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The role of overweight, obesity and exercise therapy on low-back pain

Karol Zagórski, Mateusz Kozik, Nina Skalska-Dziobek, Weronika Małagocka, Karolina Chybowska, Maria Naruszewicz, Aleksandra Midro, Przemysław Cetnarowski

Abstract

Introduction and purpose: Low back pain (LBP) is a leading cause of impairment worldwide and its occurrence is still growing. There are many modifiable risk factors contributing to developing LBP, especially obesity, smoking and physical work. In spite of a breakthrough in pharmacotherapy, lifestyle changes and exercise remain the primary prophylactic and treatment options. The aim of this paper was to summarize the data available in the literature and recent reports about the effect of obesity and overweight on LBP and the effectiveness of different exercise programs.

Material and methods: The literature was reviewed in the PubMed database, GoogleScholar and the Embase database with the use of keywords.

State of knowledge: Obesity and overweight measured by BMI and other indicators are associated with LBP. Waist circumference (WC), recommended by WHO to measure central obesity was found to increase the risk of chronic LBP by 30%, but a stronger correlation between obesity and LBP was found among the female population. Furthermore, there is low-to-moderate evidence that exercise therapy is superior to conservative treatment, when it comes to decreasing pain severity in low back pain. All in all, aerobic, Pilates, core strengthening and

stabilization and flexibility exercises were effective in reducing pain with no significant differences between the particular types of training.

Summary: The information gathered indicates that obesity and overweight are essential risk factors for LBP. Also, various forms of exercise therapy help patients decrease pain in chronic LBP, however, they should be prescribed individually including preference and fitness level to promote compliance.

Key words: Low back pain, LBP, obesity, overweight, physical activity

Introduction

Low back pain (LBP) is defined as pain below the 12th ribs and above the inferior gluteal folds that lasts at least a day[1,2]. It can be acute, sub-acute or chronic and 50-80% of general population will experience it during their life.

It is thought that economically active adults are the most exposed group to LBP, which along with respiratory infections are the leading causes of impairment of any medical condition[2]. Prevalence of LBP was 500 million cases in 2020 and according to estimated projections, more than 800 million people globally will have low back pain in 2050[3].

Types of pain vary from nociceptive, neuropathic or non-specific and can be caused by spinal degeneration, spinal stenosis, muscle conditions, arthritis or failed back surgery[4,5].

According to numerous systematic reviews and cohort studies, this condition has multiple risk factors which include abdominal and general obesity, smoking and strenuous physical work, sleep deprivation, use of vibrating tools, lack of physical activity, aging and lifestyle factors[6,7,8]. Additionally, it was found that tobacco smoking and excess body mass may lead to lumbar radicular pain and sciatica-associated hospitalization. However, a correlation between psychosocial factors and the incidence of low back pain is unclear[9]. Most sex-adjusted analyses showed that women are more vulnerable to LBP compared to men, especially after menopausal age and in school age[10].

Treatment of low back pain differ whether it is specific or non-specific. Approach to specific LBP relies on treating the underlying disease, On the other hand, non-specific pain treatment includes lifestyle changes, pharmacological treatment or various physical therapies or interventions like movement control exercise or massage. Yet, it is worth remembering that

pain not only has a somatic nature, but also emotional, cognitive, and behavioral elements, which explain the importance of psychological therapy in the pain management[4].

Purpose

The paper presents the current state of knowledge on the effect of obesity and overweight as well as an influence of physical activity on low back pain. The goal is to summarize the data available in the literature, recent reports and studies and review the effectiveness of exercise therapy in chronic low back pain and assess the effect on LBP of excess body mass using different anthropometric measures.

Material and method

A review of the PubMed database, GoogleScholar and Embase was performed. The articles were searched with the use of keywords such as "low back pain", " overweight", "obesity", "physical activity", „exercise", with a time limitation from years 2010-2024. The search provided 13109 articles, after rejecting scientific papers that did not meet the authors' criteria, 40 articles were included in this paper. The authors included papers with both statistically significant and statistically insignificant results.

