Online supplementary file 1: Systematic review search strategies for low back pain, GBD 2010

Prevalence

We searched Ovid MEDLINE, EMBASE, CINAHL, CAB abstracts, WHOLIS, and SIGLE databases for previous systematic reviews on the prevalence of low back pain (LBP) throughout the world and found six reviews published between 1980 and 2007 (see Table S1.1). Only two were published since the Year 2000 and of these, one was limited to LBP in the elderly [1], and one limited to LBP among adolescents [2]. The most recent global review of LBP prevalence across a broader age range was conducted by Walker and published in the Year 2000 [3]. This was based on studies published up to and including 1998.

Table S1.1: Systematic reviews on the global prevalence of low back pain

Authors	Year	Years in search	Age group
Volinn	1997	1980-95	All
Loney et al	1999	1981-98	Adults
Bressler et al	1999	1966-98	Elderly
Walker	2000	1966-98	All
Dionne et al	2006	1966-2004	Elderly
Jeffries et al	2007	1984-2006	Adolescents

For this GBD review, Ovid MEDLINE, EMBASE, CINAHL, CAB abstracts, WHOLIS, and SIGLE databases were searched using the following terms: *back pain, lumbar pain, back ache, backache, and lumbago* individually and combined with each of the following terms: *prevalence, incidence, cross-sectional, and epidemiology*. Ovid MEDLINE and EMBASE were also searched using the following search string:

(back pain OR lumbar pain OR back ache OR backache OR lumbago) AND "[country name]". In addition, the reference lists of full papers from the original search were examined and any eligible titles were added to the search. Inclusion criteria were:

- Published or unpublished studies
- Population-based studies
- Studies on humans
- Studies from 1980-2009
- Studies of any region or country of the world
- Studies of urban and/or rural populations
- Studies of males and/or females
- Studies of any age group
- Studies published in any language.

Exclusion criteria were:

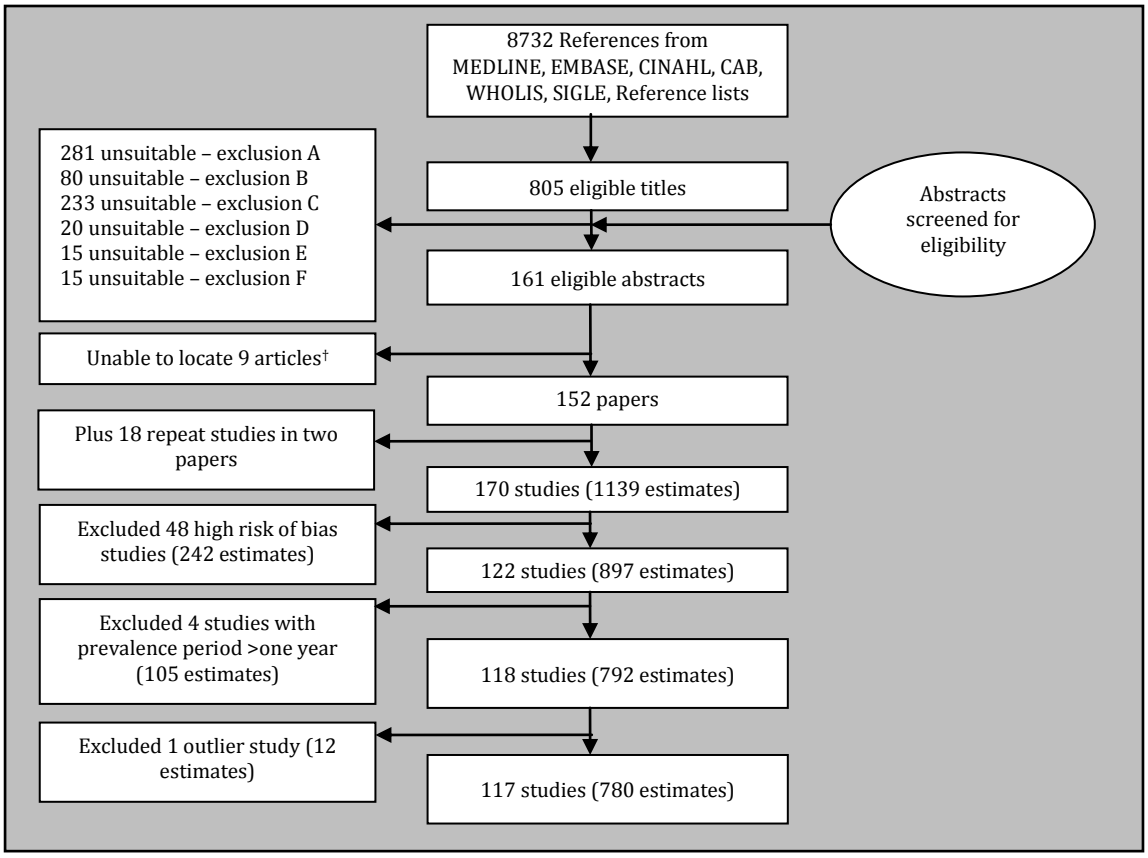
- A: Studies clearly not representative of the national population e.g. judo athletes, pregnant women, miners, or military
- B: Studies that were not population-based e.g. hospital or clinic-based studies
- C: Studies that provided no prevalence or incidence data e.g. a commentary piece or risk factor analysis
- D: Studies on a specific type of low back pain e.g. vertebral fractures
- E: Studies with a sample size less than 150
- F: Reviews.

The electronic database search yielded 8,732 studies (Figure S1.1). Irrelevant titles (n=7,927) were excluded leaving 805 eligible titles. Of these, 141 abstracts met the inclusion criteria. An additional 20 eligible papers were identified from inspection of the reference lists of included papers. Of these, full text articles of nine could not be located. Thus, in total, 152 papers met the inclusion criteria and were retrievable. One paper contained data from 18 country studies [4], and another from two country studies [5]. Thus, there were 170 studies in total, and these consisted of 1139 estimates. Of these, 37 studies (22%) were rated as having a low risk of bias (415 estimates), 85 (50%) a moderate risk of bias (482 estimates), and 48 (28%) a high risk of bias (242 estimates).

A major challenge in synthesising these data was the extent of between-study methodological heterogeneity, particularly relating to the prevalence period and case definition, namely the minimum episode duration, the anatomical location, and whether or not cases had to experience activity limitation. In an initial attempt to deal with this heterogeneity, high risk of bias estimates (n=242) were excluded leaving a total of 897 estimates from 122 studies. Estimates with a prevalence period greater than one year were then excluded, which left 792 estimates (118 studies). The data were then checked for outliers and 12 estimates (from one study) were removed. This was a German study [6] - it contained outlier data (point prevalence ranging from 77% to 92% in elderly Germans), and estimates (point prevalence ranging from 20% to 50%) that were more consistent with most other studies were available in two further German studies of equal or lower risk of bias [7, 8].

This left a total of 117 studies (from 100 papers) and 780 estimates, which were from 47 countries (Table S1.2 and S1.3). All studies had cross-sectional designs, and ascertained data through an interview or self-completed questionnaire. The majority of studies included both genders, a broad age range in the adult population, and both urban and rural populations.

Figure S1.1: Steps taken in the systematic review for low back pain prevalence data.



†Article did not exist (n=2); journal was no longer in circulation and attempts at retrieving the article through a Document Delivery service and/or directly from the author were unsuccessful (n=7).

