of the condition is enormous and includes high costs with medical care, loss of productivity and indemnity payments [6]. Despite this, investigation into risk factors for LBP is in a developing stage when compared with other common conditions such as cardiovascular disease and cancer [7]. A better understanding of factors that trigger an episode of LBP may provide important insights into the prevention and management of this condition.

LBP is a complex condition with many factors believed to contribute to its onset [8]. These factors can be aggregated into a smaller number of categories [9] including biomechanical factors (regular lifting, exposure to vibration, physically demanding jobs, bending and twisting, pushing and pulling heavy loads, awkward posture) [2, 7–20], psychological/psychosocial factors (job satisfaction, local support in the workplace, depression, job control, stress) [2, 7, 9, 16, 19–25] and individual risk factors (sedentary lifestyle, age, smoking, gender, obesity, poor general health, marital status, pregnancy) [2, 7, 9, 12, 13, 20, 21, 23, 26–31]. Past studies have investigated many of these factors and their relationship to LBP. A few studies have also investigated genetic risk factors [7, 29, 32]. Interestingly, only a small number of studies have examined risk factors across all four risk factor categories.

While there are many studies of risk factors for LBP [9, 33, 34], most knowledge stems from studies focused on specific occupational groups and working conditions [8–10, 12–19, 23]. Although studies conducted in occupational settings may reveal important risk factors for work-related back pain, these risks may not be relevant to other populations such as those drawn from primary care. In addition, previous studies of LBP have been criticised as being too narrowly focused on only one or perhaps two of the categories of individual, biomechanical, psychological/psychosocial and genetic aspects of the problem [12].

Little is known about the causes of LBP in the general population who present to primary care. The starting point in evaluating risk factors for LBP in primary care is the identification of putative risk factors that need to be investigated. Interviewing primary care clinicians who frequently manage patients with LBP can provide insight into what may be the most common triggers for this condition. The aim of this study, therefore, was to describe the most likely risk factors involving short- and long-term exposure that primary care clinicians believe could trigger a sudden episode of acute LBP.

Materials and methods

Data for this study were provided by clinicians recruiting participants to the TRIGGERS case crossover study [35]. TRIGGERS is an observational study and was designed to quantify the transient increase in risk of a sudden episode of LBP associated with acute exposure to a range of common physical and psychological factors [35].

Study sample

Participants in the study were 131 primary care clinicians (physiotherapists and chiropractors) who were recruiting patients for the TRIGGERS study from October 2011 to November 2012 in NSW, Australia.

Recruitment

Clinicians were contacted and invited to participate by e-mail. In the e-mail, we attached the invitation letter, consent form and a one-page questionnaire. The invitation letter consisted of a brief explanation of the study methods and aims. Clinicians who consented to participate were instructed to answer the one-page questionnaire based on their clinical experience and send it back to the research team. Clinicians who had not responded within 2 weeks were contacted by a study researcher and again invited to participate. Ethical approval for the study was granted by the University of Sydney Human Research Ethics Committee.

Data collection

A one-page self-administered questionnaire was designed to obtain information about the clinician's characteristics (gender, age and address), profession (physiotherapist or chiropractor) and clinical experience (years as practising clinician and years managing LBP). Two items were used to measure their beliefs about triggers for LBP. These were:

1. Based on your clinical experience, list what you consider to be the five most likely factors *involving short-term exposure* that are triggers for a sudden episode of acute low back pain?
2. Based on your clinical experience, list what you consider to be the five most likely factors *involving long-term exposure* that increase the risk of a sudden episode of acute low back pain?

All questionnaires were returned by e-mail and the answers entered in the study database.

Fig. 1 Diagram of risk factors for low back pain

Risk factors categories

We developed descriptive categories to code the free text responses based upon published risk factor studies. A search from the earliest record to January 2013 was undertaken on PubMed to identify relevant studies using the following keywords: low back pain, backache, lumbago, risk factors, causality, aetiology and epidemiology. Abstracts were retrieved and examined. Reported risk factors were extracted and entered into a table. Figure 1 describes the categories we developed including main category (or aggregate label) and the sub-categories (Table 1).

