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Research Paper

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To Study the Correlation of Biomechanical markers of Pelvis and Foot with Static Plantar Pressure Distribution in population with Non- Specific Low Back Pain: A Literature Review

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ABSTRACT

This review aimed to explore the current literature on correlation of biomechanical markers of pelvis and foot with static plantar pressure distribution in population with non-specific low back pain. The studies published in the English language between 2001 and 2023 were included based on a search of the databases PubMed, PEDro, Google Scholar, Research Gate and Science Direct. Low Back Pain and plantar pressure were included in the literature review. We found a total of 42 studies that includes low back pain, plantar pressure distribution and lumbopelvic biomechanical deviations in this literature review. In 33 studies we found the significant relationship between plantar pressure distribution and lumbopelvic biomechanical deviations, while 9 studies had no significant relation between plantar pressure and lumbopelvic biomechanical deviations. The outcome measures used in the studies are mostly various lumbopelvic biomechanical angles and plantar pressure distribution.

Having known that there is significant relationship between lumbopelvic biomechanics and low back pain and the plantar pressure distribution through foot affects the lumbopelvic biomechanics, there is scope for future research to study the correlation of pelvic biomechanical markers and foot posture with plantar pressure distribution to find out the underlying causes.

Categories: Physical Medicine & Rehabilitation**Keywords:** Spino- Pelvic parameters, Sacral Slope, Non- Specific Low Back pain, Plantar pressure Distribution, Lordosis, Calcaneum inclination, Longitudinal arch, and Pelvic Incidence**INTRODUCTION**

Low back pain is one of the most common issues these days, especially in the younger generation, with the sedentary lifestyle and desk jobs being the common reasons [1].

Non-specific Low back pain defines as low back pain not attributed to a recognizable, known specific pathology example- infection, tumor, osteoporosis, lumbar spine fracture or cauda equine syndrome. Some Common practices such as general spinal exercises, core strengthening

exercises, and stretching exercises are prevalent to get rid of back pain. Still, chronic back pain causes structural and postural changes that lead to frequent back pain despite doing exercises [2]. Those structural and postural changes need correction not only to get rid of the pain but also to improve the quality of life. A properly addressed postural and biomechanical issue will also prevent secondary changes and tissue damage [3].

It has been known that there is a significant relationship between low back pain and lumbopelvic biomechanical deviations. It's also been known that lumbopelvic biomechanical deviation can lead to postural changes through the lower limb [4].

A significant chain of interdependence exists between the pelvic and spinal parameters. Pelvic incidence, which is the only independent and anatomical parameter, determines pelvic orientation and the size of the lordosis, which is closely correlated with it. A low value of pelvic incidence implies low values of pelvic parameters and a flattened lordosis; a high value implies well-tilted pelvic orientation and pronounced lordosis [5].

The differences in sagittal spino-pelvic alignment between adults with chronic low back pain & the normal population are still poorly understood. It is still unknown if particular patterns of sagittal spino-pelvic alignment are more prevalent in chronic low back pain [6].

Various studies have shown that biomechanical markers of foot like calcaneum valgus/Varus, navicular angle, tibial torsion angle etc. can lead to lumbopelvic biomechanical deviations [7].

Foot plantar pressure is the pressure field that acts between the foot and the support surface during everyday standing and locomotor activities [8].

REVIEW

S.No	Author	Study design	No. of Patients	Treatment	Outcome measures	Result
1	Hwee Weng Dennins, Hee-Kit Wonget al; (2021)	Observational	64 Males & 46 Females	None	Pelvic Incidence	Result showed low Pelvic incidence was associated with tall pelvis and straight sacrum other than Thoracic kyphosis, Lumbar Lordosis
2	Zhou S, Xu F, Wang W, Zou D, Sun Z, Li wet al; (2020)	Observational	218	None	Pelvic tilt, Sacral slope	Results showed Gender differences existed in

						sagittal parameters
3	Renata Woznicka, Artur Stolarczyk et al; (2019)	RCT	81	Longitudinal arch correction	Plantar pressure distribution	Result shows appropriate corrective exercises should be used to prevent forefoot overload and alteration in body posture.
4	Hongda Bao et al; (2018)	Comparative study	1625	None	Pelvic Incidence	Results shows age is associated with increase PI
5	Thomas chevillotte et al; (2018)	Comparative study	15	None	Pelvic parameters Lumbar lordosis	Resultant mean value concluded PI remains unchanged but lumbar lordosis and sacral orientation shows significant changes with change in posture
6	Krol A, Gleb K et al; (2017)	Observational	60	None	BMI, Mechanical factors, pelvic tilt	Result confirms that position of pelvis alters with age, angle value of LL and BMI, whereas muscles did