Table S1.2: Countries with eligible studies retrieved from prevalence systematic review

Country	Estimates	%
Australia	22	2.82
Bangladesh	24	3.07
Belgium	11	1.41
Brazil	19	2.43
Canada	18	2.30
China	10	1.28
China, Hong Kong SAR	13	1.66
Colombia	1	0.13
Croatia	10	1.28
Cuba	2	0.26
Czech Republic	1	0.13
Denmark	98	12.55
Egypt	9	1.15
Finland	62	7.94
France	7	0.90
Germany	72	9.22
Greece	5	0.64
Hungary	3	0.38
Iceland	2	0.26
India	5	0.64
Indonesia	4	0.51
Iran (Islamic Republic of)	36	4.61
Israel	2	0.26
Italy	3	0.38
Japan	1	0.13
Kuwait	1	0.13

Lebanon	1	0.13
Malaysia	2	0.26
Mexico	13	1.66
Netherlands	16	2.05
New Zealand	4	0.51
Nigeria	25	3.20
Norway	11	1.41
Philippines	2	0.26
Saudi Arabia	2	0.26
Singapore	28	3.59
South Africa	1	0.13
Spain	21	2.69
Sudan	5	0.64
Sweden	33	4.23
Switzerland	22	2.82
Thailand	1	0.13
Turkey	19	2.43
Ukraine	1	0.13
United Kingdom	117	14.98
United States of America	14	1.79
Viet Nam	1	0.13
Total	780	100

Table S1.3: Eligible papers retrieved from prevalence systematic review (n=100)

1. Al-Arfaj, A. S., S. S. Al-Saleh, et al. (2003). "How common is back pain in Al-Qaseem region." Saudi Medical Journal 24(2): 170-3.
2. Al-Awadhi, A. M., S. O. Olusi, et al. (2004). "Musculoskeletal pain, disability and health-seeking behavior in adult Kuwaitis using a validated Arabic version of WHO-ILAR COPCORD Core Questionnaire." Clinical and Experimental Rheumatology 22(2): 177-183.
3. Andersson, H. I., G. Ejlertsson, et al. (1993). "Chronic pain in a geographically defined general population: Studies of differences in age, gender, social class, and pain localization." Clinical Journal of Pain 9(3): 174-182.
4. Balague, F., M. Nordin, et al. (1994). "Non-specific low-back pain among schoolchildren: a field survey with analysis of some associated factors." Journal of Spinal Disorders 7(5): 374-9.
5. Ballina Garcia, F. J., R. Hernandez Mejia, et al. (1994). "Epidemiology of musculoskeletal complaints and use of health services in Asturias, Spain." Scand J Rheumatol 23(3): 137-41.

6. Bergman, S., P. Herrstrom, et al. (2001). "Chronic musculoskeletal pain, prevalence rates, and sociodemographic associations in a Swedish population study." J Rheumatol 28(6): 1369-77.
7. Biering-Sorensen, F. (1982). "Low back trouble in a general population of 30-, 40-, 50-, and 60-year-old men and women. Study design, representativeness and basic results." Danish Medical Bulletin 29(6): 289-299.
8. Bingefors, K. and D. Isacson (2004). "Epidemiology, co-morbidity, and impact on health-related quality of life of self-reported headache and musculoskeletal pain - A gender perspective." European Journal of Pain 8(5): 435-450.
9. Blay, S. L., S. B. Andreoli, et al. (2007). "Co-occurrence of chronic physical pain and psychiatric morbidity in a community sample of older people." International Journal of Geriatric Psychiatry 22(9): 902-908.
10. Brage, S. and E. Laerum (1999). "Low back disorders in Norway - An epidemiological description." Tidsskrift for den Norske Laegeforening 119(11): 1619-1623.
11. Bredkjaer, S. R. (1991). "Musculoskeletal disease in Denmark. The Danish Health and Morbidity Survey 1986-87." Acta Orthop Scand Suppl 241: 10-2.
12. Cardiel, M. H. and J. Rojas-Serrano (2002). "Community based study to estimate prevalence, burden of illness and help seeking behavior in rheumatic diseases in Mexico City. A COPCORD study." Clinical & Experimental Rheumatology 20(5): 617-24.
13. Carmona, L., J. Ballina, et al. (2001). "The burden of musculoskeletal diseases in the general population of Spain: results from a national survey." Annals of the Rheumatic Diseases 60(11): 1040-5.
14. Cassidy, J. D., L. J. Carroll, et al. (1998). "The Saskatchewan health and back pain survey: The prevalence of low back pain and related disability in Saskatchewan adults." Spine 23(17): 1860-1867.
15. Catala, E., E. Reig, et al. (2002). "Prevalence of pain in the Spanish population: telephone survey in 5000 homes." Eur J Pain 6(2): 133-40.
16. Cecchi, F., P. Debolini, et al. (2006). "Epidemiology of back pain in a representative cohort of Italian persons 65 years of age and older: the InCHIANTI study." Spine 31(10): 1149-55.
17. Chaiamnuay, P., J. Darmawan, et al. (1998). "Epidemiology of rheumatic disease in rural Thailand: A WHO-ILAR COPCORD study." Journal of Rheumatology 25(7): 1382-1387.
18. Chopra, A., M. Saluja, et al. (2002). "Pain and disability, perceptions and beliefs of a rural Indian population: A WHO-ILAR COPCORD study. WHO-International League of Associations for Rheumatology. Community Oriented Program for Control of Rheumatic Diseases." J Rheumatol 29(3): 614-21.
19. Croft, P. R. and A. S. Rigby (1994). "Socioeconomic influences on back problems in the community in Britain." Journal of Epidemiology and Community Health 48(2): 166-170.
20. Currie, S. R. and J. Wang (2004). "Chronic back pain and major depression in the general Canadian population." Pain 107(1-2): 54-60.
21. Darmawan, J., H. A. Valkenburg, et al. (1992). "Epidemiology of rheumatic diseases in rural and urban populations in Indonesia: a World Health Organisation International League Against Rheumatism COPCORD study, stage I, phase 2." Ann Rheum Dis 51(4): 525-8.
22. Davatchi, F., A. R. Jamshidi, et al. (2008). "WHO-ILAR COPCORD study (stage 1, urban study) in Iran." Journal of Rheumatology 35(7): 1384-1390.
23. Demyttenaere K, Bruffaerts R, Lee S, Posada-Villa J, Kovess V, Angermeyer MC, et al. Mental disorders among persons with chronic back or neck pain: results from the World Mental Health Surveys.[see comment]. Pain. 2007 Jun;129(3):332-42.
24. Elliott, A. M., B. H. Smith, et al. (1999). "The epidemiology of chronic pain in the community." Lancet 354(9186): 1248-52.
25. Erdine, S., O. Hamzaoglu, et al. (2001). "Pain prevalance among adults in Turkey." Agri 13(2-3): 22-30.
26. Fabunmi, A. A., S. O. Aba, et al. (2005). "Prevalence of low back pain among peasant farmers in a rural community in South West Nigeria." African Journal of Medicine & Medical Sciences 34(3): 259-62.
27. Galal, S. B., S. Hamad, et al. (2001). "Self-reported adolescents' health and gender: an Egyptian study." Eastern Mediterranean Health Journal 7(4-5): 625-34.
28. Ghandour, R. M., M. D. Overpeck, et al. (2004). "Headache, stomachache, backache, and morning fatigue among adolescent girls in the United States: Associations with behavioral, sociodemographic, and environmental factors." Archives of Pediatrics and Adolescent Medicine 158(8): 797-803.
29. Goubert, L., G. Crombez, et al. (2004). "Low back pain, disability and back pain myths in a community sample: prevalence and interrelationships." Eur J Pain 8(4): 385-94.
30. Gourmelen, J., J. F. Chastang, et al. (2007). "Frequency of low back pain in the French population from age 30 to 64 years. Results of two national surveys." Annales de Readaptation et de Medecine Physique 50(8): 633-639.
31. Grimmer, K., L. Nyland, et al. (2006). "Longitudinal investigation of low back pain in Australian adolescents: a five-year study." Physiotherapy Research International 11(3): 161-72.
32. Gross, D. P., R. Ferrari, et al. (2006). "A population-based survey of back pain beliefs in Canada." Spine 31(18): 2142-5.
33. Guez, M., C. Hildingsson, et al. (2006). "Chronic low back pain in individuals with chronic neck pain of traumatic and non-traumatic origin: A population-based study." Acta Orthopaedica 77(1): 132-137.
34. Hakala, P. T., A. H. Rimpela, et al. (2006). "Frequent computer-related activities increase the risk of neck-shoulder and low back pain in adolescents." European Journal of Public Health 16(5): 536-541.
35. Haq, S. A., J. Darmawan, et al. (2005). "Prevalence of rheumatic diseases and associated outcomes in rural and urban communities in Bangladesh: a COPCORD study." Journal of Rheumatology 32(2): 348-53.
36. Harkness, E. F., G. J. Macfarlane, et al. (2005). "Is musculoskeletal pain more common now than 40 years ago?: Two population-based cross-sectional studies." Rheumatology (Oxford) 44(7): 890-5.

