Intervertebral Disc Disease of the Lumbar Spine in Health Personnel with Occupational Exposure to Patient Handling—A Systematic Literature Review and Meta-Analysis

Subjects: Pathology & Pathobiology
Created by: Christofer Schröder

Lifting or carrying loads or working while the trunk is in a bent position are well established risk factors for the development of disc disease of the lumbar spine (LDD). Patient handling is associated with certain hazardous activities, which can result in exposure to heavy loads and high pressure for the discs of the lumbar spine of the nurses performing these tasks. The purpose of this review was to examine the occurrence of work-related LDD among health personnel (HP) with occupational exposure to patient handling activities in comparison to un-exposed workers. A systematic literature search was conducted using the following databases: PubMed, CINAHL, Scopus, and Web of Science. A meta-analysis of odds ratios (OR) was conducted by stratifying for various factors. Five studies reported a higher prevalence for LDD among nurses and geriatric nurses (11.3–96.3%) compared to all controls (3.78–76.47%). Results of the meta-analysis showed a significantly increased OR for LDD among HP compared to all controls (OR 2.45; 95% confidence interval (CI) 1.41, 4.26). In particular, the results of this review suggest that nurses have a higher probability of developing disc herniation than office workers.

1. Definition

The terminology of disc disease includes various definitions and pathophysiology. The intervertebral disc connects adjacent vertebrae of the spinal column to each other and absorbs mechanical loads. It enables flexion, extension, bending, and rotation of the spine. Intervertebral disc disease leads to instability, stenosis, and deformity of the locomotor segments of the spine. Disc degeneration is defined as wear-related, morphological changes in the intervertebral disc tissue. Due to reduced water retention and reduced elasticity, the intervertebral discs are restricted in their ability to absorb and distribute pressure. There is a risk of tearing of the fibrous ring (annulus fibrosus). The consequence is a reduction in the height of the intervertebral space, resulting in a restriction of function and increased stress on the osseous parts of the joint, which leads to arthrosis. In a herniated disc, tissue is displaced or leaks from the nucleus pulposus of the disc through mostly degenerative or rarely traumatic tears in the annulus fibrosus. Disc herniation includes protrusion/bulging of the intervertebral disc in a dorsal direction.

2. Introduction

Intervertebral disc disease of the lumbar spine (LDD) has been identified as one of the main causes of low back pain that affects almost everyone, especially adults. LDD is widespread and has a multifactorial etiology. In addition, LDD is not easy to diagnose, as radiologic alterations of the disc do not necessarily mean disease. They become a disease when they are associated with typical symptoms. LDD is associated with genetic factors, ageing, smoking, lack of exercise, and obesity.

People develop LDD more frequently while carrying out certain professional activities. Work-related LDD is essentially caused or aggravated by lifting or carrying loads or working with the trunk in a bent position. Special characteristics of lifting or carrying of loads includes load handling operations such as transferring or setting down as well as holding, pulling, or pushing loads. An additional risk is associated with lifting and carrying heavy loads and work in a position that involves extreme bending of the trunk, if they are performed in a twisted posture. An increased risk for the development of LDD has been established for nursing staff and among nursing assistants.

Health personnel (HP) with occupational exposure to patient handling activities usually support a considerable part of the patients’ body weight and act in an unfavorable posture, which is characterized by...
strong bending, lateral inclination, and often simultaneous twisting of the upper body, which leads to a high load on the intervertebral disc \([19]\). Certain hazardous activities were identified in patient handling where the load is of such an extent that the spinal column of the nursing staff is overloaded \([20]\,[21]\). Such activities include raising a patient from a lying position to a sitting position in bed or at the bed’s edge; moving a lying patient towards the head of the bed (nurse at the bed’s long side or at the head of the bed) or sideways in the bed; inclining the head of the bed with a patient lying in it; positioning or removing a bedpan; moving a patient seated at the bed’s edge to a chair; and raising a patient from sitting to standing upright \([22]\,[23]\,[24]\,[25]\). Moreover, working in an inclined posture, such as washing, mobilizing, or changing beds, is considered to be an additional risk factor for back disorders. Among nursing staff, patient handling is one of the most important risk factors of lumbar spine complaints \([26]\,[27]\,[28]\), but it is also practiced by physiotherapists, rescue service personnel, hospital porters, or outpatient nursing staff, among others.

### 3. Latest Research

A systematic literature search was conducted using four databases (PubMed; CINAHL; Scopus; Web of Science). The systematic electronic search did not apply any language restrictions. The search string was created sensitively by combining the keywords with Boolean operators. The search string was created sensitively by combining the keywords with Boolean operators. Studies were included according to the PICOS-strategy. A meta-analysis of odds ratios (OR) was conducted by stratifying for various factors.

