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The effect of foot pronation on chronic low back pain in Adult :Meta-analysis systematic review

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Abstract

The study's objective was to investigate how adult chronic low back pain is impacted by foot pronation. By reviewing the literature, the study employed the qualitative method. The study's findings were based on a review of the literature. Foot position did not appear to be related to low back discomfort. However, even after controlling for age, weight, smoking, and depressive symptoms, pronated foot function was linked to low back pain in women, and this association remained significant. The findings indicate that a change in gait and leg length brought on by podiatrical abnormalities may result in low back discomfort because of a shift in pelvic alignment. Many different healthcare professionals already offer access to foot orthotic devices. In addition to structural and functional LLD, changes in pelvic position have also been linked to chronic LBP; both of these conditions can be altered by the use of orthoses. The capacity of foot orthotics to adjust foot posture and hence affect the lower limb and pelvis' kinematic posture is one plausible justification for their use. Their impact on foot position, which results in altered lower limb and pelvic muscular firing patterns, is another similar but distinct justification for their use. Elevated vertical ground response forces were not linked to foot pronation alone. The vertical ground reaction force and loading rate were higher in low back pain patients with pronated feet. According to the results of the current study, low back pain patients with pronated feet may benefit clinically from the gait ground reaction force components in terms of their prognosis and rehabilitation. The short-term reduction of felt low back pain was a result of the usage of foot orthoses built to order to control foot pronation.

Keywords: *Low back pain (LBP); Physical Therapy; Foot Posture; Foot Function; Podiatrical Deviations; Corrective Exercise Program; Shoe Insoles; Rearfoot; Pelvis.*

1. Introduction

The point prevalence of low back pain is estimated to be around 18% of the general population worldwide (Hoy et al., 2010). Low back pain (LBP) has a significant financial burden due to health care costs and lost

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productivity (Menz et al., 2013). Treatment of low back pain is difficult since, in 85% of instances, a clear pathoanatomical diagnosis cannot be made (Deyo, 2001). The illness is known to be influenced by a wide range of risk factors, including advancing age, female sex, low educational attainment, obesity, occupation, and psychosocial factors (Hoy et al., 2010).

In addition to these known risk factors, postural differences like leg length inequality and decreased lumbar lordosis have long been thought to influence the likelihood of developing low back pain (Barrey et al., 2007) by changing the loads exerted on the soft tissue structures around the spine (Menz et al., 2013). Additionally, abnormal foot posture and function have been linked. According to some writers, people who experience low back discomfort are more likely to have planus (low-arched or pronated) feet (Menz et al., 2013). However, the evidence used to back up this claim is contradictory and often of poor methodological quality. Those with moderate or severe pes planus, as evaluated by clinical observation, were nearly twice as likely to report a history of intermittent low back pain, according to a large retrospective study of 97279 military recruits (Kosashvili et al., 2008). Contrarily, no such association was discovered in two smaller clinical studies that used more objective measurements of foot position (Brantingham et al., 2006; Brantingham et al., 2007).

Despite the paucity of evidence, it makes biological and mechanical sense for foot function and posture to be related to low back discomfort. Changes in foot position can affect pelvic alignment (Khamis and Yizhar, 2007; Pinto et al., 2008; Betsch et al., 2011) and the electromyographic

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activity of the erector spinae and gluteal muscles when walking (Bird et al., 2003). Additionally, a number of minor clinical trials have found that participants who received a variety of foot orthoses saw short-term decreases in low back pain compared to those who received no therapy or "placebo" insoles, providing indirect evidence for this link (Shabat et al., 2005; Cambron et al., 2011; Castro-Méndez et al., 2013).

1.1 Research Problem

Low back pain is a common disabling illness with a variety of known etiologies and additional unidentified causes. Ages 35 to 55 are often when low back discomfort rises. Back discomfort is the second most prevalent reason for doctor visits and the most common cause of activity limitation in people under the age of 45 (O'Leary et al., 2013). This study aims to discuss the effect of foot pronation on chronic low back pain in adults.

1.2 Research Questions

The problem of the current study can be summarized in the following questions:

1. How the foot posture, foot function, and podiatrical deviations affect low back pain?
2. How do the corrective exercise program, and shoe insoles affect low back pain?
3. How the chiropractic and podiatric Treatment be useful for low back pain therapy?