37. Hartvigsen, J., K. Christensen, et al. (2003). "Back pain remains a common symptom in old age. A population-based study of 4486 Danish twins aged 70-102." European Spine Journal 12(5): 528-534.
38. Heistaro, S., E. Vartiainen, et al. (1998). "Trends of back pain in eastern Finland, 1972-1992, in relation to socioeconomic status and behavioral risk factors." American Journal of Epidemiology 148(7): 671-82.
39. Hestbaek, L., C. Leboeuf-Yde, et al. (2003). "The course of low back pain in a general population. Results from a 5-year prospective study." Journal of Manipulative and Physiological Therapeutics 26(4): 213-219.
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41. Horvath, G., P. Than, et al. (2006). "[Prevalence of musculoskeletal symptoms in adulthood and adolescence (survey conducted in the Southern Transdanubian region in a representative sample of 10.000 people]." Orvosi Hetilap 147(8): 351-6.
42. Hoy, D., M. J. Toole, et al. (2003). "Low back pain in rural Tibet." Lancet 361(9353): 225-226.
43. Huppe, A., K. Muller, et al. (2007). "Is the occurrence of back pain in Germany decreasing? Two regional postal surveys a decade apart." European Journal of Public Health 17(3): 318-22.
44. Jacob, T., M. Baras, et al. (2004). "A Longitudinal, community-based study on low back pain outcomes. ." Spine 29(16): 1810-17.
45. Jajic, I. and A. Sucur (1985). "A prospective study of low back pain in the general population." Reumatizam (Yugoslavia) 32: 5-9.
46. Jones, M. A., G. Stratton, et al. (2004). "A school-based survey of recurrent non-specific low-back pain prevalence and consequences in children." Health Education Research 19(3): 284-9.
47. Joshi VL, Chopra A. Is there an urban-rural divide? Population surveys of rheumatic musculoskeletal disorders in the Pune region of India using the COPCORD Bhigwan model. J Rheumatol. 2009 Mar;36(3):614-22
48. Kohlmann, T., R. Deck, et al. (1995). "Prevalence and severity of back pain in Lubeck." Aktuelle Rheumatologie 20(3): 99-104.
49. Kristjansdottir, G. (1997). "Prevalence of pain combinations and overall pain: a study of headache, stomach pain and back pain among school-children." Scandinavian Journal of Social Medicine 25(1): 58-63.
50. Laslett, M., C. Crothers, et al. (1991). "The frequency and incidence of low back pain/sciatica in an urban population." New Zealand Medical Journal 104(921): 424-6.
51. Lau, E. M., P. Egger, et al. (1995). "Low back pain in Hong Kong: prevalence and characteristics compared with Britain." J Epidemiol Community Health 49(5): 492-4.
52. Leboeuf-Yde, C. and K. O. Kyvik (1998). "At what age does low back pain become a common problem? A study of 29,424 individuals aged 12-41 years." Spine 23(2): 228-34.
53. Leino, P. I., M. A. Berg, et al. (1994). "Is back pain increasing? Results from national surveys in Finland during 1978/9-1992." Scandinavian Journal of Rheumatology 23(5): 269-76.
54. Liira, J. P., H. S. Shannon, et al. (1996). "Long-term back problems and physical work exposures in the 1990 Ontario Health Survey." American Journal of Public Health 86(3): 382-7.
55. Linton, S. J., A. L. Hellsing, et al. (1998). "A population-based study of spinal pain among 35-45-year-old individuals. Prevalence, sick leave, and health care use." Spine 23(13): 1457-63.
56. Mahajan, A., D. S. Jasrotia, et al. (2003). "Prevalence of major rheumatic disorders in Jammu." JK Science 5(2): 63-66.
57. Malek, J., V. Prikazsky, et al. (2003). "Prevalence of pain in the Czech Republic - A pilot study." Bolest 6(2): 113-122.
58. Manahan, L., R. Caragay, et al. (1985). "Rheumatic pain in a Philippine village. A WHO-ILAR COPCORD Study." Rheumatol Int 5(4): 149-53.
59. March, L. M., A. J. M. Brnabic, et al. (1998). "Musculoskeletal disability among elderly people in the community." Medical Journal of Australia 168(9): 439-442.
60. Mendoza-Sassi, R., J. U. BÃ©ria, et al. (2006). "Prevalence of signs and symptoms, associated sociodemographic factors and resulting actions in an urban center in southern Brazil [Portuguese]." Revista Panamericana de Salud PÃºblica 20(1): 22-28.
61. Minh Hoa, T. T., J. Darmawan, et al. (2003). "Prevalence of the rheumatic diseases in urban Vietnam: a WHO-ILAR COPCORD study.[erratum appears in J Rheumatol. 2003 Dec;30(12):2734 Note: Damarwan, John [corrected to Darmawan, John]; Shun Le, Chen [corrected to Chen, Shun Le]]." Journal of Rheumatology 30(10): 2252-6.
62. Miro, J., S. Paredes, et al. (2007). "Pain in older adults: a prevalence study in the Mediterranean region of Catalonia." Eur J Pain 11(1): 83-92.
63. Mohseni-Bandpei, M. A., M. Bagheri-Nesami, et al. (2007). "Nonspecific low back pain in 5000 Iranian school-age children." Journal of Pediatric Orthopedics 27(2): 126-9.
64. Moukhyer, M. E., N. K. de Vries, et al. (2006). "The prevalence of self-reported health problems and haemoglobin status of Sudanese adolescents." Journal of Adolescence 29(4): 613-26.
65. Murphy, S., P. Buckle, et al. (2007). "A cross-sectional study of self-reported back and neck pain among English schoolchildren and associated physical and psychological risk factors." Applied Ergonomics 38(6): 797-804.
66. Natvig, B., D. Bruusgaard, et al. (2001). "Localized low back pain and low back pain as part of widespread musculoskeletal pain: two different disorders? A cross-sectional population study." Journal of Rehabilitation Medicine 33(1): 21-5.
67. Neuhauser, H., U. Ellert, et al. (2005). "[Chronic back pain in the general population in Germany 2002/2003: prevalence and highly affected population groups]." Gesundheitswesen 67(10): 685-93.

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74. Picavet, H. S. J. and J. S. A. G. Schouten (2003). "Musculoskeletal pain in the Netherlands: prevalences, consequences and risk groups, the DMC(3)-study." Pain 102(1-2): 167-78.
75. Piko, B. (1999). "[Epidemiology of psychosomatic symptoms and subjective health evaluation among secondary school students]." Orvosi Hetilap 140(23): 1297-304.
76. Pinto-Meza, A., A. Serrano-Blanco, et al. (2006). "[Prevalence and physical-mental comorbidity of chronic back and neck pain in Spain: results from the ESEMeD Study]." Medicina Clinica 127(9): 325-30.
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79. Roth-Isigkeit, A., U. Thyen, et al. (2004). "Reports of pain among German children and adolescents: An epidemiological study." Acta Paediatrica, International Journal of Paediatrics 93(2): 258-263.
80. Santos-Eggimann, B., V. Wietlisbach, et al. (2000). "One-year prevalence of low back pain in two Swiss regions: estimates from the population participating in the 1992-1993 MONICA project." Spine 25(19): 2473-9.
81. Schmidt, C. O., H. Raspe, et al. (2007). "Back pain in the German adult population: prevalence, severity, and sociodemographic correlates in a multiregional survey." Spine 32(18): 2005-11.
82. Shiri, R., S. Solovieva, et al. (2008). "The association between obesity and the prevalence of low back pain in young adults: The Cardiovascular Risk in Young Finns Study." American Journal of Epidemiology 167(9): 1110-1119.
83. Silva, M. C. d., A. G. Fassa, et al. (2004). "[Chronic low back pain in a Southern Brazilian adult population: prevalence and associated factors]." Cadernos de Saude Publica 20(2): 377-85.
84. Skoffer, B. and A. Foldspang (2008). "Physical activity and low-back pain in schoolchildren." European Spine Journal 17(3): 373-379.
85. Skovron, M. L., M. Szpalski, et al. (1994). "Sociocultural factors and back pain. A population-based study in Belgian adults." Spine 19(2): 129-37.
86. Spahn, G., R. Schiele, et al. (2004). "[Prevalence of functional pain of the back, the hip and the knee in adolescents. Results of a cross-sectional study]." Deutsche Medizinische Wochenschrift 129(43): 2285-90.
87. Stranjalis, G., K. Tsamandouraki, et al. (2004). "Low back pain in a representative sample of Greek population: analysis according to personal and socioeconomic characteristics." Spine 29(12): 1355-60; discussion 1361.
88. Strine, T. W. and J. M. Hootman (2007). "US national prevalence and correlates of low back and neck pain among adults." Arthritis & Rheumatism 57(4): 656-65.
89. Svensson, H. O., G. B. Andersson, et al. (1988). "A retrospective study of low-back pain in 38- to 64-year-old women. Frequency of occurrence and impact on medical services." Spine 13(5): 548-52.
90. Taimela, S., U. M. Kujala, et al. (1997). "The prevalence of low back pain among children and adolescents. A nationwide, cohort-based questionnaire survey in Finland." Spine 22(10): 1132-6.
91. Thomas E, Peat G, Harris L, Wilkie R, Croft PR. The prevalence of pain and pain interference in a general population of older adults: cross-sectional findings from the North Staffordshire Osteoarthritis Project (NorStOP). Pain. 2004 Jul;110(1-2):361-8.
92. UK Department of Health. (1999). The prevalence of back pain in Great Britain in 1998, Crown Copyright
93. Unpublished study : Stefan Ma - Singapore NHSS 2007
94. Urwin, M., D. Symmons, et al. (1998). "Estimating the burden of musculoskeletal disorders in the community: the comparative prevalence of symptoms at different anatomical sites, and the relation to social deprivation.[see comment]." Annals of the Rheumatic Diseases 57(11): 649-55.
95. Veerapen, K., R. D. Wigley, et al. (2007). "Musculoskeletal pain in Malaysia: a COPCORD survey." Journal of Rheumatology 34(1): 207-13.
96. Walker, B. F., R. Muller, et al. (2004). "Low back pain in Australian adults: prevalence and associated disability." Journal of Manipulative & Physiological Therapeutics 27(4): 238-44.
97. Walsh, K., M. Cruddas, et al. (1992). "Low back pain in eight areas of Britain." Journal of Epidemiology & Community Health 46(3): 227-30.
98. Watson, K. D., A. C. Papageorgiou, et al. (2002). "Low back pain in schoolchildren: occurrence and characteristics." Pain 97(1-2): 87-92.
99. Waxman, R., A. Tennant, et al. (2000). "A prospective follow-up study of low back pain in the community." Spine 25(16): 2085-90.
100. Woo, J., S. C. Ho, et al. (1994). "Musculoskeletal complaints and associated consequences in elderly Chinese aged 70 years and over." Journal of Rheumatology 21(10): 1927-31.