Coding short- and long-term risk factors

Two researchers individually coded the free text answers about short- and long-term exposures that may be a trigger for a sudden episode of acute LBP. The free text responses were first coded into five main categories (Fig. 1):

1. Individual risk factors
2. Biomechanical risk factors
3. Psychological/psychosocial risk factors
4. Genetic risk factors
5. Other risk factors

Table 1 Clinicians' characteristics ($n = 103$)

Characteristics	n (%) or mean $\pm$ SD
Gender (male)	56 (55 %)
Age (years)	43 $\pm$ 10
Profession	
Physiotherapist	102 (99 %)
Chiropractor	1 (1 %)
Current position	
Principal/owner	45 (44 %)
Clinician/senior clinician	58 (56 %)
Clinical experience (years)	19 $\pm$ 10
Clinical experience managing LBP (years)	18 $\pm$ 9

Table 2 Reliability between researchers A and B

Risk factors categories	Observed agreement (%)	κ^a
Short-term main categories	99	0.95
Short-term sub-categories	96	0.89
Long-term main categories	94	0.88
Long-term sub-categories	89	0.71

^a Interpretation: 0.01–0.20 slight agreement; 0.21–0.40 fair agreement; 0.41–0.60 moderate agreement; 0.61–0.80 substantial agreement; 0.81–0.99 almost perfect agreement [36]

The same researchers then coded the free text responses into sub-categories. Each nominated risk factor was only classified once into a main category and a sub-category (e.g. 1: Smoking was first categorised as an “*individual risk factor*” and then sub-categorised into “*smoking*”. e.g. 2: Golf was first categorised as a “*biomechanical risk factor*” and then sub-categorised into “*sport injuries*”). In case of disagreement, a third researcher was consulted and a decision was made by consensus.

Statistical analysis

To check the reliability of the coding of free text data, we compared the independent coding of the two researchers. Inter-rater reliability was expressed using percentage exact agreement and Cohen's kappa [36] for the main categories and sub-categories.

Descriptive statistics and frequency distributions were calculated to describe the characteristics of the clinicians and the frequencies that the main risk factor categories were reported (individual, biomechanical, psychological/psychosocial, genetic and other risk factors).

The clinicians' endorsement of various categories of triggers (main categories and sub-categories) was examined using the Chi-squared (χ^2) statistic. All analyses were performed using the statistical package SPSS for Windows

Table 3 Frequency of main risk factors stratified by short and long term

Main categories risk factors	Short term ^a		Long term ^a	
	N	%	N	%
Individual	33	6.4	201	39
Biomechanical	460	89.3	279	54.2
Psychological/psychosocial	3	0.6	16	3.1
Genetic	0	0.0	1	0.2
Other risk factors	9	1.7	8	1.6
Missing data	10	1.9	10	1.9
Total	515	100	515	100

^a $\chi^2 = 180.70$, $p < 0.001$

version 21 (SPSS, Inc., Chicago, IL) with a significance level set at 0.05.

Results

Of the 131 clinicians invited to participate in the study, 103 (79 %) completed the questionnaire. The characteristics of the participating clinicians are described in Table 2. The mean age was 43 years (range 23–65), clinical experience managing LBP was 18 years (range 1–40) and slightly more were male (55 %).

In general, the reliability between the two independent researchers who coded the short- and long-term risk factor categories was very good (Table 2). The observed agreement ranged from 89 to 99 % and the inter-rater reliability ranged from substantial ($\kappa = 0.71$) to almost perfect agreement ($\kappa = 0.95$) [36].

Short- and long-term main categories risk factors

Table 3 lists the frequency of endorsement of the main short- and long-term risk factor categories. Based on the views of 103 primary care clinicians, biomechanical risk factors appear to be the most important short-term triggers (endorsed by 89.3 % of clinicians) and long-term triggers (endorsed by 54.2 % of clinicians) for a sudden episode of acute LBP. Individual risk factors were endorsed by 39 % of clinicians as important long-term triggers, while only 6.4 % of clinicians considered them important short-term triggers. Only one clinician reported genetics (0.2 %) as a long-term risk factor for acute LBP. Chi-square tests confirmed a significant difference in proportions of the main short- and long-term risk factor categories ($\chi^2 = 180.70$, $p < 0.001$). While biomechanical factors were considered the most important short- and long-term risk factors, individual factors were endorsed far more commonly as long-term risk factors.

