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Original Article

Frequency of Genu Valgum and Genu Varum among the University Students and their Association with Gender and BMI

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ABSTRACT

Background: Knee angular deformities such as genu varum and genu valgum are common conditions that can lead to further complications and affect an individual's quality of life. Factors like gender, body mass index (BMI), lifestyle, and nutritional status are thought to influence the development of these conditions.

Objective: The primary aim of the study was to investigate the relationship between gender and BMI with the prevalence of genu varum and genu valgum among university students.

Methods: A cross-sectional survey was conducted over six months, from February to July 2021, involving 140 university students aged between 18 and 25 years, who were independent in activities of daily living (ADLs). Subjects with neurological, psychological, congenital disorders, or systemic pathologies were excluded. BMI was calculated using a height-weight machine. Knee alignment was assessed using a goniometer to measure the Q-angle at both the left and right knees. Data analysis was performed using IBM SPSS Statistics version 25.

Results: The prevalence of genu varum was higher in males (23 cases) compared to females (7 cases), while genu valgum was more common in females (24 cases) than in males (5 cases). No significant difference in the incidence of genu varum and genu valgum was noted with BMI for the left knee (p=0.422), but a significant association was found for the right knee (p=0.049). Gender was significantly associated with knee angular deformities, with p-values of less than 0.0001 for both knees.

Conclusion: The study underscores a significant association of knee angular deformities with gender, and a lateral-specific correlation of BMI with the Q-angle of the right knee. These insights are crucial for developing gender-specific and BMI-inclusive strategies for the prevention and management of genu varum and genu valgum.

Keywords: genu varum, genu valgum, knee angular deformities, gender differences, body mass index, Q-angle, university students.

INTRODUCTION

Obesity, a global phenomenon affecting approximately 300 million individuals worldwide, stands as a significant challenge in developed countries due to its association with an increased risk of mortality and a decrease in life expectancy(1). This condition, primarily fueled by urbanization, sedentary lifestyles, excessive caloric intake, and the nuances of modern living, necessitates precise measurement and understanding of the body mass index (BMI) due to its widespread prevalence and associated health implications. Concurrently, knee angular deformities, specifically genu valgum and genu varum, emerge as common orthopedic conditions within the general populace. These deformities, which can be either congenital or acquired, manifest as deviations in the alignment of bones distal to a joint, leading to conditions commonly referred to as knock knees (genu valgum) and bowlegs (genu varum)(2).

The relevance of lower extremity alignment in the context of injury risk, both acute and chronic, has been well-documented, underscoring the significance of understanding and addressing changes in this anatomical area(3). However, the literature reveals a

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Journal of Health and Rehabilitation Research 2791-156X JHRR

gap in comprehensive data regarding the anatomical changes that accompany these knee deformities, particularly how they affect the joint itself and its adjacent segments. Notable observations include alterations such as internal hip rotation, external tibial rotation, and variations in foot supination or pronation in individuals with genu valgum, as well as internal hip rotation, knee hyperextension, tibial vara, and foot supination in those with genu varum(4). Levangie and Norkin (2011) further elucidated the impact of genu varum on lower extremity alignment, highlighting the internal rotation of the hip, external rotation of the tibia, and pronated foot, while noting a lack of focus on the subsequent modifications in genu valgum deformity(5).

These deviations not only predispose individuals to a higher likelihood of developing conditions such as osteoarthritis in the tibiofemoral and patellofemoral joints but also contribute to compensatory changes in the ankle and foot joints, increasing the risk of tibia fractures(6). The knee joint, pivotal for body support and weight transfer during both static and dynamic activities, faces compressive and tensile stresses that are mitigated by the surrounding muscles and ligaments, with minimal contribution from bone structures(2). The presence of genu varum and genu valgum, which may affect either a single leg or both, represents a critical area for clinical attention. The natural progression of these conditions, from maximum bowing in infants at six months towards a neutral knee angle, and the self-correction of physiological genu valgum by the age of five to six years, underscores the importance of thorough history taking and assessment to understand the onset, progression, and prior treatments of these deformities(7).