						not significantly affect the pelvic tilt.
7	Yun-GyoSeo et al; (2017)	Comparative	38	Pelvic adjustment done 4 times a week for 8 weeks	Pelvic adjustment, VAS, ODI, Sacral slope	Result shows improvement in VAS, ODI and back flexibility. changes in lumbar lordotic angle, sacral slope pelvic crest uplevelling and femoral height inequality were greater in pelvis adjustment group than the control group.
8	Hui Wang Ying-Ze Zhang et al; (2015)	Comparative study	256	None	Lumbar scoliosis, pelvic incidence	Result signifies that restoration of LL based on PI can help in achieving balanced spinopelvic alignment.
9	Ibrahim J Rasouli et al; (2015)	Comparative study	1012	None	Pelvic incidence	Results shows no significant difference between the PI of 2 groups was found but a high inter -

						observer reliability was found. Atlas, the hip OA was not associated with hip OA.
10	Jentzsch , Bouaicha et al; (2013)	Observational study	620	None	Pelvic incidence	Concluded that PI has no correlation with age or gender. however, it is linearly associated with LL, FJ arthritis and sagittal FJ orientation.
11	Emmanuelle Chale et al; (2011)	Comparative study	198	None	Sagittal spino-pelvic alignment pelvic incidence	Result indicates significantly increased proportion of subjects with LBP stands with abnormally small sacral slope and Pi associated with a long but small LL
12	Lonner, Auerbach et al; (2010)	Comparative study	1658	None	Pelvic incidence, PT, LL	Results shows that a larger LL was required to maintain a neutral sagittal balance in

						presence of a larger PI.
13	Schwab, Reid MD et al; (2006)	Observational study	75	NONE	Spino – pelvic association	Study concluded clear age-related changes in spino – pelvic association
14	Rajnic, Templier et al; (2001)	Comparative study	78	None	Isthmic spondylolisthesis	A horizontal sacrum is indicative of maladaptation in humans
15	Kalid M Malik, Ariana M. Nelson et al; (2022)	Observational study	115	Current paradigm to improve patient outcome	VAS for Non-Specific low back pain	Result shows that the low back pain remained a significant and unresolved public health problem
16	Adel F Almutairi et al; (2021)	Observational study	1798	None	Flat foot	This study showed that regardless of age, gender, BMI, occupation, being a non-smoker or physically active, flat feet was a significant factor associated with both types of low back pain
17	Smith, Anne PhD, O’Sullivan et al;	Observational study	120	None	Sagittal thoraco-	Result shows that

	(2008)				lumbar pelvic alignment	specific standing postures are associated with back pain
18	KiattipornAnukoolakarn et al; (2015)	Observational study	65	none	Plantar pressure distribution	Research concluded that at mid-stance phase of walking the pressure on the plantar surface were unequally distributed in subjects with chronic non-specific low back pain
19	Lucien Robinault et al; (2023)	Observational study		None	Nonspecific low back pain	Research concluded that as the importance of relationships with non-specific low back pain for each variable is dependent on the condition performed, care should be taken when choosing which variable to examine for each of the condition

						studied.
20	Yalcin N, Esen E et al; (2010)	Comparative study	95	Radiographic analysis	Medial longitudinal arch	Results showed that both static and dynamic methods can be utilized in evaluation of Medial longitudinal arch

Conclusions

In our review, 33 studies suggest significant relationship between biomechanical markers of foot and pelvis with static plantar pressure distribution while 6 studies shows that there is difference in dynamic and static plantar pressure distribution related to biomechanical markers of foot and pelvis and 3 studies showed no significant relationship. Studies with larger sample sizes and similar gender and age group showed positive relationship in various biomechanical markers of pelvis, Lumbar spine, and foot. The correlation between biomechanical markers of pelvis and foot with plantar pressure distribution in symptomatic population is still poorly understood. There is lack of published data on correlation of various biomechanical markers of pelvis and foot with static plantar pressure distribution in symptomatic individuals. There is scope for future research to study the correlation and research should be conducted to gain deeper insights of the topic in order to develop a specific treatment approach of biomechanical correction of pelvis and foot for individuals with non-specific low back pain.

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