State of knowledge

Overweight and Obesity

Overweight and obesity are global health issues with increasing prevalence worldwide. They both contribute to serious conditions such as: cardiovascular diseases, diabetes, renal dysfunction or carcinomas.

Obesity has long been perceived as a potential risk factor for low back pain. There are two main underlying causes of that connection. First, excess fat mass, especially abdominal fat mass, directly increases mechanical load on the lumbar spine, thus, leading to reduction in disc hydration, reduced disc height, disc herniation or hypertrophy of lumbar spine ligaments, eventually resulting in disc degeneration[11,12]. Second, adipose tissues are metabolically active and they can synthesize pro-inflammatory cytokines like: TNF-α, Il-6 or Il- 1β, which lead to low back pain by changing the cell phenotype, matrix degeneration and chemokine production[12,13].

Majority of population studies investigating the associations with LBP have focused on body mass index (BMI) as the only measure of body size, defining overweight and obesity based on BMI value. Shiri R et al. in a meta-analysis[14] found that obesity (defined by BMI value) increases the prevalence of LBP in the past 12 months by 33% and chronic low back pain by 43%. Peng T et al.[11] also examined this connection using BMI, getting odds ratios of 1,21 and 1,55 for overweight and obese population. Heuch I et al.[15] and Zhang TT at al.[5] reported

consistent results. However, Jensen JN et al.[9] whose study's population included newly educated female health care workers without LBP at baseline showed that higher BMI wasn't associated with higher prevalence of low back pain among that population.

More recent studies have included other anthropometric measures of body size, such as waist circumference (WC), hip circumference, waist-hip ratio (WHR), body fat rate (BFR), total body fat mass (BFM) and body weight (BW). WC is recommended by the WHO to measure central obesity and was found to increase the risk of chronic LBP by 30%[12], however, there are no clear guidelines on the best anatomic location to measure and the cuttoff points vary depending on sex and ethnicity. The WHR might give better insight on regional fat distribution, because it includes information about both detrimental visceral fat and gluteal fat and muscle. Both total BFM and BFR describe absolute and relative body fat amount, so they may also be used as markers representing body fat distribution[16]. Waist circumference was used as a abdominal obesity measure in various studies[7,17,18] and it was associated with greater chance of developing LBP, however, Frilander et al. and Heuch et al. similarly found a positive correlation in women, but not in men[17,18] There were significant differences between men and women, which may be explained by women having weaker and smaller lumbar paraspinal muscles. Another explanation could be menstruation or pregnancy, as these are periods with a significantly higher prevalence of low back pain[11].

Exercise therapy

One of the most beneficial treatment options for LBP remain various programs of exercise therapy. They focus on increasing muscle strength, range of motion in the joints and improving muscle function. Thus, they lead to pain and disability reduction and speed up recovery as well as resumption of work[19.] Several systematic reviews and meta-analyses clearly state that many forms of exercise decrease pain severity. Moreover, patients, who regularly take part in leisure time physical activity have increased muscle strength, decreased bone loss and improved social and psychological health[20]. Hayden et al. in a systematic review[19], found that exercise therapy of moderate-certainty evidence when it comes to reducing pain intensity compared to no treatment or placebo and low to moderate-certainty evidence when compared to other conservative treatments like electrotherapy, pharmacology, acupuncture or sole education.

In this review I included the most commonly investigated specific exercises that include: aerobic exercise, Pilates, core strengthening and flexibility training.

Aerobic exercise

Aerobic exercise is a form of physical exercise of moderate intensity consisting of numerous types of exercises, including walking, running, cycling, treadmill, and many more which may

cause weight loss; improve aerobic capacity; decrease insulin levels, resist hyperlipidemia, decrease systolic blood pressure and act anti-inflammatory[21]. It is any activity that uses large groups of muscles and can be continuously maintained as well as is relatively rhythmic and more importantly rely on aerobic metabolism[22]. The most common measure of these activities is the peak oxygen consumption (VO2). Meta-analysis performed by Meng XQ et al.[21] proved that patients with chronic LBP after aerobic exercises had positive decreases in scores of both Roland-Morris Disability Questionnaire and McGill Pain Questionnaire by 56% and 68% respectively. According to Gordon R. et al.[23] a 6-week moderate intensity aerobic exercise scheme, which included walking on a treadmill at 50% of maximum heart rate significantly diminish chronic low back pain (CLBP) by 20%. However, an 8-week intervention of similar conditions resulted in CLBP reduction by 42% compared to conventional physiotherapy. It also increased VO2max value by 3,3%.[21] Study implies to promote moderate exercise over low or high intensity, as it lowers the risk of injury and enhances compliance.