Table 4 Frequency of risk factor sub-categories stratified by short and long term

Risk factors sub-categories	Short term ^a		Long term ^a	
	N	%	N	%
Lifting	90	17.5	56	10.9
Prolonged sitting	47	9.1	69	13.4
Physical trauma	46	8.9	3	0.6
Bending	41	8.0	24	4.7
Unaccustomed activity	38	7.4	2	0.4
Other biomechanical risk factors	27	5.2	28	5.4
Sport injuries	24	4.7	9	1.7
Gardening	20	3.9	2	0.4
Bending and twisting	17	3.3	6	1.2
Twisting	14	2.7	4	0.8
Coughing/sneezing	12	2.3	1	0.2
Lifting and twisting	12	2.3	0	0.0
Lifting and bending	12	2.3	8	1.6
Driving	11	2.1	15	2.9
Bending and twisting while lifting	10	1.9	2	0.4
Sudden movements	8	1.6	1	0.2
Other risk factors	9	1.7	8	1.6
Prolonged standing	6	1.2	16	3.1
Unexpected load	6	1.2	0	0.0
Repetitive movements	5	1.0	8	1.6
Other individual risk factors	4	0.8	30	5.8
Pulling/pushing	5	1.0	2	0.4
Pregnancy/childbirth	3	0.6	13	2.5
Previous LBP episodes	2	0.4	15	2.9
Diminished trunk muscle strength and fatigability	2	0.4	22	4.3
Spine/pelvis/lower limb impairment	2	0.4	23	4.5
Sedentary work	2	0.4	14	2.7
Stress	2	0.4	9	1.7
Overweight	1	0.2	25	4.9
Spine/pelvis/lower limb pathology	1	0.2	11	2.1
Physical inactivity	0	0.0	47	9.1
Less frequent risk factors ^b	26	5.0	32	6.2
Missing data	10	1.9	10	1.9
Total	515	100	515	100

Bold top five short and long risk factor sub-categories

^a $\chi^2 = 360.456$, $p < 0.001$

^b Risk factors with a grouped frequency count ≤ 5 were combined

Short- and long-term sub-categories risk factors

Table 4 lists the frequency of endorsement of short- and long-term sub-category risk factors for acute LBP. Lifting (17.5 %) was the most frequently endorsed short-term sub-category risk factor, followed by prolonged sitting (9.1 %) and physical trauma (8.9 %). For long-term sub-category

risk factors, prolonged sitting (13.4 %) was most frequently endorsed followed by lifting (10.9 %) and physical inactivity (9.1 %). Similarly to the analysis of the main categories, the Chi-square test ($\chi^2 = 360.456$, $p < 0.001$) suggested that there was a difference between short- and long-term sub-category risk factors. Obvious sub-category differences included physical trauma and physical inactivity for short and long term; physical trauma was endorsed more frequently as a short-term risk factor, while inactivity was endorsed more commonly as a long-term risk factor.

Discussion

Statement of principal findings

Based on the opinions of 103 primary care clinicians, the most important main short- and long-term risk factors to trigger an episode of sudden acute LBP are biomechanical (89.3 and 54.2 %, respectively) and individual risk factors (6.4 and 39 %, respectively). Surprisingly, other risk factors, such as psychological/psychosocial and genetic factors, were not commonly endorsed as risk factors for an episode of LBP by primary care clinicians. Some of the most frequently reported short- and long-term sub-categories to trigger a sudden episode of acute LBP are lifting (17.5 and 10.9 %, respectively) and prolonged sitting (9.1 and 13.4 %, respectively).

Strengths and weaknesses of the study

We were able to interview a considerable number of experienced primary care clinicians currently treating patients with LBP. In addition, we identified a range of factors that are considered triggers involving short- and long-term exposures. The reliability between the two independent researchers who coded the short- and long-term risk factor categories was very good with the inter-rater reliability ranging from substantial to almost perfect agreement [36]. However, the results of the study are based on primary care clinicians' views and further investigation is needed to test the validity of these suggested risk factors.

Comparison to others studies

To our knowledge, this is the first observational study that has interviewed primary care clinicians to determine their views on short- and long-term triggers for a sudden episode of acute LBP in the general population. Most of the previous studies on risk factors for LBP tended to focus on specific triggers and included samples from occupational settings. There is a research focus on biomechanical [2, 7–20], psychological/psychosocial [2, 7, 9, 16, 19–25] and

individual risk factors [2, 7, 9, 12, 13, 20, 21, 23, 26–31] for LBP; however, only a few studies investigated risk factors from all domains together [7].