Additional information was then derived from the World Health Surveys (50 countries, 1495 data points) [9]; Australian National Health Surveys (1995, 2001, 2003/04 and 2007/08; 43 data points) [10]; Australian Surveys of Disability, Ageing and Carers (2003 and 2009; 41 data points) [11]; and the US National Health Information surveys (2001-2008, 168 data points) [12] and NHANES (2009; 20 data points) [13].

Incidence

Ovid MEDLINE, EMBASE, CINAHL, CAB abstracts, WHOLIS, and SIGLE databases were searched using the following terms: *back pain, lumbar pain, back ache, backache, and lumbago* individually and combined with each of the following terms: *incidence, cohort study, and longitudinal study*. Searches were limited to studies from 1980 to 2009 and had no language limits. Reference lists of full papers of eligible abstracts from the original search were examined and any eligible titles were added to the search.

Inclusion and exclusion criteria were the same as those of the prevalence systematic review. There were 1485 results. The titles were examined for eligibility and 1303 were excluded. Duplicates were removed (n=41) and the abstracts of the remaining titles (n=141) were further examined for eligibility and those abstracts not relevant were excluded (n=126). Similar to the prevalence review, the most common reasons for exclusion of abstracts were that they referred to studies that were clearly not representative of the national population, or they contained no incidence data (Table S1.4).

Table S1.4: Exclusion of abstracts in low back pain incidence systematic review

Exclusion criteria	Frequency
A: Studies clearly not representative of the national population e.g. judo athletes, pregnant women, miners, or military	43
B: Studies that were not population-based e.g. hospital or clinic-based studies	26
C: Studies that provided no prevalence or incidence data e.g. a commentary piece or risk factor analysis	51
D: Studies on a specific type of low back pain e.g. vertebral fractures	1
E: Studies with a sample size less than 150	1
F: Reviews	4
Total	**126**

The full papers of the eligible abstracts were downloaded for all abstracts except two, which could not be located (Figure S1.2). The reference list for included studies is shown in Table S1.5.

Key and unadjusted results

There were few studies on incidence and substantial heterogeneity between them. Incidence of a *first-ever* episode of LBP (regardless of activity-limitation) was measured in five studies. Three of the studies measured one-year incidence, which ranged from 6.3% to 15.4% (mean: 9.7%) [14-16]; one measured two-year incidence (17.8%) [17], and one measured three-year incidence (18.1%) [18]. The mean one-year incidence from the five studies was 8.8%. None of the studies measured incidence of a first-ever episode of activity-limiting LBP, which is likely to be somewhat lower than the incidence of a first-ever episode of *any* LBP.

Six studies measured the incidence of an episode of LBP, and included both *first-ever and recurrent* episodes. One of the six studies measured the incidence of an episode that lasted or was expected to last greater than six months – annual incidence was 4.3% [19]. Of the remaining five studies, the annual incidence of any episode of LBP (regardless of activity-limitation) ranged from 1.5% to 45% (mean: 18.6%) [15, 20-23]. Two studies measured the incidence of activity-limiting LBP. The one-year incidence of activity-limiting LBP ranged from 15.9% to 18.4% (mean: 17.2%) [24, 25].

All retrieved incidence studies counted the number of *people* as the numerator rather than number of incident *episodes*. To account for those people who have more than one episode per year, the mean incidence of activity-limiting LBP (17.2%) would need to be multiplied by the average number of episodes of activity-limiting LBP a person with activity-limiting LBP will experience per year. Thus, the literature was searched for data on the recurrence of activity-limiting LBP.

Again, there was considerable methodological variation between study populations. Most studies were clinic-based, and some were occupational studies. Thus, they are unlikely to be representativeness of the general population; however, these were included in the absence of general population data. There is also vast variation in relation to what constitutes recurrence. Some studies define recurrence as time off work, some as *any* LBP, and others as *activity-limiting LBP*. Variation also exists in relation to the time that a case has to be pain and/or disability-free between episodes, and the time that a case has to have had pain and/or disability in their current episode before it is counted.

Seven studies were found that measured recurrence of *any* LBP. At one year from recovery, the proportion of people who had a recurrence ranged from 33% to 79% (mean: 60.3%; median: 62.3%) [20, 26-30]. For GBD 2010, recurrence was defined as a repeat episode of activity-limiting LBP. Only one study was found on recurrence of activity-limiting LBP. Trends from this indicated that approximately 20% of cases have a recurrent episode by one year, 27% by two years, and 33% by five years [31]. In this study, recurrence was defined as being unable to perform one's usual daily activities for more than one day.

Two studies were found that reported the average number of recurrences for *any* LBP (i.e., both activity-limiting and non-activity-limiting). One study reported 1.59 recurrences per year [27], and the other reported 0.62 per year [32]. These averages reflect the mean number of recurrences for all cases irrespective of whether they have a recurrence. All of these studies were clinic-based. Data on the average number of recurrences of activity-limiting LBP was not found, and consequently, incidence was unable to be used in the burden estimates.

Figure S1.2: Steps taken in the systematic review for low back pain incidence data.

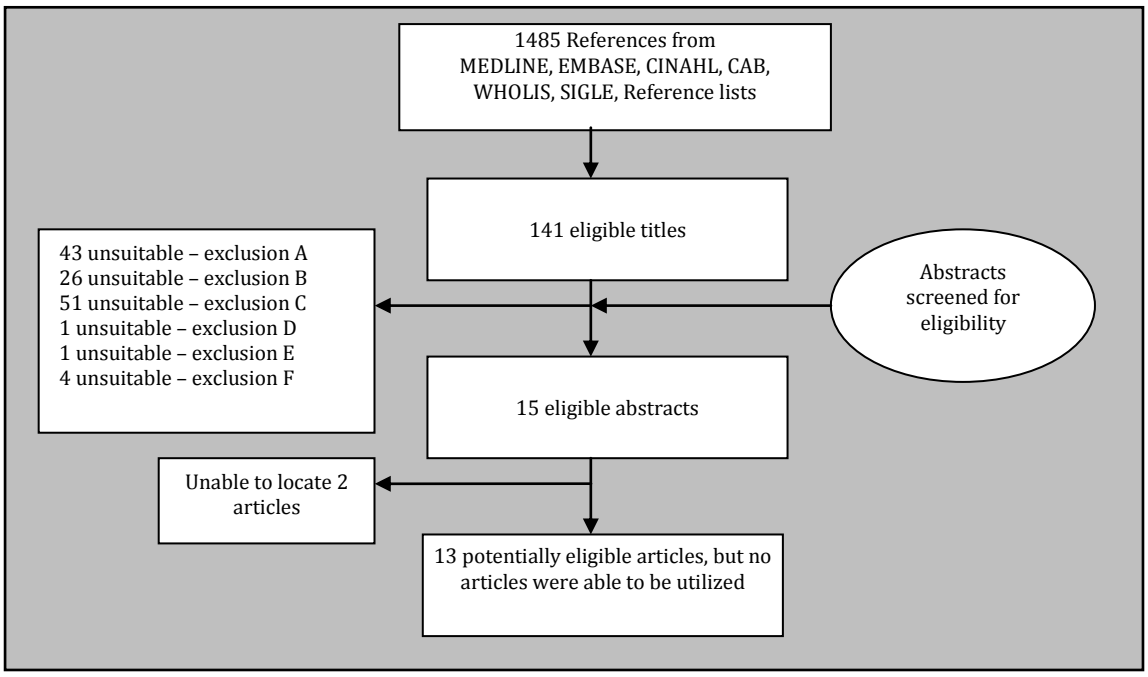


Table S1.5: Eligible studies retrieved from incidence systematic review (n=13)

