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PREVALENCE OF SCOLIOSIS, FLAT FOOT, AND LOW BACK PAIN AMONG FEMALE UNIVERSITY STUDENTS: A CROSS-SECTIONAL STUDY AT TAIBAH UNIVERSITY

AYMAN A. ALHAMMAD[1], HUSAM A. ALMALKI[2], LAMA O. ALJABRI[1] FATIMAH N. HAMEEDUDEEN[1], MOHAMMED M. ALRASHIDI[1], AHMED S ALANAZI[1], OMAR W. ALTHOMALI[3]

[1]COLLEGE OF MEDICAL REHABILITATION SCIENCES, DEPARTMENT OF PHYSICAL THERAPY, TAIBAH UNIVERSITY, MADINAH, SAUDI ARABIA
[2]COLLEGE OF APPLIED MEDICAL SCIENCES, DEPARTMENT OF PHYSICAL THERAPY, HAIL UNIVERSITY, HAIL, SAUDI ARABIA
[3]COLLEGE OF APPLIED MEDICAL SCIENCES, DEPARTMENT OF HEALTH REHABILITATION, SHAQRA UNIVERSITY, SHAQRA, SAUDI ARABIA

Abstract
Background: This study examines the prevalence of scoliosis, flat feet, and low back pain among girls students at Taibah University. Scoliosis affects 19% of individuals in Almadinah Almonawarah, primarily women, while flat feet impact 20-37% of the population, leading to potential injuries. Low back pain (LBP) has an incidence rate of 18.8% to 53.5% in Saudi Arabia.
Methods: A cross-sectional study was carried out involving 171 female students aged between 18 and 25 years, after obtaining ethical clearance. Recruitment was done through university-wide announcements. The evaluation process included the Adam Forward Bending Test to screen for scoliosis, the Oswestry Disability Index to assess low back pain, and both the Foot Posture Index and the Navicular Drop Test to identify flat-foot conditions.
Results: Statistical analyses of the 171 female participants were conducted using descriptive statistics via Microsoft Excel 365. The average age was 20.56 years, with a weight of 55.52 kg, height of 157.67 cm, and BMI of 22.33. The Oswestry Disability Index score averaged 9.27, indicating minimal disability for 86.5% of participants. Spinal assessments revealed normal thoracic angles in 82.5% and normal lumbar alignment in 92.4%. Foot posture analysis showed 50.3% neutral left feet and 55.6% neutral right feet. Navicular Drop Test results indicated normal function in 62.0% of left feet and 78.4% of right feet, with mild to moderate pronation observed but no excessive pronation or supination.
Conclusion: Our study highlights a significant prevalence of scoliosis, flat feet, and LBPamong girls students at Taibah University. These musculoskeletal issues can negatively influence physical function and overall quality of life, underscoring the importance of early detection and focused intervention programs. Increasing awareness and adopting preventive measures are crucial to reducing long-term consequences. Additional research is recommended to better understand the relationships among these conditions.
Keywords: Scoliosis, Scoliometer, Pes Planus, Flat Foot, Low Back Pain, Prevalence

INTRODUCTION

Scoliosis is a three-dimensional deformity of the spine defined by a sideways curvature affecting one or more spinal segments, along with rotational changes in the vertebrae that cause misalignment in both the coronal and sagittal planes [1]. It is commonly classified into several types, including thoracic, lumbar, and thoracolumbar scoliosis. Thoracic scoliosis primarily affects the upper segment of the spine, often presenting with a pronounced rib hump and postural asymmetry. Lumbar scoliosis involves the lower spine and can lead to significant discomfort and functional impairment. Thoracolumbar scoliosis, which affects both the thoracic and lumbar regions, may result in complex deformities and varying degrees of clinical severity.
A person's health is impacted by scoliosis in numerous ways, it can exacerbate chronic back pain and impair cardiopulmonary function. It may also negatively affect self-esteem and social integration, leading to limitations in physical activity, poor body image, and difficulty in peer relationships [2].
Scoliosis represents a significant health concern in our society, with studies revealing a troubling prevalence rate of 19% in Almadinah Almonawarah [3]. Gender has a major influence on the incidence and development of scoliosis; numerous studies have consistently shown that scoliosis affects women more than men, However, scoliosis is believed to arise from a combination of genetic, hormonal, and environmental influences. Research has identified specific gene variants linked to the condition, indicating a possible hereditary component.