1.3 Research Objectives

The main objective of the study is to explore the effect of foot pronation on chronic low back pain in adult

The problem of the current study can be summarized in the following objectives:

1. To discuss the effect of foot posture, foot function, and podiatrical deviations, on low back pain.
2. To discuss the effect of corrective exercise program, and shoe insoles on low back pain.
3. To discuss the chiropractic and podiatric Treatment for low back pain.

2. Methodology

The study makes use of qualitative research, a method created to first ascertain the current context of a specific incident before attempting to offer an explanation. As a result, it is concerned with authentically portraying the event and is based on research into reality or the event as it actually takes place (Creswell, 2003). Since it is considered to be a fundamental principle of scientific inquiry and is frequently seen as the sole approach capable of exploring many human fields, the qualitative method is crucial in research. The qualitative method involves treating the phenomenon as it actually is, in accordance with its definition, and focuses on accurately characterizing and communicating the phenomenon both qualitatively and statistically (Williams, 2007).

3. Foot Posture, Foot Function and Low Back Pain

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The study of Menz et al., (2013) examine the relationships between foot function and foot posture, and low back pain in the 1930 Framingham Study participants (2002–05). On a body chart, low back pain, aches, or stiffness were noted on most days. Using static weight-bearing measures of the arch index, foot posture was classified as normal, planus, or cavus. The centre of pressure excursion index, which was generated from dynamic foot pressure measurements, was used to classify foot function as normal, pronated, or supinated. In order to account for confounding factors, sex-specific multivariate logistic regression models were employed to investigate the relationships between foot posture, foot function, asymmetry, and low back discomfort. The findings indicate that there is no correlation between foot posture and low back pain. However, after controlling for age, weight, smoking, and depressive symptoms, pronated foot function was linked to low back pain in women (odds ratio (OR) = 1.51, 95% CI 1.1, 2.07, P = 0.011), and this association persisted (OR = 1.48, 95% CI 1.07, 2.05, P = 0.018). These results imply that low back pain in women may be caused by pronated foot function. Therefore, orthoses and other interventions that alter foot function may be useful in the management of low back pain.

The critical review of Kendall et al., (2014) evaluates the evidence supporting the link between mechanical LBP and foot function, particularly pronation. The validity of foot orthoses in the management of this ailment is also examined. The idea that foot posture, especially hyperpronation, is linked to mechanical low back pain is supported by a large body of research. Mechanisms based on mechanical posture changes or modifications in the muscular activity of the lumbar and pelvic muscles have been proposed to explain this observation. The effects of foot orthoses on chronic low back pain, particularly their impact on lumbopelvic muscle function and posture, need to be explored and quantified in more detail. Since foot orthoses are a straightforward and potentially effective treatment intervention for a clinical condition that imposes a heavy personal and social burden, the clinical implications of this work are considerable.

the main goal of Castro-Méndez et al., (2013) is to determine whether using a certain kind of personalized foot orthosis reduces low back pain. The impact of specially constructed foot orthoses on low back pain was investigated in a sample of 51 people (43 women and 8 men) with severe subtalar pronation and persistent low back pain. A randomized, double-blinded, clinical trial was used in the study; it had two groups: an experimental group that received the specially constructed foot orthoses, and a control group that received a placebo. A visual analog scale for pain and the Oswestry's Disability Index Questionnaire for lower back pain were used to assess low back pain twice: on the day of study enrollment and after 4 weeks of treatment. In the experimental group, the course of low back pain differed significantly, with both pain and disability significantly reduced (p 0.001, visual analog scale; p 0.001, Oswestry's Index). In the group examined, reducing felt low back discomfort temporarily was a result of using foot orthoses created specifically to control foot pronation.

