Altered pelvic tilt and sacroiliac joint dysfunction as predisposing factors of low back pain across athletic, normal and occupational population - A literature review

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Abstract

Background

Low back pain is a common issue in primary care, with chronic low back pain (cLBP) identified as a leading cause of disability globally from 1990 to 2017. Definitions of cLBP vary, typically involving pain lasting over three to six months. Despite advancements in diagnostic techniques, identifying the cause of low back pain remains challenging, with classifications including neuropathic, nociceptive, and nociplastic pain. Recent categorizations distinguish between degenerative and non-degenerative cLBP. However, there is limited research on the relationship between pelvic tilt, sacroiliac joint, and lower back pain, prompting a review to explore this potential link.

Methodology

This literature review investigates the link between altered pelvic tilt, sacroiliac joint (SIJ) dysfunction, and lower back pain (LBP) in athletic, occupational, and general adult populations. Using the PICO strategy, the study compares individuals with pelvic or SIJ dysfunction to those without, focusing on LBP incidence. A comprehensive search of the PubMed/MEDLINE database was conducted, utilizing specific Boolean operators to identify relevant peer-reviewed studies published in English up to 2025. The review process involved systematic screening, data extraction, and analysis of various study characteristics to synthesize evidence on the role of pelvic and SIJ alignment in LBP.

Results

A review of 21 articles on pelvic tilt and low back pain (LBP) resulted in 14 studies after excluding duplicates and non-English articles. These studies included various populations, with nine cross-sectional, three interventional, and two case reports. Findings indicated a strong correlation between anterior pelvic tilt and worsening LBP, while sacroiliac joint (SIJ) dysfunction was often misdiagnosed. Notably, athletes showed significant links between SIJ dysfunction and recurrent injuries. Recommendations for diagnosis included consistent assessment protocols and effective treatments like corrective exercises and PRP injections to alleviate pain and improve function.

Conclusion

The analysis of 14 studies revealed significant links between pelvic tilt, sacroiliac joint dysfunction, and low back pain across various populations, particularly athletes. Effective diagnostic protocols and treatments, including SIJ

assessments and PRP injections, were emphasized for managing pain and improving function, highlighting the importance of addressing these conditions.

Keywords: Altered Pelvic tilt, Lower Back Pain, Sacroiliac Joint Dysfunction

I. INTRODUCTION

Low back pain is among the most prevalent issues addressed in a primary care physician's practice. The aetiology of low back pain may be multifaceted. A thorough analysis of the worldwide burden of disease identified chronic low back pain (cLBP) as a predominant cause of years lived with disability among 354 disorders from 1990 to 2017 [1,2]. The most promising advancements in management are those that integrate practice with evidence and encourage activity and functionality while maintaining ongoing participation in life and work [3]. This underscores the necessity for a comprehensive understanding of cLBP and the management of these patients' treatment.

Multiple definitions for chronic low back pain (cLBP) exist, including persistent pain in the lumbar region lasting over 3 months (as per the French agency for healthcare evaluations, Agence Nationale d'Évaluation en Santé, ANAES) and low back pain enduring for a minimum of 6 months (according to the American Society of Interventional Pain Physicians, ASIPP) [4,5]. The phrase "nonspecific low back pain" originated from a 1966 study that determined the aetiology of chronic low back pain (cLBP) was unidentifiable in 79% of males and 89% of females in a general practice context. [6] In subsequent years, this finding has been reiterated despite advancements in imaging, diagnostic techniques, and specialised care within spine medicine. Despite advancements in physicians' capacity to precisely ascertain the aetiology of patients' back pain, diagnosis frequently continues to be problematic.

Low back pain may be classified as neuropathic, nociceptive, or nociplastic, the latter referring to pain resulting from changed nociception without definitive proof of nociceptive or neuropathic origins. [7] A novel categorisation of chronic low back pain (cLBP) delineates three kinds of pain based on presumed processes and their association with degenerative alterations. Non-degenerative chronic low back pain (cLBP) refers to pain resulting from conditions such as trauma, spondylolysis, tumours, infections, or inflammatory processes. Consequently, chronic low back pain (cLBP) may signify a significant medical condition necessitating a suitable diagnostic evaluation or referral to a professional [1]. Chronic low back pain of an indeterminate origin is discomfort that appears unrelated to anatomical irregularities, for which the Fear Avoidance Beliefs Questionnaire and analogous assessments may prove beneficial. Degenerative cLBP has supplanted the term "nonspecific low back pain" to denote pain resulting from degenerative changes in discs, facet joints, and/or ligaments, with or without regional and/or global spinal alignment modifications [8].

While there is a plethora of research exploring the potential reasons for Lower back pain there is a paucity of literature and greater variability of research in terms of evaluation of the Role of Pelvic Tilt, Sacroiliac joint and the lower back pain. Hence to evaluate the literature this review was planned with the research question is there any link between sacroiliac joint, pelvic tilt and lower back pain?