1. Al-Awadhi AM, Olusi SO, Al-Saeid K, Moussa M, Shehab D, Al-Zaid N, et al. Incidence of musculoskeletal pain in adult Kuwaitis using the validated Arabic version of the WHO-ILAR COPCORD core questionnaire. Annals of Saudi Medicine. 2005;25(6):459-62.
2. Biering-Sorensen, F. (1982). "Low back trouble in a general population of 30-, 40-, 50-, and 60-year-old men and women. Study design, representativeness and basic results." Danish Medical Bulletin 29(6): 289-299.
3. Brattberg G. The incidence of back pain and headache among Swedish school children. Quality of Life Research. 1994 Dec;3 Suppl 1:S27-31.
4. Cassidy JD, Cote P, Carroll LJ, Kristman V. Incidence and course of low back pain episodes in the general population. Spine. 2005 Dec 15;30(24):2817-23.
5. Croft PR, Papageorgiou AC, Thomas E, Macfarlane GJ, Silman AJ. Short-term physical risk factors for new episodes of low back pain. Prospective evidence from the South Manchester Back Pain Study. Spine. 1999 Aug 1;24(15):1556-61.
6. George C. The six-month incidence of clinically significant low back pain in the Saskatchewan adult population. Spine. 2002 Aug 15;27(16):1778-82.
7. Haq S, Darmawan J, Islam N, Ahmed M, Banik S, Rahman A, et al. Incidence of musculoskeletal pain and rheumatic disorders in a Bangladeshi rural community: a WHO-APLAR-COPCORD study. International Journal of Rheumatic Diseases 2008;11:216-23.

8. Hestbaek L, Leboeuf-Yde C, Engberg M, et al. The course of low back pain in a general population: results from a 5-year prospective study. J Manipulative Physiol Ther 2003;26:213–9.
9. Jacob T, Zeev A. Are localized low back pain and generalized back pain similar entities? Results of a longitudinal community based study. Disability & Rehabilitation. 2006 Mar 30;28(6):369-77.
10. Kopec JA, Sayre EC, Esdaile JM. Predictors of back pain in a general population cohort. Spine. 2003 Jan 1;29(1):70-7; discussion 7-8.
11. Mustard CA, Kalcevich C, Frank JW, Boyle M. Childhood and early adult predictors of risk of incident back pain: Ontario Child Health Study 2001 follow-up. American Journal of Epidemiology. 2005 Oct 15;162(8):779-86.
12. Szpalski M, Gunzburg R, Balague F, Nordin M, Melot C. A 2-year prospective longitudinal study on low back pain in primary school children. European Spine Journal. 2002 Oct;11(5):459-64.
13. Waxman R, Tennant A, Helliwell P. A prospective follow-up study of low back pain in the community. Spine. 2000 Aug 15;25(16):2085-90.

Duration and remission

Ovid MEDLINE, EMBASE, CINAHL, CAB abstracts, WHOLIS, and SIGLE databases were searched using the following terms: *back pain, lumbar pain, back ache, backache, and lumbago* individually and combined with each of the following terms: *duration, remission, cohort study, and longitudinal study.* Searches were limited to studies from 1980 to 2009 and had no language limits. Reference lists of full papers of eligible abstracts from the original search were examined and any eligible titles were added to the search. Inclusion and exclusion criteria were the same as those of the prevalence systematic review, except Exclusion Criterion C referred to remission and duration studies not incidence or prevalence studies. There were 2109 results. The titles of these results were examined for eligibility and 1921 were excluded. Duplicates were removed (n=50) and the abstracts of the remaining titles (n=138) were further examined for eligibility. All abstracts were excluded (n=138).

The most common reason for exclusion of abstracts was that they contained no duration or remission data. Table S1.6 shows the distribution of exclusion across the

exclusion criteria. While no studies were found that measured duration or remission of an episode of activity-limiting LBP in the *general population*, a number of studies were found that measured the remission of an episode of LBP presenting to *primary care* (see Figure S1.3, and Table S1.7). However, the information was later considered too weak to generalize to all regions of the world.

Table S1.6: Exclusion of abstracts in low back pain duration and remission systematic review

Exclusion criteria	**Frequency**
A: Studies clearly not representative of the national population e.g. judo athletes, pregnant women, miners, or military	9
B: Studies that were not population-based e.g. hospital or clinic-based studies	18
C: Studies that provided no remission or duration data e.g. a commentary piece or risk factor analysis	97
D: Studies on a specific type of low back pain e.g. vertebral fractures	1
E: Studies with a sample size less than 150	5
F: Reviews	8
Total	**138**

Figure S1.3: Steps taken in the systematic review for low back pain duration and remission data.