The evaluation of knee joint alignment plays a crucial role in diagnosing pathological conditions, necessitating a clear differentiation between pathological and physiological deformities, understanding their severity, and their correlation with other deformities. Examination of the patient's feet, knees, and pelvis is imperative, with particular attention to limb length in comparison to the trunk, which may indicate a dwarfing condition. The diagnostic process benefits significantly from observing the patient in standing and walking positions, allowing for a comprehensive examination of limb alignment and asymmetry in both the sagittal and frontal planes. Identifying the type and location of the deformity, assessing hip and knee rotation, evaluating knee joint ligament stability, and measuring torsion on the tibia are critical steps in this assessment process, with radiographs serving as a vital tool for confirming the presence of deformity(9).

In terms of treatment, conventional methods such as bracing, which is effective in 50 to 80% of cases, and passive stretching exercises to alleviate valgus deforming forces by addressing the contracted iliotibial band, play a significant role(10). The prescription of Knee Ankle Foot Orthosis (KAFO) can provide support to knee ligaments and prevent over-stretching injuries, particularly in pathological genu valgum cases. Surgical intervention becomes a consideration for adolescents with severe genu valgum and marked mechanical axis deviation(11).

Recent research underscores the association between gender, BMI, and skeletal anomalies, particularly angular knee deformities, prompting an exploration of the causative link between BMI and these skeletal abnormalities in our study. By examining the relationship between genu varum and genu valgum abnormalities and gender, our research aims to enhance public awareness regarding knee angular deformities and offer guidance on prevention and correction strategies.

MATERIAL AND METHODS

The present study was designed as a cross-sectional survey, conducted over a period of six months, commencing in February 2021 and concluding in July 2021. The research setting comprised various educational institutions located within Islamabad and Rawalpindi. The sample included 140 university students, selected through a non-randomized convenient sampling technique. The inclusion criteria targeted individuals aged between 18 and 25 years who were independent in activities of daily living (ADLs). Exclusion criteria were established to omit participants with any neurological, psychological, or congenital disorders, as well as those suffering from any systemic pathology, ensuring the homogeneity of the sample with respect to the study's objectives.

Prior to data collection, written informed consent was obtained from all participants, in accordance with the ethical standards of the Declaration of Helsinki. This procedure underscored the ethical commitment to respect participant autonomy, confidentiality, and the right to informed participation. The measurement of height and weight was performed using a standard height-weight machine to calculate the Body Mass Index (BMI) of each participant. This was a crucial step in establishing a baseline for assessing the relationship between BMI and knee angular deformities among the study population.

For the assessment of knee joint alignment, a goniometer, recognized as a standardized instrument for evaluating joint range of motion, was employed. The procedure involved marking the anterior superior iliac spine (ASIS) and the anterior tibial tuberosity, in addition to the center of the patella. The goniometer was then precisely positioned at the center of the patella, with its arms aligned along the marked lines, thereby facilitating the accurate measurement of the Q angle for each subject(12). This process was meticulously carried out for both sides of each individual to ensure comprehensive data collection.

Data analysis was conducted using IBM SPSS Statistics version 25, a decision that reflects an update from the previously mentioned version to take advantage of the software's enhanced analytical capabilities. The use of this advanced statistical package enabled a

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Journal of Health and Rehabilitation Research 2791-156X JHRR

robust analysis of the collected data, allowing for a thorough investigation of the associations between gender, BMI, and the presence of genu varum and genu valgum among the participants. This analytical approach was instrumental in identifying significant patterns and correlations, thereby contributing to the study's aim of elucidating the relationship between these variables.

RESULTS

The bar graph presents a comparison of knee conditions categorized by gender and BMI. In terms of gender, among females, 7 have genu varum, 36 have normal knee alignment, and 24 have genu valgum. Conversely, males exhibit higher instances of genu varum with 23 affected, while 45 have normal knee alignment, and a smaller number, 5, have genu valgum. When viewed through the lens of BMI, individuals with genu varum are predominantly in the normal weight category (14), with underweight and obese categories having 4 and 1 individuals respectively, and none in the overweight category. Those with normal knee alignment are mostly found in the normal weight category (65), followed by the overweight (12), underweight (15), and obese (4) categories. For genu valgum, the distribution is more even across underweight and normal categories, both with 9 individuals, followed by overweight (6) and obese (1) categories. The data labels on the graph indicate the exact number of individuals for each condition within the respective categories.