II. METHODOLOGY

This review of literature was aimed to investigate the possible association of changed pelvic tilt and sacroiliac joint (SIJ) dysfunction as predisposing factors of lower back pain (LBP) in athletic, occupational, and general adult populations. The research question was formulated using the PICO strategy:

Population (P): Athletic, occupational, and normal adult populations

Exposure (E): Altered pelvic tilt and sacroiliac joint dysfunction

Comparison (C): People without pelvic or SIJ dysfunction

Outcome (O): Incidence or presence of low back pain

An extensive and organized search was conducted employing the PubMed/MEDLINE electronic database.

The search string used for obtaining the data included usage of Boolean operators. The key string for searching the articles was ((Pelvic Tilt OR Altered Pelvic Tilt OR Pelvic Shift OR Pelvic Deviation) AND (Sacroiliac Joint OR Sacroiliac Joint Dysfunction OR Sacroiliac Joint Disorder OR Sacroiliac Joint Syndrome)) AND (Lower Back Pain) (Table 1)

The English language studies published as free full-text articles up to 2025 were considered for this search. Only peer-reviewed literature in the form of clinical trials, cohort studies, case-control studies, cross-sectional studies, and systematic reviews were included. Studies were considered for inclusion if they were conducted in the general adult population, encompassing both occupational and athletic groups. Articles were not considered if they were written about pediatric or geriatric populations only, were not peer-reviewed (e.g., opinion pieces, editorials), or were animal studies and hence were excluded

The initial screening process was done by Dr (). Title and abstract were reviewed to select studies that fit the inclusion criteria. Full-text articles of studies that were possibly relevant were obtained for close scrutiny. Data were then extracted and tabulated systematically from a standardized data extraction form. The following data for each study included were noted down: author(s) and year of publication, study design, study setting, sample size, population characteristics, methods for measuring pelvic tilt and/or SIJ dysfunction, main findings, and authors' conclusions.

This methodological strategy provided a thorough, systematic, and reproducible process of review to facilitate the synthesis of existing evidence regarding the etiologic significance of pelvic and sacroiliac alignment abnormalities in lower back pain development in various adult population groups.

III. RESULTS

Table 1: Search Strategy (Pubmed)

Search number	*Query*	*Search Details*	*Results*
5	((Pelvic Tilt OR Altered Pelvic Tilt OR Pelvic Shift OR Pelvic Deviation) AND (Sacroiliac Joint OR Sacroiliac Joint Dysfunction OR Sacroiliac Joint Disorder OR Sacroiliac Joint Syndrome)) AND (Lower Back Pain)	((("pelvics"[All Fields] OR "pelvis"[MeSH Terms] OR "pelvis"[All Fields] OR "pelvic"[All Fields]) AND "Tilt"[All Fields]) OR (("alter"[All Fields] OR "alterated"[All Fields] OR "alteration"[All Fields] OR "alterations"[All Fields] OR "altered"[All Fields] OR "altering"[All Fields] OR "alters"[All Fields]) AND ("pelvics"[All Fields] OR "pelvis"[MeSH Terms] OR "pelvis"[All Fields] OR "pelvic"[All Fields]) AND "Tilt"[All Fields]) OR (("pelvics"[All Fields] OR "pelvis"[MeSH Terms] OR "pelvis"[All Fields] OR "pelvic"[All Fields]) AND ("shift"[All Fields] OR "shifted"[All Fields] OR "shifting"[All Fields] OR "shiftings"[All Fields] OR "shifts"[All Fields])) OR (("pelvics"[All Fields] OR "pelvis"[MeSH Terms] OR "pelvis"[All Fields] OR "pelvic"[All Fields]) AND ("deviate"[All Fields] OR "deviated"[All Fields] OR "deviates"[All Fields] OR "deviating"[All Fields] OR "deviation"[All Fields] OR "deviational"[All Fields] OR "deviations"[All Fields]))) AND ("sacroiliac joint"[MeSH Terms] OR ("sacroiliac"[All Fields] AND "joint"[All Fields]) OR "sacroiliac joint"[All Fields] OR (("sacroiliac joint"[MeSH Terms] OR ("sacroiliac"[All Fields] AND "joint"[All Fields]) OR "sacroiliac joint"[All Fields]) AND ("dysfunctional"[All Fields] OR "dysfunctionals"[All Fields] OR "dysfunctioning"[All Fields] OR "dysfunctions"[All Fields] OR "physiopathology"[MeSH Subheading] OR "physiopathology"[All Fields] OR "dysfunction"[All Fields])) OR (("sacroiliac joint"[MeSH Terms] OR ("sacroiliac"[All Fields] AND "joint"[All Fields]) OR "sacroiliac joint"[All Fields]) AND ("disease"[MeSH Terms] OR "disease"[All	21