Hormonal fluctuations during puberty and irregular growth patterns may also contribute, although the exact mechanisms remain unclear [4].

Scoliosis is initially assessed through a physical examination, but a definitive diagnosis is made using imaging techniques such as CT scans, MRIs, or X-rays. The scoliometer is an inclinometer widely used for scoliosis screening. It is typically applied during the Adam's forward bend test, where the individual bends at the hips to assess rib cage and spinal column asymmetry. When the device detects an angle of trunk rotation above the clinical threshold, further evaluation such as specialist referral and spinal radiographs is recommended. This simple and efficient tool has long been central to scoliosis assessment. With advances in smartphone technology, digital scoliometer applications have also become increasingly available [5].

Pes planus, or flatfoot, is a common structural foot deformity marked by a partial or complete collapse of the medial longitudinal arch, which results in the foot coming close to or fully touching the ground. The medial longitudinal arch is composed of a resilient and dynamic complex of ligaments, tendons, and fascial structures that span from the forefoot to the hindfoot. Flat feet can be either congenital or acquired. Moreover, flat feet may lead to compensatory postural adjustments, which in turn can contribute to the onset of LBPand spinal deviations such as scoliosis [6]. The prevalence of flat feet varies according to age and population. In the general population, studies report that approximately 20–37% of people have some degree of flat foot [7]. In adults, flexible flat foot has been observed in 13.6% of the population, with a slightly higher prevalence in females (14.4%) than in males (12.8%) [8].

Flat feet can be either congenital or acquired. Congenital causes include tarsal coalition, accessory navicular bone, and congenital vertical talus [9]. Acquired flat foot commonly results from posterior tibial tendon dysfunction (PTTD), which can lead to a gradual collapse of the arch [10]. Other risk factors that contribute to the development of flat feet include obesity, aging, foot or ankle trauma, rheumatoid arthritis, and diabetes, all of which can weaken the structures that support the foot arch [11].

One of the most common biomechanical consequences of flat feet is overpronation, which refers to an excessive inward rolling motion of the foot during walking or running [6]. Pronation is a natural component of gait, but excessive pronation (overpronation) disrupts normal biomechanics and increases the risk of injuries such as shin splints and plantar fasciitis [12]. Research shows that 14% of the population exhibits overpronation, while 20% show signs of over supination [13]. Among younger adults, females are more likely to have pronated feet (35.6%) compared to males (11.3%) [14].

Causes of overpronation include muscle imbalances, ligament laxity, overuse of supporting tendons, tight calf muscles, and inappropriate footwear that lacks arch support [15,16]. Left untreated, overpronation can lead to several complications, such as plantar fasciitis, medial tibial stress syndrome (shin splints), Achilles tendinopathy, and patellofemoral pain syndrome [6].

Early diagnosis and proper intervention can significantly improve quality of life, reduce discomfort, and prevent long-term complications related to abnormal foot mechanics [6].

The most prevalent musculoskeletal disorder that impairs quality of life, particularly if it persists, is low back pain (LBP). While LBP refers to a symptom, it can also refer to a complex clinical disorder that can have detrimental effects on disability and job absence, depending on its severity and length. Discomfort in one or both legs is frequently present together with low back discomfort, which is located between the buttock creases and the lower rib borders [17]. Acute (pain lasting less than six weeks), sub chronic (pain lasting six to twelve weeks), and chronic (pain lasting more than twelve weeks) are the three durable categories for LBPsyndrome]18].