Findings from our study suggest that the views of clinicians are as variable as in the evidence found in the literature. Our study found that biomechanical risk factors, such as lifting, prolonged sitting and bending, were considered by primary care clinicians to be important risk factors for the onset of LBP, in accordance with previous studies [10, 15, 26, 37]. On the other hand, individual risk factors, such as physical inactivity, have only weak support in the literature as a risk factor for developing LBP [27, 29]. This is in contrast to the study clinicians who considered physical inactivity as a common long-term risk factor for LBP. Although psychological/psychosocial and genetic risk factors did not appear to be endorsed strongly by the primary care clinicians interviewed in this study, there is strong evidence in the literature suggesting the opposite [12, 22, 37]. However, this inconsistency between the present study and the literature may be due to the different settings in which the studies were performed and/or clinician's lack of awareness about the importance of psychological risk factors. Psychological/psychosocial factors may be more important in occupational settings than in primary care. Conversely, individual risk factors may be more important in primary care settings than occupational settings.

Meaning of the study: possible mechanisms and implications for clinicians

Based on the opinion of primary care clinicians, the most likely short-term risk factors for triggering an episode of LBP are, by far, the biomechanical risk factors and the most likely causes involving long-term exposure are individual and biomechanical risk factors. This is somewhat inconsistent with the literature [27, 29]. The reasons why experienced clinicians think such factors are important may be due to the fact that they are seeing a general sample of the population, while previous studies tend to focus on occupational settings. One other reason may be that primary care clinicians have limited expertise in assessing psychosocial/psychological and genetic factors as likely triggers for an onset of LBP.

A better understanding of the most endorsed risk factors for LBP in primary care will help clinicians to improve patient treatment and also provide important advice in prevention of future LBP episodes.

Unanswered questions and future research

Future studies should investigate risk factors for LBP in samples of the general population and simultaneously

investigate all main categories of risk factors found to trigger an episode of LBP (individual, biomechanical, psychosocial/psychological, genetic and others risk factors). There is also a need to investigate the combination of two or more risk factors. Previous studies have confirmed that a combination of two or more risk factors (i.e. poor posture, repetitive lifting and high job strain) are commonly identified in the same individual [23]. Increasing our understanding of what triggers an episode of LBP will enable us to design better prevention programs. Future research could involve the modification of endorsed triggers in a clinical trial to determine the effectiveness in reducing future episodes of LBP. In addition, there is a need to determine whether psychological/psychosocial features are important risk factors in the primary care setting using rigorous prospective cohort designs.

Conclusions

Based on primary care clinicians' opinion, biomechanical risk factors are the most important short-term triggers, while biomechanical and individual risk factors are the most important long-term triggers for sudden-onset LBP. Psychological/psychosocial and genetic risk factors were not considered important risk factors by primary care clinicians. Findings from this study should be further investigated to better understand short- and long-term exposures that are triggers for an acute sudden episode of LBP. This information will help inform LBP prevention programs.

Conflict of interest None.

References

1. Britt H, Miller G, Knox S, Charles J, Pan Y, Henderson J, Baryram C, Valenti L, Ng A, O'Halloran J (2005) General practice activity in Australia 2004–2005. General practice series No. 18. Australian Institute of Health and Welfare, Canberra
2. Rubin DI (2007) Epidemiology and risk factors for spine pain. *Neurol Clin* 25(2):353–371. doi:10.1016/j.ncl.2007.01.004
3. Williams C, Maher C, Hancock M, McAuley J, McLachlan A, Britt H, Fahridin S, Harrison C, Latimer J (2010) Low back pain and best practice care: a survey of general practice physicians. *JAMA* 303(3):271–277
4. Deyo R (1998) Low-back pain. *Sci Am* 279(2):48–53
5. Murray CJ, Vos T, Lozano R, Naghavi M, Flaxman AD, Michaud C, Ezzati M, Shibuya K, Salomon JA, Abdalla S, Aboyans V, Abraham J, Ackerman I, Aggarwal R, Ahn SY, Ali MK, Alvarado M, Anderson HR, Anderson LM, Andrews KG, Atkinson C, Baddour LM, Bahalim AN, Barker-Collo S, Barrero LH, Bartels DH, Basanez MG, Baxter A, Bell ML, Benjamin EJ, Bennett D, Bernabe E, Bhalla K, Bhandari B, Bikbov B, Bin Abdulhak A, Birbeck G, Black JA, Blencowe H, Blore JD, Blyth F, Bolliger I, Bonaventure A, Boufous S, Bourne R, Boussinesq M, Braithwaite T, Brayne C, Bridgett L, Brooker S, Brooks P, Brugh TS, Bryan-