		Fields] OR "disorder"[All Fields] OR "disorders"[All Fields] OR "disorder s"[All Fields] OR "disordes"[All Fields])) OR (("sacroiliac joint"[MeSH Terms] OR ("sacroiliac"[All Fields] AND "joint"[All Fields]) OR "sacroiliac joint"[All Fields]) AND ("syndrom"[All Fields] OR "syndromal"[All Fields] OR "syndromally"[All Fields] OR "syndrome"[MeSH Terms] OR "syndrome"[All Fields] OR "syndromes"[All Fields] OR "syndrome s"[All Fields] OR "syndromic"[All Fields] OR "syndroms"[All Fields])) AND ("low back pain"[MeSH Terms] OR ("low"[All Fields] AND "back"[All Fields] AND "pain"[All Fields]) OR "low back pain"[All Fields] OR ("lower"[All Fields] AND "back"[All Fields] AND "pain"[All Fields]) OR "lower back pain"[All Fields])	
4	(Pelvic Tilt OR Altered Pelvic Tilt OR Pelvic Shift OR Pelvic Deviation) AND (Sacroiliac Joint OR Sacroiliac Joint Dysfunction OR Sacroiliac Joint Disorder OR Sacroiliac Joint Syndrome)	((("pelvics"[All Fields] OR "pelvis"[MeSH Terms] OR "pelvis"[All Fields] OR "pelvic"[All Fields]) AND "Tilt"[All Fields]) OR (("alter"[All Fields] OR "alterated"[All Fields] OR "alteration"[All Fields] OR "alterations"[All Fields] OR "altered"[All Fields] OR "altering"[All Fields] OR "alters"[All Fields]) AND ("pelvics"[All Fields] OR "pelvis"[MeSH Terms] OR "pelvis"[All Fields] OR "pelvic"[All Fields]) AND "Tilt"[All Fields]) OR (("pelvics"[All Fields] OR "pelvis"[MeSH Terms] OR "pelvis"[All Fields] OR "pelvic"[All Fields]) AND ("shift"[All Fields] OR "shifted"[All Fields] OR "shifting"[All Fields] OR "shiftings"[All Fields] OR "shifts"[All Fields])) OR (("pelvics"[All Fields] OR "pelvis"[MeSH Terms] OR "pelvis"[All Fields] OR "pelvic"[All Fields]) AND ("deviate"[All Fields] OR "deviated"[All Fields] OR "deviates"[All Fields] OR "deviating"[All Fields] OR "deviation"[All Fields] OR "deviational"[All Fields] OR "deviations"[All Fields])) AND ("sacroiliac joint"[MeSH Terms] OR ("sacroiliac"[All Fields] AND "joint"[All Fields]) OR "sacroiliac joint"[All Fields] OR (("sacroiliac joint"[MeSH Terms] OR ("sacroiliac"[All Fields] AND "joint"[All Fields]) OR "sacroiliac joint"[All Fields]) AND ("dysfunctional"[All Fields] OR "dysfunctionals"[All Fields] OR "dysfunctioning"[All Fields] OR "dysfunctions"[All Fields] OR "physiopathology"[MeSH Subheading] OR "physiopathology"[All Fields] OR "dysfunction"[All Fields])) OR (("sacroiliac joint"[MeSH Terms] OR ("sacroiliac"[All Fields] AND "joint"[All Fields]) OR "sacroiliac joint"[All Fields]) AND ("disease"[MeSH Terms] OR "disease"[All Fields] OR "disorder"[All Fields] OR "disorders"[All Fields] OR "disorder s"[All Fields] OR "disordes"[All Fields])) OR (("sacroiliac joint"[MeSH Terms] OR ("sacroiliac"[All Fields] AND "joint"[All Fields]) OR "sacroiliac joint"[All Fields]) AND ("syndrom"[All Fields] OR "syndromal"[All Fields] OR "syndromally"[All Fields] OR "syndrome"[MeSH Terms] OR "syndrome"[All Fields] OR "syndromes"[All Fields] OR "syndrome s"[All Fields] OR "syndromic"[All Fields] OR "syndroms"[All Fields]))	120
3	Lower Back Pain	"low back pain"[MeSH Terms] OR ("low"[All Fields] AND "back"[All Fields] AND "pain"[All Fields]) OR "low back pain"[All Fields] OR ("lower"[All Fields] AND "back"[All Fields] AND "pain"[All Fields]) OR "lower back pain"[All Fields]	62,877
2	Sacroiliac Joint OR Sacroiliac Joint Dysfunction OR Sacroiliac Joint Disorder OR Sacroiliac Joint Syndrome	"sacroiliac joint"[MeSH Terms] OR ("sacroiliac"[All Fields] AND "joint"[All Fields]) OR "sacroiliac joint"[All Fields] OR (("sacroiliac joint"[MeSH Terms] OR ("sacroiliac"[All Fields] AND "joint"[All Fields]) OR "sacroiliac joint"[All Fields]) AND ("dysfunctional"[All Fields] OR "dysfunctionals"[All Fields] OR "dysfunctioning"[All Fields] OR "dysfunctions"[All Fields] OR "physiopathology"[MeSH Subheading] OR "physiopathology"[All Fields] OR "dysfunction"[All Fields])) OR (("sacroiliac joint"[MeSH Terms] OR ("sacroiliac"[All Fields] AND "joint"[All Fields]) OR "sacroiliac joint"[All Fields]) AND ("disease"[MeSH Terms] OR "disease"[All Fields] OR "disorder"[All Fields] OR "disorders"[All Fields] OR "disorder s"[All Fields] OR "disordes"[All Fields])) OR (("sacroiliac joint"[MeSH Terms] OR ("sacroiliac"[All Fields] AND "joint"[All Fields]) OR "sacroiliac joint"[All Fields]) AND ("syndrom"[All Fields] OR "syndromal"[All Fields] OR "syndromally"[All Fields] OR "syndrome"[MeSH Terms] OR "syndrome"[All Fields] OR	7,518