**PICOS-strategy**

1. **P**: Health personnel
2. **I (E)**: Manual patient transfer, patient transfer with small or technical patient handling aids, performing nursing activities, job-title based exposure
3. **C**: General population, other occupational groups, subgroups within HP, or self-comparison over time
4. **O**: Specific disease of the lumbar spine such as disc degeneration, disc herniation, disc protrusion, disc bulging, spondylosis, modic changes, and endplate changes
5. **S**: Any design involving a comparison group

All studies reported a higher prevalence of LDD for HP with occupational exposure to patient handling compared to controls, with the exception being hospital porters, who had a marginally lower prevalence of LDD than office workers. All included studies that examined nurses showed an increased effect measure for LDD among nurses compared to the reference groups. Nurses in intensive care units (ICU) and operating theatres (OP) had a non-significant lower risk of disc degeneration than clinic nurses. The pooled analysis of all studies showed a significantly increased OR of 2.45 (95% CI 1.41, 4.26). A stratification through the sole inclusion of nurses and geriatric nurses as an exposure group and office workers as a comparison group, nurses and geriatric nurses showed a significantly increased OR of disc herniation compared to office workers (OR 2.70; 95% CI 1.61, 4.55).

**References**

1. Makarand V. Risbud; Irving M. Shapiro; Role of cytokines in intervertebral disc degeneration: pain and disc content. *Nature Reviews Rheumatology* **2013**, 10, 44-56, 10.1038/nrrheum.2013.160.
2. Daisuke Sakai; Gunnar B. J. Andersson; Stem cell therapy for intervertebral disc regeneration: obstacles and solutions. *Nature Reviews Rheumatology* **2015**, 11, 243-256, 10.1038/nrrheum.2015.13.
3. Jun Lu; Xiaotao Wu; Yonggang Li; Xiangfei Kong; Surgical results of anterior corpectomy in the aged patients with cervical myelopathy. *European Spine Journal* **2007**, 17, 129-135, 10.1007/s00586-007-0518-4.
4. Xiaotao Wu; Suyang Zhang; Zubin Mao; Hui Chen; Microendoscopic Discectomy for Lumbar Disc Herniation. *Spine* **2006**, 31, 2689-2694, 10.1097/01.brs.0000244615.43199.07.
5. Pschyrembel online . Augsburg. Retrieved 2020-7-14
6. Gunnar Bj Andersson; Epidemiological features of chronic low-back pain. *The Lancet* **1999**, 354, 581-585, 10.1016/s0140-6736(99)01312-4.
7. Luigi Aurelio Nasto; Kevin Ngo; Adriana S. Leme; Andria R. Robinson; Qing Dong; Peter Roughley; Arvydas Usas; Gwendolyn A. Sowa; Enrico Pola; James Kang; et al.Laura J. NiedernhoferSteven ShapiroNam Vo Investigating the role
of DNA damage in tobacco smoking-induced spine degeneration. *The Spine Journal* **2013**, *14*, 416-23, 10.1016/j.spinee.2013.08.034.

8. Evelien De Schepper; Jurgen Damen; Joyce B. J. Van Meurs; Abida Z. Ginai; Maria Popham; Albert Hofman; Bart W. Koes; Sita M. Bierma-Zeinstra; The Association Between Lumbar Disc Degeneration and Low Back Pain. *Spine* **2010**, *35*, 531-536, 10.1097/BRS.0b013e3181a5b33.

9. Jason Pui Yin Cheung; Jaro Karppinen; Danny Chan; Daniel Wai Hung Ho; You-Qiang Song; Pak Sham; Kathryn Song Eng Cheah; John C. Y. Leong; Keith D. K. Luk; Prevalence and Pattern of Lumbar Magnetic Resonance Imaging Changes in a Population Study of One Thousand Forty-Three Individuals. *Spine* **2009**, *34*, 934-940, 10.1097/BRS.0b013e3181a01b3f.

10. F. Wang; F. Cai; R. Shi; X.-H. Wang; X.-T. Wu; Aging and age related stresses: a senescence mechanism of intervertebral disc degeneration. *Osteoarthritis and Cartilage* **2016**, *24*, 398-408, 10.1016/j.joca.2015.09.019.

11. Fabrizio Russo; Roberto A. Hartman; Kevin M. Bell; Nam Vo; Gwendolyn A. Sowa; James D. Kang; Gianluca Vadalaí; Vincenzo Denaro; Biomechanical Evaluation of Transpedicular Necrotomy With Intact Annulus Fibrosus. *SPINE* **2017**, *42*, E193-E201, 10.1097/BRS.0000000000001762.

12. M. Teraguchi; N. Yoshimura; Hiroshi Hashizume; Shigeyuki Muraki; H. Yamada; A. Minamide; H. Oka; Y. Ishimoto; Keiji Nagata; R. Kagotani; et al.N. TakiguchiT. AkunéH. KawaguchiK. NakamuraM. Yoshiida Prevalence and distribution of intervertebral disc degeneration over the entire spine in a population-based cohort: the Wakayama Spine Study. *Osteoarthritis and Cartilage* **2014**, *22*, 104-110, 10.1016/j.joca.2013.10.019.