Pilates training

One type of exercise that has gained popularity over the last years and has been used as a treatment option for LBP patients is Pilates. It has been developed by Joseph Pilates around one hundred years ago and is based on six principles: centering, concentration, precision, control, flow of movement and breathing[24,25]. This method include both stretching and strength and stability exercises of deep abdominal muscles and many studies revealed that they improve muscle strength, range of motion, flexibility or balance[24,25]. Those exercises can be grouped into 2 main categories: mat Pilates and exercises with a use of Pilates apparatus, which use different springs and pulleys that provide resistance for the body muscles, especially deep back, abdominal, pelvic and diaphragm muscles[25]. One study performed by Cruz-Díaz D et al.[26] assessed effect of 12-week Pilates training on disability and pain in patients with chronic LBP. Pain and disability were measured using visual analogue scale and Roland-Morrise Disability Questionnaire and there was a statistically important improvement in both mat Pilates group and in a group using Pilates apparatus, however, the equipment-based group demonstrated quicker advancement. Another randomized controlled trial was performed by Natour J et al.[27] Results were convergent, however, both groups received medication treatment simultaneously and a unique outcome was that a group assigned to Pilates training took fewer nonsteroidal anti-inflammatory drugs. Despite promising results, two reviews included in the Cochrane database[15,19] found low to moderate-certainty evidence that Pilates effectiveness on pain management in CLBP is superior to usual care or no treatment. This was caused by a number of limitations including: low sample sizes, short follow-up period and publication bias.

Core strengthening and stabilization

Core strength reduction may result in lumbar instability and consequently weaker flexibility of the lumbar spine[23]. Thus, patients with CLBP, who avoid trunk movements, reduce their core strength and stabilization, which results in pain exacerbation. Based on that knowledge, core stabilization exercises (CSE) have been used as a treatment and preventive option for low back pain. CSE are a combination of exercises focused on transversus abdominis (TrA) and lumbar multifidus (LM) muscles[23,28]. Transversus abdominis muscle is responsible for stabilization of the spine and those exercises are targeted on strengthening and increasing endurance of these muscles and in the long run increasing spine stability and intra-abdominal pressure[28,29]. Another important effect is enhancing proprioception, which in patients with CLBP is significantly impaired. This leads to inability to maintain neutral spinal posture and coordinated muscle contractions[29,30]. Exercises introduced in most studies include: slow curl ups, bird dog, the plank and sit ups[31].

Suh JH et al.[31] performed a randomized controlled trial and lumbar stabilization were included. Participants followed a strict exercise protocol and VAS was used to measure its change in LBP patients as a primary outcome. There was a significant difference of VAS during both rest and physical exercise. Moreover, patients improved their results in test for core stability, such as posteriori shear test and prone instability tests. Another RCT by Bhaduria et. Al[32] also proved that lumbar stabilization exercises enhance pain management using VAS score, lumbar flexion and extension and core strength. Yet, the study's exercise plan involved only 10 training sessions and there was a short follow-up. Hlaing SS et al.[29], on the other hand, apart from exploring various pain related outcomes, focused also on: proprioception, balance and muscle thickness. Core stabilization exercises were compared with strengthening exercises and CSE group turned out to receive better results when it comes to proprioception (measured by joint repositioning error), balance (single-leg standing with open and closed eyes) and muscle thickness of TrA and LM (measured using ultrasound). Also, pain-related outcomes corresponded with previous studies[31,32].