Chronic LBP is the second most prevalent cause for adults 65 and older to visit a doctor, making it a widespread and effective public health issue globally. According to studies, as people age, the frequency and prevalence of chronic LBPrise [18]. In Saudi Arabia, LBP is a prevalent reason for health workers' absences from work. It is very common all around the world. One Its estimated incidence in Saudi Arabia ranges from 18.8% 2 to 53.5% [19].

Globally, around 619 million people are estimated that suffer from LBP a complex biopsychosocial condition influenced by psychological, neurological, social, behavioural, and physical factors, and the number of affected individuals continues to rise [20].

To our knowledge, no earlier research has focused on determining the prevalence of scoliosis, flat feet, and LBPamong girls students at Taibah University in Medina. Consequently, the impact and distribution of these musculoskeletal conditions within this group are not yet well understood.

This research was therefore initiated to address this gap by investigating the prevalence of scoliosis, flat feet, and LBPamong girls students at Taibah University in Medina. The study aims to provide reliable epidemiological data that can serve as a foundation for future research into the shared risk factors and potential biomechanical or physiological mechanisms linking these disorders.

By conducting comprehensive biomechanical assessments, this study also seeks to improve diagnostic accuracy and contribute to a more nuanced understanding of these conditions. Additionally, the research will explore common lower extremity disorders within this population to inform the development of targeted preventive and therapeutic strategies within the university setting.

Ultimately, the findings are expected to support healthcare professionals in the early identification and effective management of musculoskeletal health issues among university students, thereby promoting overall student well-being and academic performance.

METHODS

This cross-sectional study was conducted to assess the prevalence of scoliosis, LBP(LBP), and flat feet among girls students at Taibah University in Medina, Saudi Arabia Participants were aged between 18 and 25 years. Informed consent was obtained from all participants prior to the start of the study. The Research Ethics Committee of the College of Rehabilitation Sciences has reviewed and approved the research proposal with approval number (CMRS-REC2025-0018). Participants were informed about the purpose and procedures of the study, as well as their right to withdraw at any stage without any consequences. Confidentiality and privacy were ensured throughout the study in accordance with approved ethical standards. A total of 171 female students were enrolled. The sample size was guided by similar studies using cross-sectional designs and was selected to balance statistical power with practical feasibility.

The female students aged 18 to 25 years are included in our study, currently enrolled at Taibah University. The exclusion criteria include history of spinal surgery or significant spinal trauma, presence of neuromuscular disorders or connective tissue diseases that could affect musculoskeletal health, history of lower limb fractures or surgeries, known congenital or acquired lower limb deformities, severe foot deformities other than flat foot, such as clubfoot, Inability to provide informed consent, and leg length discrepancy above 2cm.

Participants were recruited from student rest areas and various colleges at Taibah University. Recruitment was conducted via posters, university-wide announcements, and online platforms. Interested students visited the College of Medical Rehabilitation, where they were informed about the study and provided written informed consent. Female students between the ages of 18 and 25 were invited to participate through university-wide announcements, posters, and online platforms.

Interested students visited the College of Medical Rehabilitation, where they received detailed information about the study and provided informed consent. Several methods exist for measuring the Cobb angle, including traditional manual techniques, semi-automated digital computer– assisted methods, fully automated systems, and smartphone-based applications.

The Adam's Forward Bending Test (AFBT), in combination with a smartphone-based sociometer (Scolio Life™, iOS app installed, running on iOS 18.3.2), was used to detect axial trunk rotation (ATR). A reading of ≥5° was considered indicative of scoliosis, based on literature correlating this value with a Cobb angle >20° [21].

The Oswestry Disability Index (ODI) was facilitate to evaluate disability and functional impairment associated with low back pain. It includes ten domains (e.g., pain intensity, walking, sitting, personal care, sleeping), with each scored from no disability (0) to maximum disability (5). The total score is calculated as a percentage from 0 to 100%, with higher scores indicating greater impairment [20].

Foot posture was assessed using the validated Foot Posture Index (FPI-6), which evaluates six visual indicators of foot alignment. Each component is scored from −2 to +2, resulting in a total score between −12 and +12. Scores between +6 and +9 indicate pronated feet, while scores ≥+10 indicate highly pronated feet , participants were asked to stand with the feet bare and shoulder width apart, and the lower legs exposed. take a few steps forward and then stand still with arms along the side and looking forward [22].