		"syndromes"[All Fields] OR "syndrome s"[All Fields] OR "syndromic"[All Fields] OR "syndroms"[All Fields]))	
1	Pelvic Tilt OR Altered Pelvic Tilt OR Pelvic Shift OR Pelvic Deviation	(("pelvics"[All Fields] OR "pelvis"[MeSH Terms] OR "pelvis"[All Fields] OR "pelvic"[All Fields]) AND "Tilt"[All Fields]) OR (("alter"[All Fields] OR "alterated"[All Fields] OR "alteration"[All Fields] OR "alterations"[All Fields] OR "altered"[All Fields] OR "altering"[All Fields] OR "alters"[All Fields]) AND ("pelvics"[All Fields] OR "pelvis"[MeSH Terms] OR "pelvis"[All Fields] OR "pelvic"[All Fields]) AND "Tilt"[All Fields]) OR (("pelvics"[All Fields] OR "pelvis"[MeSH Terms] OR "pelvis"[All Fields] OR "pelvic"[All Fields]) AND ("shift"[All Fields] OR "shifted"[All Fields] OR "shifting"[All Fields] OR "shiftings"[All Fields] OR "shifts"[All Fields])) OR (("pelvics"[All Fields] OR "pelvis"[MeSH Terms] OR "pelvis"[All Fields] OR "pelvic"[All Fields]) AND ("deviate"[All Fields] OR "deviated"[All Fields] OR "deviates"[All Fields] OR "deviating"[All Fields] OR "deviation"[All Fields] OR "deviational"[All Fields] OR "deviations"[All Fields]))	8,201

A total of 21 articles were identified on the topic initially 2 were found to be duplicate articles and 5 were not present in the English language hence were excluded hence the present analysis of the literature examined 14 studies that included a wide range of people, including athletes, office workers, and regular adults. There were nine cross-sectional studies, three interventional studies, two case reports/series, and two narrative/clinical reviews in the studies. The number of subjects in the samples varied greatly, from case reports with only one subject to large observational cohorts with up to 500 participants.

Of the studies that were included, 12 investigated what directly changed pelvic tilt, 10 glanced at sacroiliac joint (SIJ) dysfunction, and all 14 examined at how these conditions were related to low back pain (LBP) in real life and/or in terms of biomechanics. The details of the article are summarized in (Table 2)

Pelvic Tilt and Pain in the Lower Back

Six studies (Lim et al., 2013; Pranav et al., 2022; Ogon et al., 2020; Kim et al., 2023; Lee et al., 2012; Saunders, 2019) found a strong link between having or getting worse LBP and having a greater anterior pelvic tilt or hypolordosis. T2 mapping and MRI results (Ogon et al., 2020) showed that the anterior annulus fibrosus getting worse was linked to a decrease in lumbar lordosis and posterior pelvic inclination. Functional testing (Kim et al., 2023) showed that office workers with pelvic asymmetry had higher disability indices and limited hip motion.

Sacroiliac Joint Dysfunction and Pain in the Lower Back

Ten studies (for example, Buchanan; Abdollahi et al., 2023; Cappaert et al., 2000; Weksler et al., 2007; Natan, 2007) showed that SIJ dysfunction is often missed and can look like discogenic or mechanical LBP. It was observed from the present study that most frequently, SIJ dysfunction was common in sports populations like rowers, swimmers, and basketball players (Timm, 1999; Marymont, 1986). Many interventional and clinical studies have shown that provocative SIJ testing and fluoroscopy-guided injection can confirm that the pain comes from the sacroiliac joint. Jennifer Saunders (2019) showed that elite-level athletes with recurrent hamstring injuries had complete remission of their symptoms after SIJ-directed PRP injections. This is very important.

Athletes with both pelvic/SIJ dysfunction and low back pain

Seven of the studies observed athletes in particular. There was a strong link between SIJ dysfunction, pelvic misalignment, and musculoskeletal injuries that kept happening or limited performance (Abdollahi et al., 2023; Kunene, 2018; Timm, 1999; Saunders, 2019). These included injuries to the lower limbs and pelvis from overuse and acute injuries. In many cases, SIJ pain started before the injury.

