

Review Article

The relationship between obesity, low back pain, and lumbar disc degeneration when genetics and the environment are considered: a systematic review of twin studies

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Abstract

BACKGROUND CONTEXT: The relationships between obesity and low back pain (LBP) and lumbar disc degeneration (LDD) remain unclear. It is possible that familial factors, including genetics and early environment, affect these relationships.

PURPOSE: To investigate the relationship between obesity-related measures (eg, weight, body mass index [BMI]) and LBP and LDD using twin studies, where the effect of genetics and early environment can be controlled.

STUDY DESIGN: A systematic review with meta-analysis.

METHODS: MEDLINE, CINAHL, Scopus, Web of Science, and EMBASE databases were searched from the earliest records to August 2014. All cross-sectional and longitudinal observational twin studies identified by the search strategy were considered for inclusion. Two investigators independently assessed the eligibility, conducted the quality assessment, and extracted the data. Meta-analyses (fixed or random effects, as appropriate) were used to pool studies' estimates of association.

RESULTS: In total, 11 articles met the inclusion criteria. Five studies were included in the LBP analysis and seven in the LDD analysis. For the LBP analysis, pooling of the five studies showed that the risk of having LBP for individuals with the highest levels of BMI or weight was almost twice that of people with a lower BMI (odds ratio [OR] 1.8; 95% confidence interval [CI] 1.6–2.0; $I^2=0\%$). A dose-response relationship was also identified. When genetics and the effects of a shared early environment were adjusted for using a within-pair twin case-control analysis, pooling of three studies showed a reduced but statistically positive association between obesity and prevalence of LBP (OR 1.5; 95% CI 1.1–2.1; $I^2=0\%$). However, the association was further diminished and not significant (OR 1.4; 95% CI 0.8–2.3; $I^2=0\%$) when pooling included two studies on monozygotic twin pairs only. Seven studies met the inclusion criteria for LDD. When familial factors were not controlled for, body weight was positively associated with LDD in all five cross-sectional studies. Only two cross-sectional studies investigated the relationship between obesity-related measures and LDD accounting for familial factors, and the results were conflicting. One longitudinal study in LBP and three longitudinal studies in LDD found no increase in risk in obese individuals, whether or not familial factors were controlled for.

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CONCLUSIONS: Findings from this review suggest that genetics and early environment are possible mechanisms underlying the relationship between obesity and LBP; however, a direct causal link between these conditions appears to be weak. Further longitudinal studies using the twin design are needed to better understand the complex mechanisms underlying the associations between obesity, LBP, and LDD. © 2015 Elsevier Inc. All rights reserved.

Keywords: Obesity; Body mass index; Body weight; Low back pain; Lumbar disc degeneration; Genetics; Twins

Introduction

Low back pain (LBP) is a major health problem globally [1], being the largest contributor to the number of years that people live with disability [2]. Although decades of research have been dedicated to identifying the etiology of LBP, the factors that trigger an episode of LBP remain unclear [3], limiting the possibility of designing effective preventative strategies. A variety of factors have inconsistently been found to be associated with LBP, and the increased risk has been small. One of these factors, obesity, is a potential target for prevention strategies, and therefore, it has been the focus of several studies in the field [4,5].

Obesity is recognized as a major public health problem, and its prevalence is increasing rapidly in westernized countries [6,7]. Obese individuals are at higher risk of developing a wide spectrum of chronic diseases such as diabetes, cardiovascular disease, cancer, and musculoskeletal disorders, such as spinal problems [8]. Body weight, an important factor related to spinal loading, has been associated with several signs of lumbar disc degeneration (LDD), including disc space narrowing [9] and decreased signal intensity of the lumbar intervertebral discs [10]. Despite controversy [11–13], LDD has been proposed as one of the main risk factors of LBP [10,14].

Previous studies have suggested that familial factors (ie, early environmental and genetic influences) play an important role on obesity, LBP, and LDD. According to twin studies, the estimated contribution from heritability for total body fat ranges between 70% and 80% [15], for LBP between 30% and 46% [16], and for LDD the contribution ranges between 47% and 60% [14], suggesting a major genetic component in these conditions. However, most studies that investigated the relationship between obesity, LBP, and LDD did not account for genetic or early environmental factors, which might explain their conflicting findings.

Twin studies represent a unique and powerful design for investigating risk factors for health conditions as they allow controlling for various confounders, including genetic factors, consequently providing more precise estimates of risk. To our knowledge, there has been no published systematic review specifically investigating the relationship between obesity, LBP, and LDD in twin studies. Therefore, this systematic review aimed to investigate whether there is an association between obesity and LBP and obesity and LDD, and whether this association is influenced by genetics and early environment.

Methods

A review protocol was registered in the “International prospective register of systematic reviews” under the registration number CRD42014005747. We used the Meta-analysis of Observational Studies in Epidemiology guidelines to lead each section of this systematic review [17].

Search strategy

MEDLINE, CINAHL, Scopus, Web of Science, and EMBASE databases were searched using a combination of key words related to obesity, LBP, and LDD. The search was conducted from the earliest records to August 2014 to identify cross-sectional and longitudinal observational twin studies that investigated the obesity-LBP and obesity-LDD relationships. Additionally, citation tracking was conducted of the reference list of included studies and relevant publications in the field. If additional clarification or data were required, authors were contacted by email.

Selection of studies

All articles identified by the search strategy were independently screened by two investigators (ABD and TL), with a third independent investigator (PHF) resolving any disagreement. The assessment involved three stages: screening of titles, abstracts, and full text. The number of studies identified was recorded for all screening stages.

Inclusion and exclusion criteria

We included cross-sectional and longitudinal observational studies that investigated the relationship between obesity and LBP and obesity and LDD using twins, where the genetic and early shared environment components were or were not adjusted for (case-control studies and studies that recruited twin samples, respectively). Twins needed to account for at least 90% of the total sample, with no restriction on age, gender, or zygosity. No restriction was applied on the year of publication or language. Studies were excluded if they investigated specific spinal pathologies (fracture, cancer, and systemic diseases) or pregnancy-related LBP.

Exposure factors

The exposure factors were obesity or a measure of obesity such as body mass index (BMI), percent fat mass, or weight.

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