All six components of the FPI-6 were evaluated, including talar head palpation, observation of the curves above and below the lateral malleolus, detection of any bulging at the talonavicular joint, assessment of calcaneal inversion or eversion, evaluation of the alignment of the medial longitudinal arch, and examination of forefoot adduction or abduction in relation to the rearfoot. Each item was scored on a scale from −2 to +2, resulting in a total score ranging from −12 to +12. Scores from 0 to +5 were classified as normal foot posture, +6 to +9 as pronated, and +10 or higher as highly pronated, while scores from −1 to −4 indicated a supinated posture and −5 to −12 represented a highly supinated foot. [22]

The Navicular Drop Test was performed to evaluate the collapse of the medial arch. First, with the participant seated in a non–weight-bearing position, the vertical distance between the navicular bone and the floor was recorded. The measurement was then repeated while the participant stood in a weight-bearing position. A navicular drop greater than 10 mm was considered indicative of flatfoot [23].

Statistical Analysis

All statistical analyses were conducted using IBM Spss 26. Descriptive statistics were applied to summarize participant demographics and study outcomes. Continuous variables such as age, height, weight, BMI (body mass index), and Oswestry Disability Index scores were expressed as means and standard deviations. Categorical variables, including gender, Oswestry disability levels, spinal alignment (thoracic and lumbar scoliosis), foot posture based on the modified Foot Posture Index, and navicular drop test classifications, were presented as frequencies and percentages. As the study was observational and focused on reporting prevalence and distribution patterns, only descriptive analyses were performed, and no inferential statistical tests were used.

RESULTS

A total of 171 individuals participated in the study. all of whom were female (100%). The mean age was 20.56 years (SD = 1.52), with an average body weight of 55.52 kg (SD = 12.99), height of 157.67 cm (SD = 5.91), and BMI of 22.33 (SD = 5.11).

Table1: Demographic data

Deviation		Mean	Standard	Count
Age		20.56	1.52	
Gender	Female			171
Weight		55.52	12.99	
Height		157.67	5.91	
BMI		22.33	5.11	

The average score on the Oswestry Disability Index was 9.27 (SD = 9.90), suggesting minimal disability in this population. Specifically, 86.5% (n = 148) of participants fell within the "minimal disability" range (0–20%), while 13.5% (n = 23) were categorized as having "moderate disability" (21–40%).

With respect to spinal posture, 82.5% (n = 141) of participants had a normal thoracic angle (<5°), while 17.5% (n = 30) showed signs of thoracic scoliosis (>4°). Lumbar spine assessment revealed that 92.4% (n = 158) were within the normal range (<5°), whereas 7.6% (n = 13) had lumbar scoliosis (>4°).

Table 2: Oswestry Disability Index and scoliometer measurement

		Mean	Standard Deviation	Count N %
Oswestry		9.27	9.90	
Oswestry disability index	Min. disability (0-20%)			148 (86.5%)
	Moderate disability (21-40%)			23 (13.5%)
Scoliosis categories based on thoracic angle	Normal (Angle <5 degrees)			141 (82.5%)
	Scoliosis (Angle >4 degrees)			30 (17.5%)
Scoliosis categories based on lumbar assessment	Normal (Angle <5 degrees)			158 (92.4%)
	Scoliosis (Angle >4 degrees)			13 (7.6%)

Foot posture analysis using the modified Foot Posture Index (FPI) showed that 50.3% (n = 86) of participants had a neutral left foot posture, and 49.7% (n = 85) had a pronated left foot. On the right side, 55.6% (n = 95) had a neutral posture, while 44.4% (n = 76) were pronated. No participants demonstrated supinated or highly pronated/supinated postures on either side.