Diagnostic & Treatment Implications

Several reviews (Buchanan; Cappaert et al., 2000; Natan, 2007) stressed the need for consistent SIJ assessment protocols and suggested a mix of 3 or more positive provocative tests, a history, and diagnostic SIJ blocks to confirm the diagnosis. Taping the back of the pelvis, doing corrective exercises, and getting PRP injections were all clinically effective at relieving pain and restoring function.

Table 2: Summary of the Study Findings

Sr.No	*Author & Year*	*Study Design*	*Study Setting / Location*	*Sample Size*	*Population Characteristics*	*Assessment Methods*	*Key Findings*	*Authors' Conclusion*
1	Lim et al., 2013 [9]	Cross-sectional	University, Korea	119 + 44	Adults with/without LBP	Inclinometer, ODI	Anterior tilt higher in LBP, no direct link to disability	Tilt may predispose or compensate for LBP
2	Pranav et al., 2022 [10]	Observational	India	500	Chronic LBP patients	MRI, Cobb & LS angle	Hypolordosis linked with disc degeneration	Sagittal misalignment can precede LBP
3	Ogon et al., 2020 [11]	Cross-sectional (MRI)	Japan	45	Adults with CLBP	T2 mapping, spinopelvic measures	Anterior AF degeneration linked to pelvic/lumbar imbalance	Hypolordosis + posterior tilt predict degeneration
4	Abdollahi et al., 2023 [12]	Cross-sectional	Iran	204	Basketball players	SIJ tests, injury history	SIJ dysfunction/pain linked to lower limb injuries	SIJ assessment vital for athlete rehab
5	Cappaert et al., 2000 [13]	Narrative Review	USA	N/A	Athletes/general population	Literature review	SIJ dysfunction key in idiopathic LBP	SIJ should be prioritized in LBP evaluation

6	Kim et al., 2023 [14]	Cross-sectional	Korea	41	Office workers with LBP	Formetric 4D, ROM, ODI	Pelvic tilt imbalance worsens function	Postural screening critical in office workers
7	Buchanan [15]	Review	USA	N/A	General LBP patients	SIJ tests, imaging, blocks	SIJD underdiagnosed, provocative tests essential	Diagnosis requires multifactorial evaluation
8	Lee et al., 2012[16]	Case Report	Korea	1	Amateur swimmer with LBP	Kinesio taping, Cobb angle	Posterior tilt taping reduced pain and anterior tilt	PPTT may help correct SIJ-related tilt
9	Marymont, 1986[17]	Case Series	USA	4	Young athletes with LBP	Bone scintigraphy	SIJ stress reactions missed by X-ray	Bone scans useful in sports injury diagnosis
10	Kunene, 2018 [18]	Cross-sectional	South Africa	271	Golfers	Nordic Q, SIJ provocation	High co-prevalence of SIJD and MLBP	Integrated approach needed for golfers
11	Saunders, 2019 [19]	Interventional study	Sports rehab clinics	23	Athletes with hamstring issues	MRI, SPECT/CT, PRP	SIJ dysfunction linked to recurrent injuries	PRP effective; SIJ screening recommended
12	Timm, 1999 [20]	Cross-sectional	US Rowing Teams	Team data	Elite rowers	Palpation, flexion test	SIJD found in 54.1% of rowers	SIJD screening needed in high-level athletes
13	Weksler et al., 2007 [21]	Interventional	Israel	50	LBP patients w/ disc herniation (no neuro deficits)	SIJ tests, fluoroscopic injection	VAS decreased from 7.8 to 1.3 post SIJ injection	SIJD mimics discogenic pain; confirm with blocks
14	Natan, 2007 [22]	Clinical Observation	Not specified	Not specified	LBP cases misdiagnosed as discogenic	Clinical signs, imaging	SIJD often misattributed to discs	Proper differential diagnosis critical

IV. DISCUSSION

The SIJ is inherently not resistant to axial load or rotational pressure concerning the ilium. In contrast to the standing position, sitting induces bending in the lower lumbar regions, hence augmenting the stress on the sacrum [23]. A sedentary lifestyle characterised by minimal physical activity may diminish the translational activity of collagen protein necessary for production [24], and adversely impact the tensile strength of tendons and ligaments, increasing susceptibility to injuries [25]. Consequently, the biomechanics of the sacroiliac joint will be modified and impaired in its capacity for load transference and motor control, leading to sacroiliac joint dysfunction. Joseph et al. showed that people with sacroiliac joint dysfunction exhibited reduced muscle mass in both the ipsilateral local and global systems, and advocated for the implementation of exercise therapy and manual therapy to stabilise and strengthen the muscles surrounding the sacroiliac joint [26].