- Hancock C, Bucello C, Buchbinder R, Buckle G, Budke CM, Burch M, Burney P, Burstein R, Calabria B, Campbell B, Canter CE, Carabin H, Carapetis J, Carmona L, Cella C, Charlson F, Chen H, Cheng AT, Chou D, Chugh SS, Coffeng LE, Colan SD, Colquhoun S, Colson KE, Condon J, Connor MD, Cooper LT, Corriere M, Cortinovis M, de Vaccaro KC, Couser W, Cowie BC, Criqui MH, Cross M, Dabhadkar KC, Dahiya M, Dahodwala N, Damsere-Derry J, Danaei G, Davis A, De Leo D, Degenhardt L, Dellavalle R, Delossantos A, Denenberg J, Derrett S, Des Jarlais DC, Dharmaratne SD, Dherani M, Diaz-Torne C, Dolk H, Dorsey ER, Driscoll T, Duber H, Ebel B, Edmond K, Elbaz A, Ali SE, Erskine H, Erwin PJ, Espindola P, Ewoigbokhan SE, Farzadfar F, Feigin V, Felson DT, Ferrari A, Ferri CP, Fevre EM, Finucane MM, Flaxman S, Flood L, Foreman K, Forouzanfar MH, Fowkes FG, Fransen M, Freeman MK, Gabbe BJ, Gabriel SE, Gakidou E, Ganatra HA, Garcia B, Gaspari F, Gillum RF, Gmel G, Gonzalez-Medina D, Gosselin R, Grainger R, Grant B, Groeger J, Guillemin F, Gunnell D, Gupta R, Haagsma J, Hagan H, Halasa YA, Hall W, Haring D, Haro JM, Harrison JE, Havmoeller R, Hay RJ, Higashi H, Hill C, Hoen B, Hoffman H, Hotez PJ, Hoy D, Huang JJ, Ibeanusi SE, Jacobsen KH, James SL, Jarvis D, Jasrasaria R, Jayaraman S, Johns N, Jonas JB, Karthikeyan G, Kassebaum N, Kawakami N, Keren A, Khoo JP, King CH, Knowlton LM, Kobusingye O, Koranteng A, Krishnamurthi R, Laden F, Lalloo R, Laslett LL, Lathlean T, Leasher JL, Lee YY, Leigh J, Levinson D, Lim SS, Limb E, Lin JK, Lipnick M, Lipshultz SE, Liu W, Loane M, Ohno SL, Lyons R, Mabweijano J, MacIntyre MF, Malekzadeh R, Mallinger L, Manivannan S, Marcenes W, March L, Margolis DJ, Marks GB, Marks R, Matsumori A, Matzopoulos R, Mayosi BM, McAnulty JH, McDermott MM, McGill N, McGrath J, Medina-Mora ME, Meltzer M, Mensah GA, Merriam TR, Meyer AC, Miglioli V, Miller M, Miller TR, Mitchell PB, Mock C, Mocumbi AO, Moffitt TE, Mokdad AA, Monasta L, Montico M, Moradi-Lakeh M, Moran A, Morawska L, Mori R, Murdoch ME, Mwaniki MK, Naidoo K, Nair MN, Naldi L, Narayan KM, Nelson PK, Nelson RG, Nevitt MC, Newton CR, Nolte S, Norman P, Norman R, O'Donnell M, O'Hanlon S, Olives C, Omer SB, Ortblad K, Osborne R, Ozgediz D, Page A, Pahari B, Pandian JD, Rivero AP, Patten SB, Pearce N, Padilla RP, Perez-Ruiz F, Perico N, Pesudovs K, Phillips D, Phillips MR, Pierce K, Pion S, Polanczyk GV, Polinder S, Pope CA, 3rd, Popova S, Porini E, Pourmalek F, Prince M, Pullan RL, Ramaiah KD, Ranganathan D, Razavi H, Regan M, Rehm JT, Rein DB, Remuzzi G, Richardson K, Rivara FP, Roberts T, Robinson C, De Leon FR, Ronfani L, Room R, Rosenfeld LC, Rushton L, Sacco RL, Saha S, Sampson U, Sanchez-Riera L, Sanman E, Schwebel DC, Scott JG, Segui-Gomez M, Shahraz S, Shepard DS, Shin H, Shivakoti R, Singh D, Singh GM, Singh JA, Singleton J, Sleet DA, Sliwa K, Smith E, Smith JL, Stapelberg NJ, Steer A, Steiner T, Stolk WA, Stovner LJ, Sudfeld C, Syed S, Tamburlini G, Tavakkoli M, Taylor HR, Sudfeld C, Syed S, Tamburlini G, Tavakkoli M, Taylor HR, Taylor JA, Taylor WJ, Thomas B, Thomson WM, Thurston GD, Tleyjeh IM, Tonelli M, Towbin JA, Truelsen T, Tsilimbaris MK, Ubeda C, Undurraga EA, van der Werf MJ, van Os J, Vavilala MS, Venketasubramanian N, Wang M, Wang W, Watt K, Weatherall DJ, Weinstock MA, Weintraub R, Weisskopf MG, Weissman MM, White RA, Whiteford H, Wiebe N, Wiersma ST, Wilkinson JD, Williams HC, Williams SR, Witt E, Wolfe F, Woolf AD, Wulf S, Yeh PH, Zaidi AK, Zheng ZJ, Zonies D, Lopez AD, AlMazroa MA, Memish ZA (2012) Disability-adjusted life years (DALYs) for 291 diseases and injuries in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet* 380 (9859):2197–2223. doi:10.1016/S0140-6736(12)61689-4