Navicular Drop Test results indicated that 62.0% (n = 106) of left feet and 78.4% (n = 134) of right feet were within normal range. Mild to moderate pronation was observed in 38.0% (n = 65) of left feet and 21.6% (n = 37) of right feet. No cases of excessive pronation or supination were detected.

Table 3: Foot posture index and Navicular drop test

Particulars		Count (N)	N %
Left foot posture index category	Highly supinated	0	0.0%
	Supinated	0	0.0%
	Neutral	86	50.3%
	Pronated	85	49.7%
	Highly pronated	0	0.0%
Right foot posture index category	Highly supinated	0	0.0%
	Supinated	0	0.0%
	Neutral	95	55.6%
	Pronated	76	44.4%
	Highly pronated	0	0.0%
Left foot navicular drop test category modified	Normal	106	62.0%
	Mild to moderate pronation	65	38.0%
	Excessive pronation	0	0.0%
	Supination or rigid foot	0	0.0%

Right foot navicular drop test category modified	Normal	134	78.4%
	Mild to moderate pronation	37	21.6%
	Excessive pronation	0	0.0%
	Supination or rigid foot	0	0.0%

DISCUSSION

Scoliosis is a three-dimensional spinal curvature that has a major negative influence on both physical and mental health. Up to 19% of people, including female students at Taibah University have scoliosis. The disorder is more prevalent in female, possibly because of the impact of oestrogen on spinal growth during puberty. Scoliosis can result from both low and high body mass indices because they can impair bone growth or increase the mechanical stress on the spine. Sedentary habits increase risk because they cause muscular imbalances and bad posture. Recent studies also point to a possible link between low melatonin levels and the development of scoliosis. For people at risk to improve their outcomes, a comprehensive prevention plan that includes routine screenings, public education, and lifestyle changes is essential.

As for Oswestry Disability Index (ODI), the results of this study showed that the mean score among participants was 9.27, indicating a very low level of LBP associated disability. Interestingly, 86.5% of students were documented as having “minimal disability” 0-20% and only

13.5% fell under “moderate disability” 21-40%. The data suggests that most participants experienced minimal barriers to functioning, which aligns with the study population's demographics young, largely healthy female college students aged 18 to 25. On the other hand, Al-amer et al. (2020) research with that focus employed different methods and reached varying conclusions. With this research, we opted for a cross sectional approach coupled with primary data collection from women. Their work was a systematic review that collected and analysed data from previously published literature instead. They concentrated their efforts on published literature about LBP in healthcare professionals in Saudi Arabia. Within that population, there was a reported greater prevalence and more severe LBP. This approach allowed them to identify key common risk factors and determine the prevalence across studies. Unlike our participants who mostly reported minimal disability, Al-amer found that the healthcare workers experienced more substantial disability [19].

In this study, it was found that 49.7% (n = 85) of participants exhibited pronation in the left foot, while 44.4% (n = 76) had pronation in the right foot. Neutral foot position was observed in 50.3% (n = 86) of the left feet and 55.6% (n = 95) of the right feet. These findings align with the research by Mickle et al. (2011), which reported more pronated feet among young adult females. The slight differences may be attributed to variations in population, footwear, and levels of physical activity.

Mild to moderate pronation was detected in 38.0% (n = 65) of the left feet and 21.6% (n = 37) of the right feet, as assessed by the Navicular Drop Test. Notably, no participants were identified with excessive pronation or supination, suggesting that the majority of subjects demonstrated normal or nearly normal foot function.

These results highlight the importance of early screening, as alterations in foot posture may increase the risk of developing conditions such as low back pain. However, limitations of the study include the exclusive focus on a female sample and reliance on clinician-rated measures. Future research with larger and more diverse populations is essential to investigate potential long-term effects and associations with other musculoskeletal complaints[14].

CONCLUSION

This study highlights a significant prevalence of scoliosis, flat feet, and LBP among girls students at Taibah University. These conditions affect physical function and quality of life, stressing the need for early screening and targeted interventions. Raising awareness and implementing preventive strategies are essential to minimize long-term impact. Further studies are needed to establish a clearer association between these musculoskeletal conditions.

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