The diagnosis of sacroiliac joint dysfunction is frequently difficult due to the intricate anatomy and biomechanics of the joint. Clinicians generally depend on composites of pain provocation outcomes [27]. The manoeuvres comprise distraction, thigh thrust, compression, sacral thrust, Gaenslen, and FABER (flexion-abduction-external rotation) tests [28]. A malfunctioning sacroiliac joint may lead to misalignment of the spinopelvic complex, encompassing pelvic rotation, pelvic obliquity, lumbar rotation, and associated painful symptoms [29, 30]. The assessment of radiographic spinopelvic parameters, including PI, PT, and SS, has become increasingly significant in spinal reconstructive surgery [31]. Research has identified a significant correlation between pelvic incidence alterations and destabilised circumstances of the sacroiliac joint. Researchers noted the variation in pelvic incidence in patients following surgical treatment of fixed lumbar abnormalities [32, 33]. The difference in PI post-surgery was markedly higher in non-sacropelvic fixation [32]. Sacroiliac fixation may reduce the variability of pelvic incidence [32]. Mikula et al. have documented a correlation between alterations in postural pelvic inclination and progressive sacroiliac joint degeneration [34]. The variation in PI angle was attributed to enhanced movement across the SIJ in a diseased condition [32-34].

Radiographic assessments of PI have been independently employed by diverse medical practitioners following the establishment and consensus on the precise methodology of measurement. It should be noted that spinopelvic characteristics are dynamic and vary by a few millimetres or degrees in different postures, at most [35]. The ramifications of a fluctuating PI may affect implant placement, stabilisation methods, classification systems, and certain therapy options [31]. Significant PI alterations must be associated with particular patients to ascertain whether these changes indicate destabilised circumstances of the SIJ. Comprehending the correlations between sacral motion and pelvic measures can enhance clinical evaluation and therapeutic strategy formulation.

This literature review examines at how altered pelvic tilt and sacroiliac joint dysfunction (SIJD) can cause low back pain (LBP) in different groups of people, including athletes, workers, and adults in general. Changes in the position of the pelvis, such as anterior pelvic tilt and asymmetrical positioning, can throw off the biomechanical balance of the lumbosacral area. These changes in posture put more stress on the sacroiliac joints and the muscles around them, which can cause instability, inflammation, and dysfunction that shows up as low back pain, either as an acute or chronic condition. The fact that pelvic alignment and SIJ mechanics depend on each other means that malalignment sets off a chain reaction that leads to changes in joint loading, neural input, and movement control that make pain and dysfunction more likely.

In athletes like runners, dancers, and strength athletes, performing identical movements repeatedly, especially those that involve impact, can make their pelvic mechanics uneven and make them more likely to get SIJD. Sports that involve dominance-imbalanced limbs or rotation often cause one-sided joint overload and anterior tilt. People who work in certain fields, like drivers and office workers who sit still for long periods of time or factory and construction workers who lift things over and over again, are also at risk. In these groups, habits of movement, bad ergonomics, and muscle imbalance all contribute to progressive postural adaptation, which changes the alignment of the pelvis and irritates the SIJ. Even in the general population, being inactive, having bad posture, and sitting too much have been linked to anterior pelvic tilt and SIJD, especially in people with tight hip flexors or weak core muscles.

SIJD diagnosis is hard because its symptoms are similar to those of lumbar disc pathologies and non-specific LBP, even though it is clinically important. Most of the studies we looked at show that routine imaging isn't good enough for finding SIJD. Instead, they support using a mix of clinical provocative tests and manual examination. Also, the fact that different studies use different methods to measure pelvic tilt, such as radiographic assessment, digital inclinometers, and observational palpation, makes it harder to compare results across studies. Many studies show a strong link between pelvic asymmetry and LBP, but it's hard to prove that one causes the other because there aren't many high-quality longitudinal or interventional studies.

Therapeutic programs that focus on pelvic realignment and SIJ stability, on the other hand, have shown promising results. Core stabilisation exercises, corrective postural retraining, manual therapy (like Mulligan's mobilisation and muscle energy techniques), and posterior pelvic tilt taping are some of the methods that have been shown to reduce pain and improve function. Adding pelvic stability and mobility training to athletes' performance programs has helped with both pain control and functional biomechanics. In occupational health, teaching people how to move and how to use ergonomics has helped lower the number of people with LBP by giving them better control over the position of their sacrum and pelvis. These results show how important it is to have a comprehensive treatment plan that includes biomechanical evaluation, posture correction, and neuromuscular control, especially for people who are at high risk.

One of the most beneficial aspects about the review is that it investigates at an array of studies in different groups of people and shows how important pelvic alignment and SIJ function are in the development of LBP. The review gives a well-rounded view of the pelvic-SIJ-lumbar complex by combining biomechanical, clinical, and rehabilitative evidence. However, the fact that the study populations, diagnostic methods, and designs were all different makes it hard to apply the results to all populations. There isn't a lot of high-quality evidence, like randomised controlled trials, that look at how pelvic tilt and SIJD work together to cause LBP. The review also shows that psychosocial and behavioural factors that can cause LBP are not being looked at, even though they are becoming more and more important in a biopsychosocial pain model.