The study of Farahpour et al., 2016 divided the Forty-five subjects into a control group, a group of subjects with pronated feet only, and another group with pronated feet and LBP. During shod, ground reaction forces were examined. The results show that increased lateral-medial ground reaction force, impulse, and duration to peak of all reaction forces in the heel contact phase were related to foot pronation without low back discomfort (p=0.03). In comparison to the pronated foot without low back pain group, low back pain patients with pronated feet showed stronger vertical reaction forces (p=0.001), loading rate, and time to peak on propulsion force. The able-bodied group with a normal foot had a smaller posterior-anterior reaction force impulse than the other groups (p 0.05). The LBP group's positive peak of free minutes was noticeably higher than those of the other groups (p 0.05). Elevated vertical ground response forces were not linked to foot pronation alone. The vertical ground reaction force and loading rate were higher in low back pain patients with pronated feet. According to the results of the current study, low back pain patients with pronated feet may benefit clinically from the gait ground reaction force components in terms of their prognosis and rehabilitation.

The purpose of the Castro-Méndez et al., (2021) study is to evaluate the effects of foot orthoses on participants with CLBP and foot pronation. The study included 101 patients with pronated foot posture index (FPI) and non-specific CLBP. Two were chosen at random. Custom-made foot orthotics were employed in the experimental group (n = 53), while non-biomechanical effect orthoses were used in the control group (n = 48). The Oswestry Disability Index (ODI) Questionnaire and a visual analogue scale (VAS), both for measuring lower back pain, were used to assess the CLBP. Two times, once at the beginning of the trial and once after the participant had received treatment for four weeks, the symptoms were assessed. Results analysis revealed a substantial reduction in CLBP in the group of participants who used custom-made foot orthoses (p 0.001 ODI; p 0.001 VAS). These results imply that reducing excessive foot pronation by utilizing foot orthoses tailored to order may greatly enhance CLBP.

The aim of the Yazdani et al., (2018) study was to investigate the effect of chronic idiopathic low back pain on kinetic variables of gait in different foot masks. The participants in this study included 13 healthy matched controls and 11 patients with idiopathic persistent low back pain. The ground reaction force and impulse were measured during barefoot, everyday walking using the Emed foot-scanner device. The data was then recovered using Multimask Evaluation programs after the average footprints were split into 10 masks using the Automask software. The Quebec questionnaire was used to gauge the disability caused by low back pain. According to our findings, patients' medial and lateral midfoot and hallux mask ground reaction forces and impulses were significantly lower than those of controls. Additionally, these patients outperformed the control group in terms of ground reaction force and impulse in the 3-5th metatarsals mask. The foot masking variables and the low back pain interacted significantly. In conclusion, low back discomfort has an impact on the ground reaction forces and impulses in several foot regions. As a result, the kinetic gait analysis should be taken into account as a suitable instrument in the evaluation and prescription of an effective treatment plan for individuals with low back pain.

This study of Almutairi et al., (2021) sought to identify the prevalence and risk factors for low back pain (acute and chronic) in people with flat feet. During a national festival in Saudi Arabia in 2018, a cross-sectional

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study was carried out, and 1798 adult attendees were invited to take part in one-on-one interviews. Participants' characteristics were divided according to their foot type, and whether they had acute low back pain (ALBP) or chronic low back pain was also asked (CLBP). Following a multivariate analysis, the odds ratio (OR) was reported as a measure of this association. Participants with flat feet had a 65.9% prevalence of LBP, of which 51.6% had ALBP and 48.4% had CLBP. ALBP and CLBP were more likely to occur in people with flat feet by 3.28 and 4.5 times, respectively. Following stratification, all participants with flat feet showed significantly greater ALBP and CLBP compared to their counter groups. According to multivariate analysis, women were more likely to report having ALBP. Participants who did not exercise were more likely to experience ALBP complaints. Participants who were older and female were more likely to report ALBP and CLBP complaints. Participants with flat feet were more likely to experience LBP 65.9% of the time, with 51.6% experiencing ALBP and 48.4% experiencing CLBP. ALBP and CLBP were both 3.28 and 4.5 times more likely to occur in people with flat feet, respectively. All subjects with flat feet had significantly higher ALBP and CLBP after stratification compared to their counter groups. Females were more prone to complain about ALBP, according to multivariate analysis. Participants who did not exercise were more likely to report having ALBP. More participants who were older and female complained of ALBP and CLBP.