A series of systematic reviews and meta-analyses[19,23,28,30] included core strengthening and stabilization exercises. Gordon R. et al.[23] reported that core stabilization training and core strengthening plan reduce CLBP by 39-76,8% and 61,6% respectively. Smrcina Z. et al.[30] included 5 RCT's. 4 studies used VAS for pain and 1 used NRS for measuring pain. All of these studies showed, that CSE resulted in lower pain and improved muscle function. Both meta-analyses[19,28] presented corresponding results, that core stability and strengthening exercises

decreased pain severity, however, effects were greater in the short term. Long term follow-up did not provide significant difference when compared to general exercise.

Flexibility training

Stretching exercises are those supposed to elongate soft tissues, especially muscles, ligaments and tendons[19,23]. This allows to enhance range of motion in the joints and spine and decrease muscle stiffness[23]. Fasuyi FO et al.[33] stated, that patients with LBP experience hamstring shortening and that elongating hamstrings decreases tilt of the pelvis. Moreover, iliopsoas muscle's shortening was associated with LBP by Imamura et al.[34] Effect of tightness of tensor fasciae latae was also studied and Bae HI et al.[35] reported, that stretching exercises focused on that muscle enhance hip and pelvis motion and reduce low back pain. Also, Leung FT et al.[36] discovered, that size of piriformis muscle, which is a hip rotator, increases in the presence of LBP, in which hip rotation is limited.

Many RCT were conducted[31,37,38], which implemented stretching exercise scheme as one of interventions. Suh JH et al.[31] included flexibility exercise group which involved stretching of quadriceps, tensor fasciae latae, abdominal muscles, hamstrings, piriformis muscle and quadratus lumborum muscles for half an hour and pain severity during rest was significantly decreased in that group. Furthermore, frequency of painkillers use was decreased in that group. Chen HM et al.[37] included stretching exercise intervention and participants followed a detailed protocol for total of 6 months training. The experimental group demonstrated lowered values in VAS after 6 months and 81% declared moderate to high low back pain relief. Kim B et al.[38] performed a trial allocating patients to 3 groups for 6 weeks: hip stretching, hip strengthening and sham(placebo). Hip stretching exercises aimed at stretching hamstring, iliopsoas, piriformis and tensor fasciae latae muscles and there was a significant improvement in both pain intensity (VAS) and hip muscle flexibility (toe-touch test) after 6-week intervention. Gordon R. and Bloxham S.[23] in a systematic review concluded that increasing flexibility of the lumbar spine and hamstrings reduces CLBP by 18,5-58%. Yet, there are limited and not significantly different results when stretching is compared to other exercises.

Discussion and conclusions

This work attempts to review and present current state of knowledge about associations with low back pain for obesity and overweight as well as the effectiveness of different types of exercise plans. Still, low back pain remains a major public health problem with a predicted rising prevalence especially in low-income and middle-income countries[3,39]. Most studies[5,11,14,15] have proven, that obesity and overweight measured by BMI significantly lead to LBP. Recently, body distribution of different tissues has been studied[17] and more

anthropometric measures have been used showing, that BMI may not be the most adequate measure of obesity for predicting low back pain.

Papers on all discussed exercises provided promising results, however, LBP is multi factorial in nature, and it is unlikely that one particular type of exercise is the best treatment option[19,40]. Overall, Aerobic, Pilates, core strengthening and stabilization and stretching exercises significantly reduced pain severity in CLBP patients. Yet, the evidence was of low- to-moderate-certainty and the papers have a few limitations, including: low sample size, inability to blind patients to exercise groups, which caused performance bias, lack of adherence or irregular co-interventions[19,40].

Disclosures

Author contribution: Conceptulization: Karol Zagórski and Mateusz Kozik; ***methodology:*** Nina Skalska-Dziobek; ***software:*** Weronika Małagocka; ***check:*** Karolina Chybowska; ***formal analysis:*** Maria Naruszewicz; ***investigation:*** Aleksandra Midro; ***resources:*** Przemysław Cetnarowski; ***data curation:*** Nina Skalska-Dziobek; ***writing – rough preparation:*** Karol Zagórski; ***writing – review and editing:*** Mateusz Kozik, Weronika Małagocka, Karolina Chybowska; ***visualization:*** Przemysław Cetrnarowski; ***supervision:*** Maria Naruszewicz; ***project administration:*** Aleksandra Midro.

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