6. Hoy D, March L, Brooks P, Woolf A, Blyth F, Vos T, Buchbinder R (2010) Measuring the global burden of low back pain. *Best Pract Res Clin Rheumatol* 24:155–165
  7. Manek NJ, MacGregor AJ (2005) Epidemiology of back disorders: prevalence, risk factors, and prognosis. *Curr Opin Rheumatol* 17:134–140
  8. Latza U, Karmaus W, Stürmer T, Steiner M, Neth A, Rehder U (2000) Cohort study of occupational risk factors of low back pain in construction workers. *Occup Environ Med* 57:28–34
  9. Ferguson S, Allread W, Burr D, Heaney C, Marras W (2012) Biomechanical, psychosocial and individual risk factors predicting low back functional impairment among furniture distribution employees. *Clin Biomech* 27:117–123
  10. Burdorf A, Naaktgeboren B, de Groot HCWM (1993) Occupational risk factors for low back pain among sedentary workers. *J Occup Med* 35(12):1213–1220
  11. Frymoyer JW, Pope MH, Clements JH, Wilder DG, MacPherson B, Ashikaga T, Vermont B (1983) Risk factors in low-back pain: An epidemiological survey. *J Bone Joint Surg* 65-A(2):213–218
  12. Kerr MS, Frank JW, Shannon HS, Norman RWK, Wells RP, Neumann WP (2001) Biomechanical and psychosocial risk factors for low back pain at work. *Am J Pub Health* 91(7):1069–1075
  13. Lee P, Helewa A, Goldsmith CH, Smythe HA, Stitt LW (2000) Low back pain: prevalence and risk factors in an industrial setting. *J Rheumatol* 28(2):346–351
  14. Marras W, Lavender S, Leurgans S, Fathallah F, Ferguson S, Allread W, Rajulu S (1995) Biomechanical risk factors for occupationally related low back disorders. *Ergonomics* 38(2):377–410
  15. Murtezani A, Ibraimi Z, Sllamniku S, Osmani T, Sherifi S (2011) Prevalence and risk factors for low back pain in industrial workers. *Folia Med* 53(3):68–74
  16. Nieuwenhuys AV, Fatkhutdinova L, Verbeke G, Pirenne D, Johannik K, Somville PR, Mairiaux P, Moens GF, Masschelein R (2004) Risk factors for first-ever low back pain among workers in their first employment. *Occup Med* 54:513–519
  17. Smedley J, Egger P, Cooper C, Coggon D (1995) Manual handling activities and risk of low back pain in nurses. *Occup Environ Med* 52:160–163
  18. Troup JDG (1984) Causes, prediction and prevention of back pain at work. *Scand J Work Environ Health* 10:419–428
  19. Vandergrift JL, Gold JE, Hanlon A, Punnett L (2012) Physical and psychosocial ergonomic risk factors for low back pain in automobile manufacturing workers. *Occup Environ Med* 69:29–34
  20. Vindigni D, Walker BF, Jamison JR, Da Costa C, Parkinson L, Blunden S (2005) Low back pain risk factors in a large rural Australian Aboriginal community. An opportunity for managing co-morbidities? *Chiropr Osteopathy* 13(1):21
  21. Griffith LE, Shannon HS, Wells RP, Walter SD, Cole DC, Cote P, Frank J, Hogg-Johnson S, Langlois LE (2012) Individual participant data meta-analysis of mechanical workplace risk factors and low back pain. *Am J Public Health* 102:309–318
  22. Hoogendoorn WE, van Poppel MNM, Bongers PM, Koes BW, Bouter LM (2000) Systematic review of psychosocial factors at work and private life as risk factors for back pain. *Spine* 25(16):2114–2125
  23. Janwantanakul P, Sitthipornvorakul E, Paksaichol A (2012) Risk factors for the onset of nonspecific low back pain in office workers: a systematic review of prospective cohort studies. *J Manip Physiol Ther* 35:568–577
  24. Linton SJ (2000) A review of psychological risk factors in back and neck pain. *Spine* 25(9):1148–1156
  25. Ramond A, Bouton C, Richard I, Roquelaure Y, Baufreton C, Legrand E, Huez J (2011) Psychosocial risk factors for chronic low back pain in primary care—a systematic review. *Fam Pract* 28:12–21
  26. Adams M, Mannion AF, Dolan P (1999) Personal risk factors for first-time low back pain. *Spine* 24(23):2497–2505