13. Francesca Cannata; Gianluca Vadalaí; Luca Ambrosio; Sara Fallucca; Nicola Napoli; Rocco Papozilli; Paolo Pozzilli; Vincenzo Denaro; Intervertebral disc degeneration: A focus on obesity and type 2 diabetes. *Diabetes/Metabolism Research and Reviews* **2019**, *36*, e3224, 10.1002/dmrr.3224.

14. Luciana Macedo; Michele C. Battilé; The association between occupational loading and spine degeneration on imaging - a systematic review and meta-analysis. *BMC Musculoskeletal Disorders* **2019**, *20*, 489-15, 10.1186/s12891-019-2835-2.

15. M. Estryn-Behar; M. Kaminski; E. Peigne; M. F. Maillard; A. Pelletier; C. Berthier; M. F. Delaporte; M. C. Paoli; J. M. Leroux; Strenuous working conditions and musculo-skeletal disorders among female hospital workers. *International Archives of Occupational and Environmental Health* **1990**, *62*, 47-57, 10.1007/bf00397848.

16. Kaplan, R. M. Deyo, R. A.; Back pain in health care workers. *Occup. Med.* **1988**, *3*, 61-73.

17. P J Venning; S D Walter; L W Stitt; Personal and job-related factors as determinants of incidence of back injuries among nursing personnel. *Journal of occupational medicine. : official publication of the Industrial Medical Association* **1987**, *29*, 820-825.

18. T Videman; T Nurminen; S Tola; I Kuorinka; H Vanharanta; J D G Troup; Low-Back Pain in Nurses and Some Loading Factors of Work. *Spine* **1984**, *9*, 400-404, 10.1097/00007632-198405000-00013.

19. S S Ulin; D B Chaffin; C L Patellos; S G Blitz; C A Emerick; F Lundy; L Misher; A biomechanical analysis of methods used for transferring totally dependent patients. *SCI nursing : a publication of the American Association of Spinal Cord Injury Nurses* **1997**, *14*, 19-27.

20. Eric Bakker; Arianne P. Verhagen; Emiel Van Trijffel; Cees Lucas; Bart W. Koes; Spinal Mechanical Load as a Risk Factor for Low Back Pain. *Spine* **2009**, *34*, E281-E293, 10.1097/BRS.0b013e318195b257.

21. Daniel Cury Ribeiro; Daniela Aldabe; J. Haxby Abbott; Gisela Sole; Stephan Milosavljevic; Dose-response relationship between work-related cumulative postural exposure and low back pain: A systematic review. *The Annals of Occupational Hygiene* **2012**, *56*, 684-696, 10.1093/annhyg/mes003.

22. Alex Burdorf; Elin Koppelaar; Bradley A. Evanoff; Assessment of the impact of lifting device use on low back pain and musculoskeletal injury claims among nurses. *Occupational and Environmental Medicine* **2013**, *70*, 491-497, 10.1136/oemed-2012-101210.

23. Matthias Jäger; Claus Jordan; Andreas Theilmeier; Norbert Wortmann; Stefan Kuhn; Albert Nienhaus; Alwin Luttmann; Lumbar-Load Analysis of Manual Patient-Handling Activities for Biomechanical Overload Prevention Among Healthcare Workers. *The Annals of Occupational Hygiene* **2012**, *57*, 528-544, 10.1093/annhyg/mes088.

24. B Schibye; A.Faber Hansen; C T Hye-Knudsen; M Essendrop; M Bocher; J Skotte; Biomechanical analysis of the effect of changing patient-handling technique. *Applied Ergonomics* **2003**, *34*, 115-123, 10.1016/s0003-6870(03)00003-6.

25. J.H. Skotte; M. Essendrop; A.F. Hansen; B. Schibye; A dynamic 3D biomechanical evaluation of the load on the low back during different patient-handling tasks. *Journal of Biomechanics* **2002**, *35*, 1357-1366, 10.1016/s0021-9290(02)00181-1.

26. Inga-Lill Engkvist; Back injuries among nurses – A comparison of the accident processes after a 10-year follow-up. *Safety Science* **2008**, *46*, 291-301, 10.1016/j.ssci.2007.06.001.

27. Inga-Lill Engkvist; Ewa Wigaeus Hjelm; Mats Hagberg; Ewa Menckel; Lena Ekenvall; Risk Indicators for Reported Over-Exertion Back Injuries among Female Nursing Personnel. *Epidemiology* **2000**, *11*, 519-522, 10.1097/00001648-200009000-00006.

28. Annalee Yassi; Karen Lockhart; Work-relatedness of low back pain in nursing personnel: a systematic review.
International Journal of Occupational and Environmental Health 2013, 19, 223-244, 10.1179/2049396713y.0000000027.

Keywords
Health personnel; occupational exposure; patient handling; intervertebral disc disease; disc degeneration; musculoskeletal disorders

Retrieved from https://encyclopedia.pub/1929