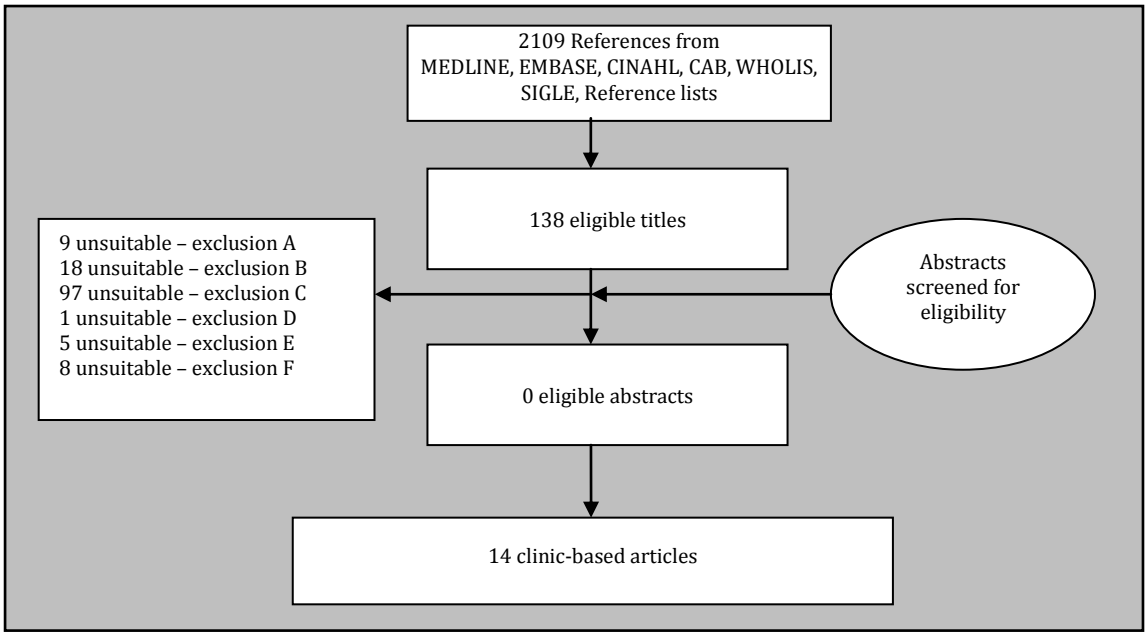


Table S1.7: Studies retrieved from duration/remission systematic review

1. Dunn KM, Jordan K, Croft PR. Characterizing the course of low back pain: a latent class analysis. American Journal of Epidemiology. 2006 Apr 15;163(8):754-61.
2. Jones GT, Johnson RE, Wiles NJ, Chaddock C, Potter RG, Roberts C, et al. Predicting persistent disabling low back pain in general practice: A prospective cohort study. British Journal of General Practice. 2006;56(526):334-41.
3. Hancock MJ, Maher CG, Latimer J, Herbert RD, McAuley JH. Can rate of recovery be predicted in patients with acute low back pain? Development of a clinical prediction rule. European Journal of Pain: Ejp. 2009 Jan;13(1):51-5.
4. Van den Hoogen HJM, Koes BW, Deville W, Van Eijk JTM, Bouter LM. The prognosis of low back pain in general practice. Spine. 1997;22(13):1515-21.
5. Schiottz-Christensen B, Nielsen GL, Hansen VK, Schodt T, Sorensen HT, Olesen F. Long-term prognosis of acute low back pain in patients seen in general practice: a 1-year prospective follow-up study. Family Practice. 1999 Jun;16(3):223-32.
6. Carey TS, Garrett J, Jackman A, et al. The outcomes and costs of care for acute low back pain among patients seen by primary care practitioners, chiropractors, and orthopedic surgeons. New Engl J Med 1995;333:913–7. AND Carey TS, Garrett JM, Jackman AM. Beyond the good prognosis. Examination of an inception cohort of patients with chronic low back pain. Spine. 2000 Jan;25(1):115-20. AND Personal communication T Carey 26/02/2010
7. Enthoven P, Skargren E, Oberg B. Clinical course in patients seeking primary care for back or neck pain: A prospective 5-year follow-up of outcome and health care consumption with subgroup analysis. Spine. 2004;29(21):2458-65.
8. Dunn KM, Croft PR, Main CJ, Von Korff M: A prognostic approach to defining chronic pain: replication in a UK

primary care low back pain population. Pain 2008, 135:48-54.

9. Nyiendo J, Haas M, Goldberg B, et al. Pain, disability, and satisfaction outcomes and predictors of outcomes: a practicebased study of chronic low back pain patients attending primary care and chiropractic physicians. J Manipulative Physiol Ther 2001;24:433–9.
10. Thomas E, Silman AJ, Croft PR, Papageorgiou AC, Jayson MIV, Macfarlane GJ (1999) Predicting who develops chronic low back pain in primary care: a prospective study. BMJ 318:1662– 1667
11. Von Korff M, Miglioretti DL: A prognostic approach to defining chronic pain. Pain 2005, 117:304-313.
12. Henschke N, Maher CG, Refshauge KM, Herbert RD, Cumming RG, Bleasel J, et al. Prognosis in patients with recent onset low back pain in Australian primary care: inception cohort study. BMJ. 2008;337:a171.
13. Costa Lda C, Maher CG, McAuley JH, Hancock MJ, Herbert RD, Refshauge KM, et al. Prognosis for patients with chronic low back pain: inception cohort study. Bmj. 2009;339:b3829.
14. Leboeuf-Yde C, Gronstvedt A, Borge JA, Lothe J, Magnesen E, Nilsson O, et al. The Nordic back pain subpopulation program: a 1-year prospective multicenter study of outcomes of persistent low-back pain in chiropractic patients. Journal of Manipulative & Physiological Therapeutics. 2005 Feb;28(2):90-6.

Mortality

There was no consistent and conclusive evidence that LBP is associated with an increased risk of mortality compared with the general population. Zhu et al. found those with back pain had a greater overall mortality risk (hazards ratio = 2.03; 95% confidence interval: 1.14 to 3.60) and a greater risk for death from coronary heart disease than those without back pain [33]. However, in two further studies, no relationship was found between mortality and back pain [34, 35]. Similarly, no evidence was found on case fatality, and cause-specific mortality. Further research is needed in this area.

Online supplementary file 2: Summary statistics for LBP case definition and prevalence period variations derived from systematic review and regression analysis

Variable	Observations	Prevalence			Regression results		
		Mean (%)	95% CI LL	95% CI UL	Coefficient	95% CI LL	95% CI UL
Prevalence period							
Point	185	18.2	16.7	19.7			
One day	8	16.9	8.9	24.9	-0.089	-0.249	0.072
One week	97	25.6	22.0	29.2	0.142	0.070	0.215
Two weeks	22	34.3	29.1	39.5	0.341	0.237	0.444
One month	150	27.6	25.2	30.0	0.345	0.285	0.405
Two months	1	35.1	.	.	0.353	-0.089	0.794
Three months	21	35.5	28.8	42.2	0.494	0.381	0.607
Six months	35	50.8	45.1	56.4	0.576	0.490	0.661
One year	254	38.7	36.3	41.0	0.490	0.443	0.538
Anatomical case definition							
Back	166	29.6	27.2	32.0			
Low back	246	26.8	24.6	29.1	0.048	-0.008	0.104
Lumbar	26	11.5	8.5	14.6	-0.441	-0.557	-0.326
Lumbar or sacro-iliac joint(s)	8	15.7	13.6	17.8	-0.120	-0.301	0.061
Neck or back	18	22.3	19.5	25.0	-0.760	-1.039	-0.481
C7 to lower GFs[*]	28	56.8	49.3	64.2	0.565	0.448	0.683
R12 to lower GFs[†]	235	32.5	30.2	34.8	0.152	0.080	0.224

Thoracic or lumbar	18	48.0	43.9	52.2	0.306	0.179	0.433
Thoraco-lumbo-sacral	27	28.9	22.6	35.2	0.214	0.087	0.340
Minimum episode duration							
Not specified	515	32.9	31.2	34.6			
One day	154	27.6	25.3	30	-0.126	-0.179	-0.074
Three days	1	67.8	.	.	0.332	-0.105	0.770
One week	28	23.8	21	26.5	-0.459	-0.567	-0.350
Seven weeks	8	4.4	2.7	6.1	0.041	-0.161	0.243
Three months	30	19.6	17.1	22	-0.214	-0.305	-0.123
Chronic	21	23.9	19.5	28.2	0.365	0.105	0.626
Six months	15	11.6	8.6	14.6	-0.432	-0.552	-0.312

[*]'Posterior aspect of the body from the seventh cervical vertebra to the lower gluteal folds'

[†]'Posterior aspect of the body from the lower margin of the twelfth ribs to the lower gluteal folds'

Online supplementary file **3: Modeling low back pain in DisMod-MR**

All LBP prevalence data from the systematic review (780 estimates) as well as the additional information derived from the World Health Surveys (1495 estimates), Australian National Health Surveys (1995, 2001, 2003/04 and 2007/08; 43 data points), Australian Surveys of Disability, Ageing and Carers (2003 and 2009; 41 data points), and the US National Health Information surveys (2001-2008, 168 data points) and NHANES (2009; 20 data points) were entered into DisMod-MR.

Dataset	**LOW BACK PAIN**
Model number	#41426
Priors set by	Theo Vos
Link	http://winthrop.ihme.washington.edu/dismod/summary/41426
	Input Prevalence; Set mortality to zero; Set the bounds around remission.

PRIOR SETTINGS

	Smoothness			**Heterogeneity**	**Level Value**			**Level Bounds**		**Increasing**		**Decreasing**		**Unimodal**	
	Degree	**Age Start**	**Age End**	**Degree**	**Value**	**Age Before**	**Age After**	**Lower**	**Upper**	**Age Start**	**Age End**	**Age Start**	**Age End**	**Age Start**	**Age End**
Prevalence	Slightly	0	100	Very	0.0	5	100	0	1.0	0	0	0	0	0	0
Incidence	Slightly	0	100	Slightly	0.0	0	100	0	1.0	0	0	0	0	0	0
Remission	Slightly	0	100	Slightly	0.0	0	100	1.36	2.06	0	0	0	0	0	0
Excess Mortality	Slightly	0	100	Slightly	0.0	100	100	0	1.0	0	0	0	0	0	0
Duration	No Prior	0	100	Slightly	10.0	0	100	0	100.0	0	0	0	0	0	0
Relative Risk	No Prior	0	100	Slightly	1.0	100	100	1	1000.0	0	0	0	0	0	0

Prevalence period and case definition variations were dealt with using the Bayesian approach to ensure estimates were aligned to how LBP is defined in GBD 2010. For example, a ratio of 2.39 for ‘period prevalence (3 months to 1 year): point prevalence’

means that estimates for studies pertaining to a period prevalence of 3 months to 1 year were 2.39 times higher than for point prevalence. DisMod accordingly adjusts such data points down by 139%. Note that these adjustments are applied in the prior calculation phase in DisMod-MR but the final results are evaluated based on the adjusted priors and the actual data for each country and region. Thus, while the coefficient for sex indicates that male estimates are 15% higher than for females, the actual results show a smaller sex differential.