27. Chen S, Liu M, Cook J, Bass S, Lo SK (2009) Sedentary lifestyle as a risk factor for low back pain: a systematic review. *Int Arch Occup Environ Health* 82:797–806
28. Leboeuf-Yde C (2000) Body weight and low back pain: a systematic literature review of 56 journal articles reporting on 65 epidemiologic studies. *Spine* 25(2):226–237
29. Leboeuf-Yde C (2004) Back pain—individual and genetic factors. *J Electromyogr Kinesiol* 14:129–133
30. Reisbord LS, Greenland S (1985) Factors associated with self-reported back-pain prevalence: a population-based study. *J Chronic Dis* 38(8):691–702
31. Wang S, Dezinno P, Maranets I, Berman M, Caldwell-Andrews AA, Kain ZN (2004) Low back pain during pregnancy: prevalence, risk factors, and outcomes. *Am Coll Obstet Gynecol* 104(1):65–70
32. Livshits G, Popham M, Malkin I, Sambrook PN, MacGregor AJ, Spector T, Williams FMK (2011) Lumbar disc degeneration and genetic factors are the main risk factors for low back pain in women: the UK Twin Spine Study. *Ann Rheum Dis* 70:1740–1745
33. Ferguson SA, Marras WS (1997) A literature review of low back disorder surveillance measures and risk factors. *Clin Biomech* 12(4):211–226
34. Davis K, Heaney C (2000) The relationship between psychosocial work characteristics and low back pain: underlying methodological issues. *Clin Biomech* 15(6):389–406
35. Steffens D, Ferreira ML, Maher CG, Latimer J, Koes BW, Blyth FM, Ferreira PH (2012) Triggers for an episode of sudden onset low back pain: study protocol. *BMC Musculoskelet Disord* 13(1):7. doi:[10.1186/1471-2474-13-7](https://doi.org/10.1186/1471-2474-13-7)
36. Viera AJ, Garrett JM (2005) Understanding interobserver agreement: the kappa statistic. *Fam Med* 37(5):360–363
37. Hoy D, Brooks P, Blyth F, Buchbinder R (2010) The epidemiology of low back pain. *Best Pract Res Clin Rheumatol* 24:769–781