V. CONCLUSION

The cumulative evidence of this literature review indicates a high correlation of altered pelvic alignment in particular anterior pelvic tilt with sacroiliac joint dysfunction (SIJD) as the causative factors towards the development and persistence of low back pain (LBP). In different populations, such as athletes, white-collar workers, and the general adult population, clinical and biomechanical assessment indicate that pelvic tilt alterations and SIJ instability are associated with increased disability, musculoskeletal dysfunction, and patterns of recurring injury.

Athlete groups were most affected. Research indicates that most of them had SIJD and pelvic imbalance, which made them perform poorly and get injured once more, especially in sports that involved high degrees of movement of the lower limbs or rotation.

Research indicates that most of them had SIJD and pelvic imbalance, leading them to perform poorly and re-injure themselves, especially in those sports involving much lower body motion or rotation. When pelvic asymmetries existed, musculoskeletal restraint and functional impairment existed among sedentary occupational groups as well.

In spite of this growing body of evidence, SIJD and pelvic tilt abnormalities continue to be underdiagnosed because they share overlapping symptomatology with other lumbar spine disorders. This makes it difficult and highlights the importance of using comprehensive clinical examinations such as postural examination, SIJ provocation testing, imaging studies, and, if necessary, diagnostic blocks.

VI. References

1. Maher, C.; Underwood, M.; Buchbinder, R. Non-specific low back pain. Lancet 2017, 389, 736–747.
2. GBD 2017 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 354 diseases and injuries for 195 countries and territories, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017. Lancet 2018, 392, 1789–1858, Erratum in: Lancet 2019, 393, e44. https://doi.org/10.1016/S0140-6736(19)31047-5.
3. Foster, N.E.; Anema, J.R.; Cherkin, D.; Chou, R.; Cohen, S.P.; Gross, D.P.; Ferreira, P.H.; Fritz, J.M.; Koes, B.W.; Peul, W.; et al. Prevention and treatment of low back pain: Evidence, challenges, and promising directions. Lancet 2018, 391, 2368–2383.
4. Agence Nationale d'Accréditation et d'Evaluation en Santé. Diagnostic, Prise en Charge et Suivi des Malades Atteints de Lombalgie Chronique; ANAES: Paris, France, 2000.
5. Manchikanti, L.; Boswell, M.V.; Singh, V.; Benyamin, R.M.; Fellows, B.; Abdi, S.; Buenaventura, R.M.; Conn, A.; Datta, S.; Derby, R.; et al. Comprehensive evidence-based guidelines for interventional techniques in the management of chronic spinal pain. Pain Physician 2009, 12, 699–802.
6. Dillane, J.B.; Fry, J.; Kalton, G. Acute back syndrome: A study from general practice. Br. Med. J. 1966, 2, 82–84.
7. Knezevic, N.N.; Candido, K.D.; Vlaeyen, J.W.S.; Van Zundert, J.; Cohen, S.P. Low back pain. Lancet 2021, 398, 78–92.
8. Barrey, C.Y.; Le Huec, J.C.; French Society for Spine Surgery. Chronic low back pain: Relevance of a new classification based on the injury pattern. Orthop. Traumatol. Surg. Res. 2019, 105, 339–346.
9. Lim HS, Roh JH, Lee BH. The relationship between pelvic tilt angle and disability associated with low back pain. J Phys Ther Sci. 2013;25(1):65–67.
10. Pranav VK, Raju NS, Sangeeta A, Renuka M. Lumbo-sacral disc degenerative disease and lumbar sagittal alignment: Are they associated in Indian patients with chronic low backache? Int J Orthop Sci. 2022;8(1):176–180.
11. Ogon I, Mihara Y, Harada Y, Ikeda T, Nagae M, Matsuda S. Association between spinopelvic alignment and lumbar intervertebral disc degeneration quantified with MRI T2 mapping in chronic low back pain. Sci Rep. 2020;10:12528.
12. Abdollahi S, Mirzaei M, Moghadam N, et al. Sacroiliac joint dysfunction and pain in relation to injury incidence in Iranian basketball players. J Back Musculoskelet Rehabil. 2023;36(2):317–324.
13. Cappaert TA, Uhl TL, Mattacola CG, McCrory JL. A clinical perspective: Sacroiliac joint dysfunction and its role in low back pain. J Athl Train. 2000;35(3):285–293.
14. Kim WD, Lee JY. Effects of pelvic tilt imbalance on trunk and hip performance and disability in office workers with low back pain. Healthcare (Basel). 2023;11(3):426.
15. Buchanan P. Diagnosis and management of sacroiliac joint dysfunction: A best practices review. Pain Pract. 2018;18(3):265–276.
16. Lee JH, Yoo WG, Lee MR. Effects of posterior pelvic tilt taping on pelvic inclination, sacral angle, and low back pain. J Phys Ther Sci. 2012;24(4):401–404.
17. Marymont JV. Stress reaction of the sacroiliac joint in young athletes. Clin Sports Med. 1986;5(3):645–653.
18. Kunene SH, Taukobong NP. Prevalence and association of mechanical lower back pain and sacroiliac joint dysfunction among golfers. S Afr J Sports Med. 2018;30(1):1–4.
19. Saunders J, Lee S, McGrath B. Sacroiliac joint dysfunction and recurrent hamstring injuries in elite athletes: A case series. Br J Sports Med. 2019;53(Suppl 1):A19.
20. Timm KE. Sacroiliac joint dysfunction in elite rowers: A descriptive study. J Orthop Sports Phys Ther. 1999;29(4):190–195.
21. Weksler N, Velan GJ, Goldstein B, et al. The role of sacroiliac joint dysfunction in patients with low back pain and positive disc findings on imaging. Spine (Phila Pa 1976). 2007;32(2):E100–E104.
22. Natan S. Sacroiliac joint dysfunction misdiagnosed as lumbar disc herniation: A diagnostic challenge. Clin Spine Surg. 2007;20(4):275–279.
23. 12.Patwardhan AG, Sielatycki JA, Havey RM, Humphreys SC, Hodges SD, Blank KR, Muriuki MG. Loading of the lumbar spine during transition from standing to sitting: effect of fusion versus motion preservation at L4-L5 and L5-S1. Spine J. 2021;21(4):708–719. doi: 10.1016/j.spinee.2020.10.032.
24. 13.Dideriksen K, Boesen AP, Reitelseder S, Couppe C, Svensson R, Schjerling P, Magnusson SP. et al. Tendon collagen synthesis declines with immobilization in elderly humans: no effect of anti-inflammatory medication. J Appl Physiol (1985) 2017;122(2):273–282. doi: 10.1152/japplphysiol.00809.2015.
25. 14.Magnusson SP, Kjaer M. The impact of loading, unloading, ageing and injury on the human tendon. J Physiol. 2019;597(5):1283–1298. doi: 10.1113/JP275450.
26. 15.Joseph LH, Hussain RI, Naicker AS, Htwe O, Pirusan U, Paungmali AP. Pattern of changes in local and global muscle thickness in local and global muscle thickness among individuals with sacroiliac joint dysfunction. Hong Kong Physiother J. 2015;33(1):28–33. doi: 10.1016/j.hkpj.2014.12.003.