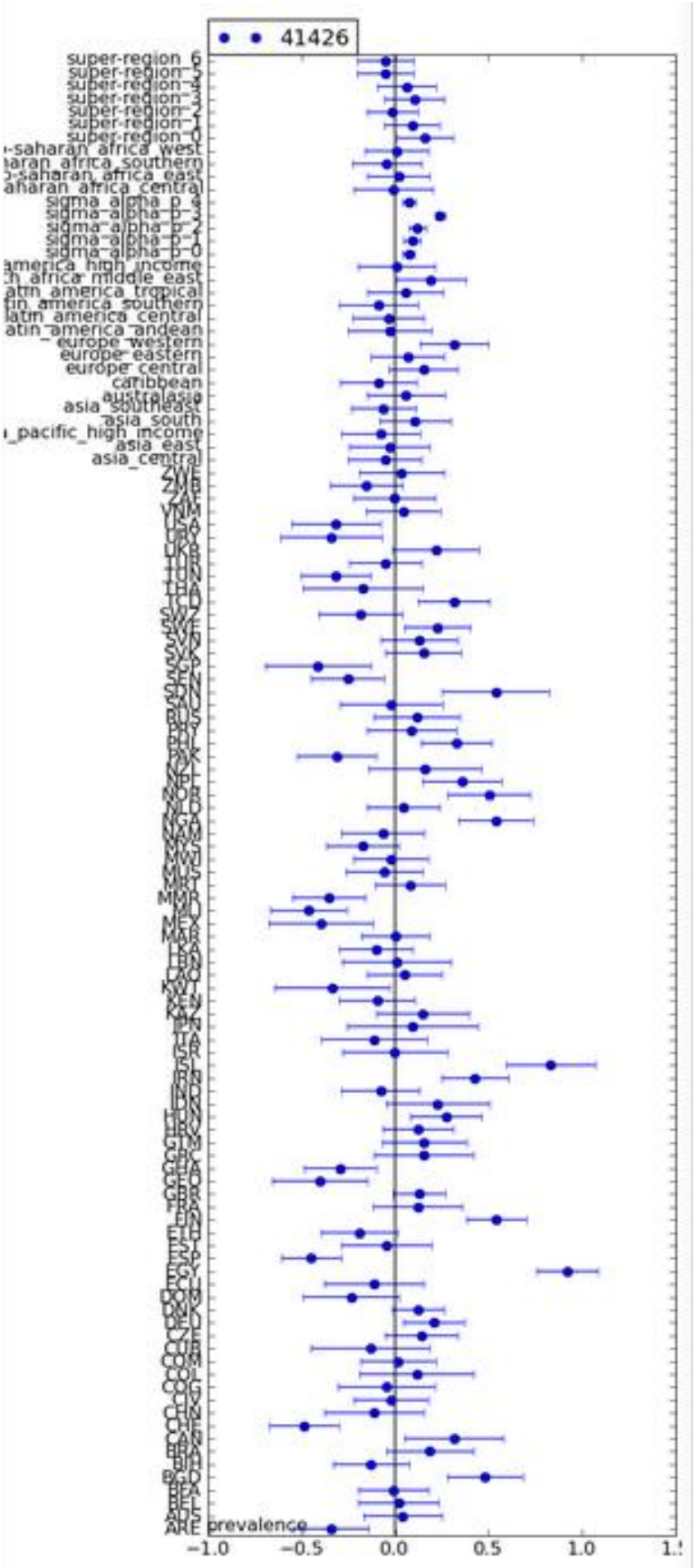
Table S3.2: The ratios generated from the Bayesian meta-regression to convert all low back pain estimates to align with the desired case definition*, GBD 2010

Description	**Ratio (95% CI)**
Male: female	1.15 (1.11-1.19)
Period prevalence (3 months to 1 year): point prevalence	2.39 (2.27-2.52)
Period prevalence (1 week to 2 months): point prevalence	1.28 (1.20-1.35)
Minimum episode duration (3 months or more): desirable minimum episode duration	0.72 (0.65-0.79)
Thoraco-lumbar region: desirable anatomical location	1.38 (1.11-1.19)
Lumbar, 'lumbar or SIJs', 'neck or back': desirable anatomical location	0.67 (0.60-0.75)
Activity limiting: activity **and** non-activity limiting	0.50 (0.43-0.57)

*Point prevalence of LBP lasting >1 day

The ‘empirical prior’ was then estimated, which involved generating an age pattern for each parameter independently and by imputing regional estimates from the data supplied. It is a line of best fit through the data, and generates an age pattern for each sex/region/year grouping (e.g., males, Europe, Western, 1990; females, Asia, Southeast, 2010 etc.). The posteriors were then run, which involved deriving an internally-consistent full set of disease parameters for each age/sex/region/year grouping using the empirical priors, whilst also estimating values for the missing parameters.

Random effects for countries, regions and *super-regions* are shown below. It shows that most of the variation is driven by country random effects apart from a bit higher random effect for all of Western Europe and the high income region. The higher prevalence estimates for the North Africa Middle East region are driven by high prevalence data points from Egypt and Iran. In Western Europe, Finland, Sweden and Germany are pushing up the regional estimates.


41426
super-region_6
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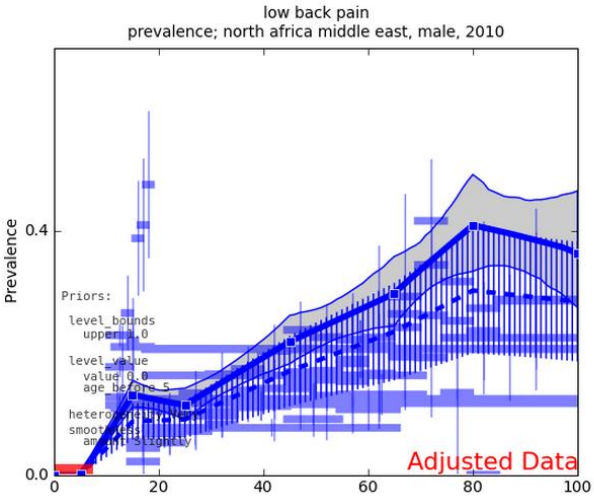
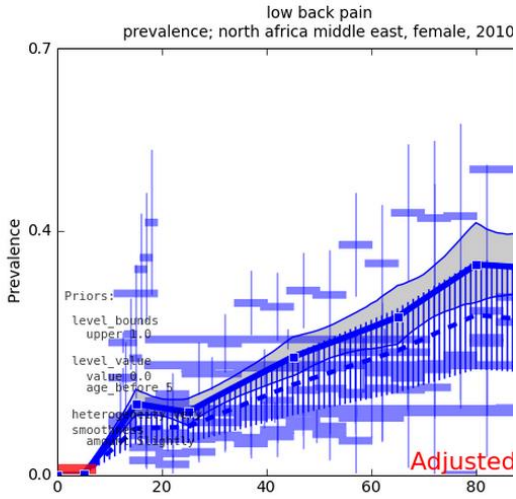
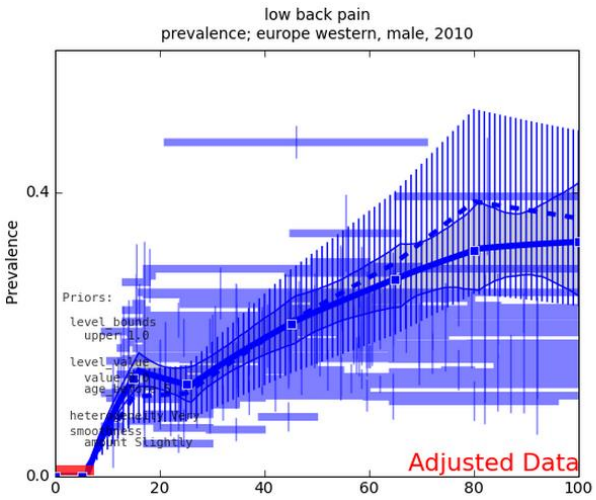
super-region_4
super-region_3
super-region_2
super-region_1
super-region_0
sigma_alpha_p_4
sigma_alpha_p_3
sigma_alpha_p_2
sigma_alpha_p_1
sigma_alpha_p_0
europe_western
europe_eastern
europe_central
caribbean
australasia
asia_southeast
asia_south
asia_east
asia_central
prevalence
−1.0
−0.5
0.0
0.5
1.0

A selection of high and low regional prevalence plots for 2010 are shown below. The horizontal bars indicate study data points and their age range; the vertical line through each reflects the 95% confidence interval. The dashed line reflects the prior, a Bayesian statistical term, which reflects the internally consistent estimates of each parameter at the level of the world taking into account the covariates at study and country level. The solid line represents the posterior, another Bayesian statistical term, which reflects the final calculation after updating the prior with data for that region and time period. The grey area around the solid line of the posterior represents the 95% uncertainty interval, which can be interpreted as a confidence interval in traditional statistics.