4. Podiatrical Deviations and Low Back Pain

According to the review findings of O'Leary et al., (2013), a change in pelvic alignment that results in a change in gait and leg length due to podiatrical abnormalities may eventually cause low back discomfort. Although the body of knowledge in this area is still far from complete, it can be concluded from the review that abnormalities of the ankle and foot have an effect on the lower back and may contribute to chronic low back pain. As a result, the cause and effect relationship between the deviations and LBP comes into play. Additionally, no RCTs have specifically examined any of these podiatric traits with LBP. To determine the precise aberrations that cause low back pain, additional RCTs must be conducted to examine the cause and effect relationship.

5. Corrective Exercise Program, Shoe Insoles, and Low Back Pain

In the study of Madadi-Shad et al., (2020), back pain patients with pronated feet were examined to see how a corrective exercise program affected GRF components, back pain, a disability score, and muscle activity. 36 senior citizens with pronated foot and back discomfort volunteered to take part in this study. They were split into two equal groups at random (experimental and control groups). Data on kinetics and EMG were captured before and after the test. Back pain and disability values were evaluated using the Visual Analog Pain Scale and the Roland-Morris Disability Questionnaire, respectively. Walking speed considerably increased from pre to posttest in the experimental group but not in the control group ($p = 0.001$). Both during the pre- and post-test, the loading rate and free moment values were comparable ($p > 0.05$). The disability score, back discomfort, tibialis anterior activity, and rectus abdominis activity were lower at the posttest than they were during the pretest in the experimental group but not in the control group (p 0.001). After completing the training procedure, the experimental group

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outperformed the control group in terms of walking speed, muscular activity and pain, disability score, loading rate, and free moments. These results show an improvement in gait efficiency.

By Chuter et al., 2014, a thorough search of MEDLINE, CINAHL, EMBASE, and The Cochrane Library was carried out. Independently reviewing and choosing pertinent randomised controlled trials were two authors. The Downs and Black Checklist and the Cochrane Collaboration Risk of Bias Tool were used to assess quality. Wherever it was practical, study data were subjected to meta-analysis. Eleven trials were selected, five of which looked at LBP treatment (n = 293) and six of which looked at LBP prevention (n = 2379) using foot orthoses or insoles. In both the treatment and prevention trials, meta-analysis revealed no statistically significant benefit for foot orthoses or insoles (standardized mean difference (SMD) -0.74, 95% confidence interval [CI]: -1.5 to 0.03).

The pilot study of Cambron et al., (2011) goal was to determine whether a randomized clinical trial using shoe orthotics for chronic low back pain was feasible. 50 patients with chronic low back pain were enrolled in the trial through media advertising in a suburb of the Midwest. At a chiropractic office, a low back examination and a medical history were finished. Randomization was used to place the subjects into two groups: one received custom-made shoe orthotics, and the other was a wait-list control group. The wait-list control group also received personalized orthotics after six weeks. In this study, patients with persistent low back pain were assessed for changes in their felt pain levels (Visual Analog Scale) and functional health status (Oswestry Disability Index) after receiving orthotic treatment for either 6 or 12 weeks, as opposed to when

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they received no treatment. According to this study, using shoe orthotics for six weeks reduced back pain and impairment when compared to a control group of people on the waiting list. The 12-week visit appears to have maintained improvement, but the patients did not advance throughout this time.

This study of Bird et al., (2003) goal was to ascertain the effects of various foot wedging techniques on the bilateral surface electromyographic activity of the 13 people without LBP's gluteus medius and erector spinae (ErSp) at the L3 level. Bilateral heel lifts and bilateral lateral forefoot wedging during the gait cycle markedly accelerated the initiation of ErSp activity. With bilateral heel lifts and with a unilateral heel lift on the ipsilateral side, GlMed activity started substantially later ($P = 0.0125$). For any of the wedging types that were evaluated, no discernible amplitude changes were seen in either muscle. These findings demonstrate that foot wedging can alter the timing of muscle contractions in the low back and pelvis during the gait cycle in meaningful ways. To ascertain whether this effect aids in the reduction of LBP, more research is necessary.

6. Chiropractic and Podiatric Treatment for Low Back Pain

The article of Gevers-Montoro et al., (2021) goal is to outline a procedure for treating chronic low back pain (CLBP) in people who have a functionally short leg on the same side as a unilaterally pronated foot by combining podiatric orthotic therapy with multimodal chiropractic treatment. This protocol outlines a feasibility study for determining the effectiveness of combining multimodal chiropractic care with podiatric

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orthotic therapy to treat CLBP in patients who have a functionally short leg on the same side as a unilaterally pronated foot.