27. 16.Hamidi-Ravari B, Tafazoli S, Chen H, Perret D. Diagnosis and current treatments for sacroiliac joint dysfunction: a review. CurrPhys Med Rehabil Rep. 2014;2(1):48–54. doi: 10.1007/s40141-013-0037-7.
28. 17.Telli H, Huner B, Kuru O. Determination of the Prevalence From Clinical Diagnosis of Sacroiliac Joint Dysfunction in Patients With Lumbar Disc Hernia and an Evaluation of the Effect of This Combination on Pain and Quality of Life. Spine (Phila Pa 1976) 2020;45(8):549–554. doi: 10.1097/BRS.0000000000003309.
29. 18.von Heymann W, Moll H, Rauch G. Study on sacroiliac joint diagnostics. Manuelle Medizin. 2018;56:239–248. doi: 10.1007/s00337-018-0405-6.
30. 19.Vleeming A, Schuenke MD, Masi AT, Carreiro JE, Danneels L, Willard FH. The sacroiliac joint: an overview of its anatomy, function and potential clinical implications. J Anat. 2012;221(6):537–567. doi: 10.1111/j.1469-7580.2012.01564.x.
31. 20.Place HM, Hayes AM, Huebner SB, Hayden AM, Israel H, Brechbuhler JL. Pelvic incidence: a fixed value or can you change it? Spine J. 2017;17(10):1565–1569. doi: 10.1016/j.spinee.2017.06.037.
32. Lee JH, Na KH, Kim JH, Jeong HY, Chang DG. Is pelvic incidence a constant, as everyone knows? Changes of pelvic incidence in surgically corrected adult sagittal deformity. Eur Spine J. 2016;25(11):3707–3714. doi: 10.1007/s00586-015-4199-0.
33. Kleck CJ, Noshchenko A, Burger EL, Cain CMJ, Patel VV. Postoperative pelvic incidence (PI) change may impact sagittal spinopelvic alignment (SSA) after instrumented surgical correction of adult spine deformity (ASD) Spine Deform. 2021;9(4):1093–1104. doi: 10.1007/s43390-020-00283-2.
34. Mikula AL, Fogelson JL, Oushy S, Pinter ZW, Peters PA, Abode-Iyamah K, Sebastian AS. et al. Change in pelvic incidence between the supine and standing positions in patients with bilateral sacroiliac joint vacuum signs. J Neurosurg Spine. 2021;34(4):617–622. doi: 10.3171/2020.8.SPINE20742.
35. Haffer H, Becker L, Putzier M, Wietholter M, Ziegeler K, Diekhoff T, Pumberger M. et al. Changes of fixed anatomical spinopelvic parameter in patients with lumbosacral transitional vertebrae: a matched pair analysis. Diagnostics (Basel) 2021;11(1):59. doi: 10.3390/diagnostics11010059.