It is important to note the uncertainty intervals are around the estimates. This reflects the heterogeneity in prevalence estimates even after taking into account variations in measurement by applying the covariate 'crosswalks' to adjust data points with measurement characteristics that deviated from our GBD 2010 case definition. Note, the crosswalk is used to describe adjustments to data points that are affected by a systematic bias upwards or downwards due to non-reference study methods






low back pain
prevalence; europe western, male, 2010
Prevalence
0.0
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Priors:
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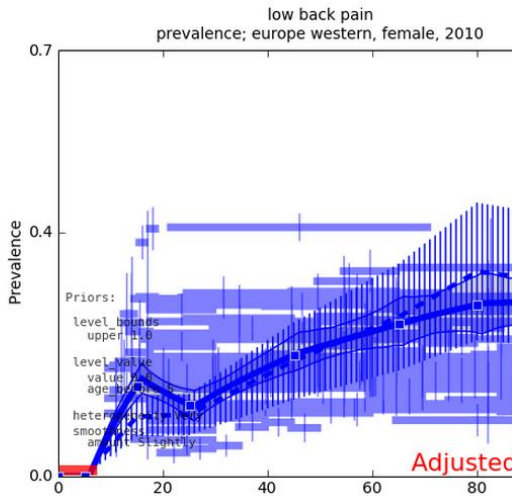
level_value
value 0.0
age_before 5
heterogeneity Very
smoothness
amount Slightly
Adjusted Data


low back pain
prevalence; europe western, female, 2010
Prevalence
0.0
0.4
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Priors:
level_bounds
upper 1.0
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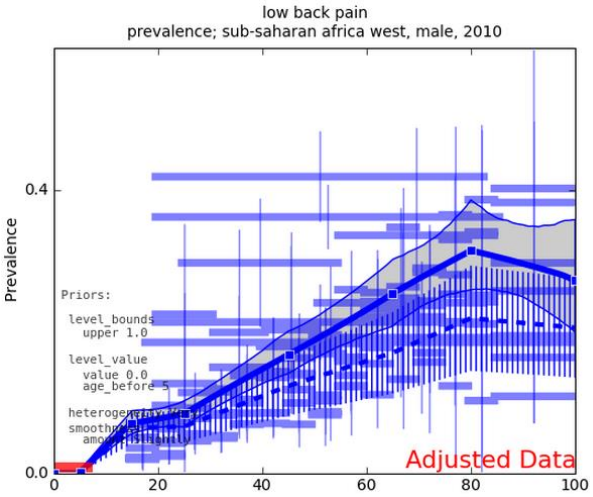
value 0.0
age_before 5
heterogeneity Very
smoothness
amount Slightly
Adjusted


low back pain
prevalence; sub-saharan africa west, male, 2010
Prevalence
0.0
0.4
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Priors:
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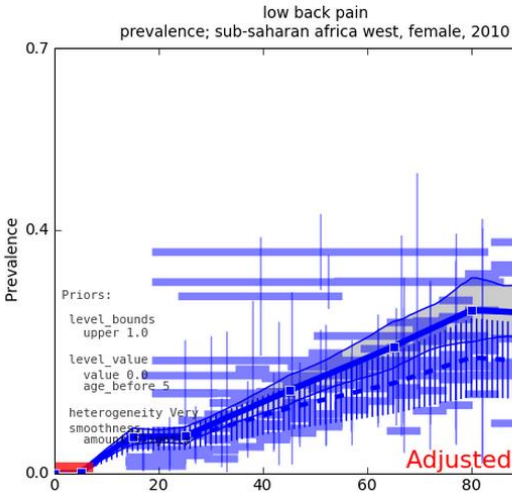
age_before 5
heterogeneity Very
smoothness
amount Slightly
Adjusted Data


low back pain
prevalence; sub-saharan africa west, female, 2010
Prevalence
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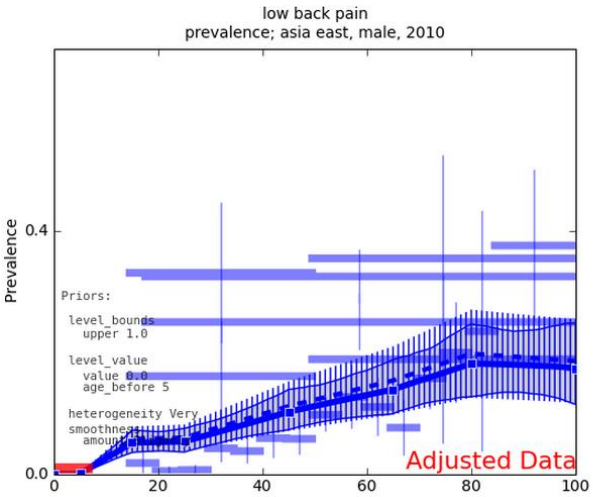
heterogeneity Very
smoothness
amount Slightly
Adjusted


low back pain
prevalence; asia east, male, 2010
Prevalence
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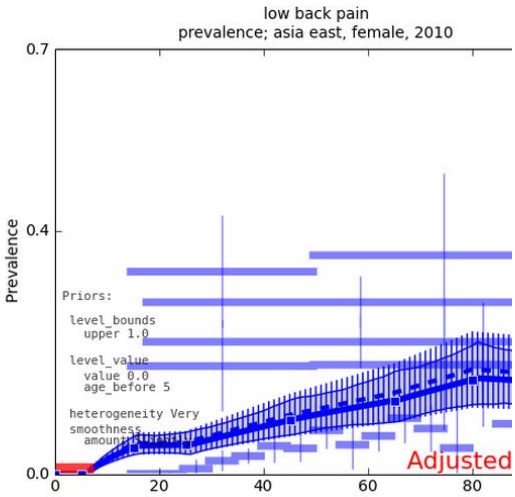
smoothness
amount Slightly
Adjusted Data


low back pain
prevalence; asia east, female, 2010
Prevalence
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heterogeneity Very
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amount Slightly
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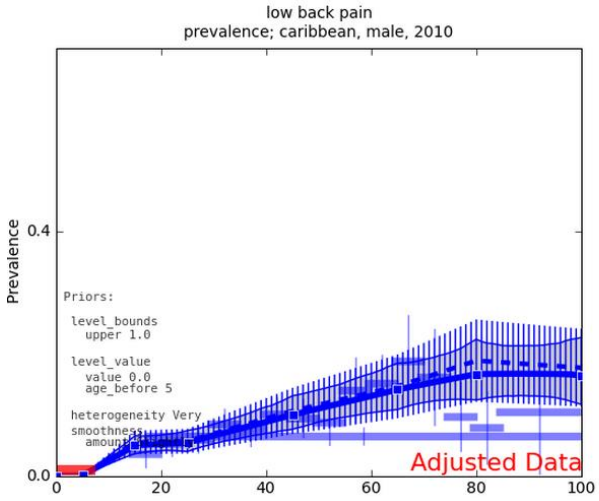

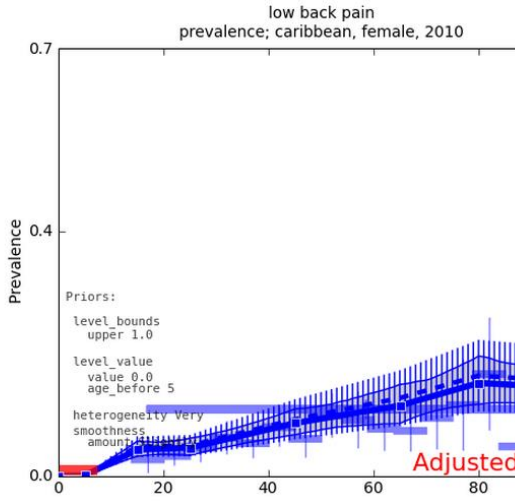

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