7. The Rearfoot, Pelvis, and Low-Back

The initial goal of the Duval et al., (2010) study was to determine whether foot pronation, which is evaluated by calcaneal eversion, caused an anterior pelvic tilt and increased lumbar lordosis. Second, the study looked at whether foot supination (calcaneal inversion as a measure of foot supination) caused a posterior pelvic tilt and a reduction in lumbar lordosis. Participants stood on a solid platform with their feet in 18 various positions. 11 of these postures ranged from 40 degrees of external foot rotation to 40 degrees of internal foot rotation, while seven of them ranged from 15 degrees of foot eversion to 15 degrees of foot inversion. A 3D motion analysis system was used to evaluate lumbar lordosis and pelvic tilt. The connection between foot pronation and supination and pelvic tilt ($r = 0.3$) and lumbar lordosis ($r = 0.05$) was not statistically significant. The pelvis tipped anteriorly when the legs were rotated internally, and posteriorly when the legs were rotated externally ($r = 0.58$). Leg rotation and lumbar lordosis had no correlation ($r = 0.24$). It is unlikely that there is a connection between induced foot pronation and an increase in lumbar lordosis because the effects of pelvic tilt on the lumbar spine were only apparent when pelvic tilt was exacerbated beyond values found in this study.

The objective of Sadler et al., (2017) was to comprehensively review prospective cohort studies looking at risk factors for lower back and/or lower limb musculoskeletal disorders. Twelve studies that looked at 5459

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people' musculoskeletal risk factors for developing low back pain were included. Based on risk factors that were present in many research, specific meta-analyses were undertaken. Reduced lumbar lordosis (OR = 0.73, 95% CI 0.55-0.98, p = 0.034), restricted hamstring range of motion (OR = 0.96, 95% CI 0.94-0.98, p = 0.001), and reduced lateral flexion range of motion (OR = 0.41, 95% CI 0.24-0.73, p = 0.002) were all found to be significantly associated with the onset of low back pain. The results of meta-analyses on the cross sectional areas of the erector spinae and quadratus lumborum as well as the lumbar extension range of motion, quadriceps flexibility, fingertip to floor distance, lumbar flexion range of motion, back muscle strength, back muscle endurance, and abdominal strength were not statistically significant.

8. Conclusion and Recommendations

The aim of the study is to explore the effect of foot pronation on chronic low back pain in adult. The study use the qualitative method by reviewing the literature. By looking at the literature, the study reached some results, Foot posture showed no association with low back pain. However, pronated foot function was associated with low back pain in women and this remained significant after adjusting for age, weight, smoking, and depressive symptoms. The results show that a change in gait and leg length due to podiatrical deviations could potentially lead to low back pain due to a change in pelvic alignment. Foot orthotic devices are already widely accessible through a range of health care practitioners. Chronic LBP has also been associated with changes in pelvic posture as well as structural and functional LLD, both of which can be influenced by the use of orthoses. A possible rationale for the use of foot orthotics is

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their ability to alter foot posture, leading to kinematic postural changes of the lower limb and pelvis. Another related but different rationale for their use is their effect on foot posture leading to changes in firing patterns of lower limb and pelvic musculature. Foot pronation alone was not associated with elevated vertical ground reaction forces. While, low back pain patients with foot pronation displayed higher vertical ground reaction force as well as higher loading rate. Present results reveal that gait ground reaction force components in low back pain patients with pronated foot may have clinical values on the prognosis and rehabilitation of mechanical LBP patients. The use of custom-made foot orthoses to control foot pronation had a short-term effect in reduction of perceived low back pain.

Based on the conclusions reached by the study, the study came out with the following recommendations:

- The effects of foot orthoses on the management of chronic LBP require further study in order to be explored and quantified.
- Future studies should focus on identifying LBP patients who will benefit the most from foot orthoses or insole treatment, as there is some evidence to suggest that trials designed in this way have a higher impact on lowering LBP.
- In addition to the ankle and foot, other areas distal to the low back, such as the shoulder, neck, or arm, should also be evaluated to determine whether comparable aberrations there also contribute to low back discomfort.

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