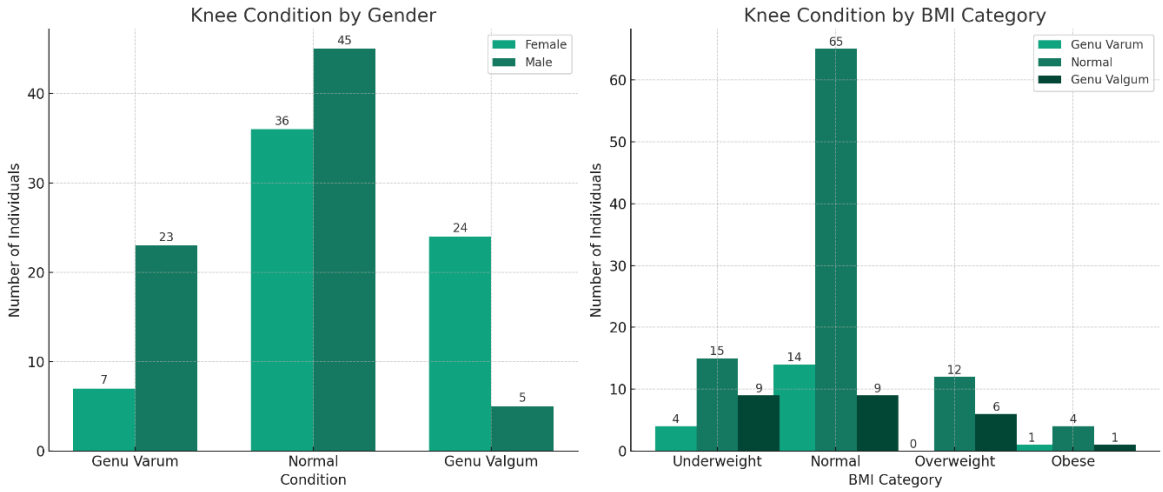

Figure 1 Demographic and Study Characteristics

Table 1 Association of Q-Angle Measurements with BMI and Gender

	BMI (p-value)	Gender (p-value)
Left Knee	0.422	<0.0001
Right Knee	0.049	<0.0001

The table displays p-values for the association of Q-angle measurements with BMI and gender across left and right knees. The Q-angle of the left knee shows no significant association with BMI (p=0.422), whereas the right knee exhibits a marginally significant correlation (p=0.049). In stark contrast, gender presents a highly significant association with the Q-angle for both knees, with p-values of less than 0.0001, indicating a strong link between gender and the angular measurement of the knees.

DISCUSSION

In the exploration of factors contributing to knee angular deformities, our research aimed to elucidate the roles of gender and body mass index (BMI). The findings indicated a gender disparity in the prevalence of these conditions, with genu varum being predominantly observed in males and genu valgum more frequently occurring in females. These observations are in line with the findings of Noam Shohat and colleagues(13), as well as the study by Mahmoud Karimi and colleagues(14), both of which corroborate the gender-related patterns in the manifestation of genu varum and genu valgum.

When considering the influence of BMI on knee angular deformities, our results did not demonstrate a significant impact, echoing the conclusions drawn by Anirejuoritse Bafor and associates(15), who reported no correlation between BMI and knee angular deformities. However, this lack of association was specific to the left knee, as a notable correlation was observed for the right knee. This is somewhat consistent with the results from F. Rahmani Nia and colleagues(16), who found a higher prevalence of genu valgum

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among obese and overweight females. Our study's demographic composition, with a majority presenting a normal BMI, may explain the absence of a pronounced link between BMI and knee deformities, particularly in the context of the left knee. Yet, the significant association found with the right knee warrants further investigation.

The strong association between gender and knee angular deformities was highlighted, considering the balanced distribution of male and female participants in our study. This gender-specific prevalence is supported by existing literature (17, 19, 20, 21, 22) and underscores the importance of considering gender as a variable in the study of knee deformities.

Reflecting on the study, it is important to acknowledge its strengths, including the methodological approach and the consideration of both gender and BMI as key variables. Nevertheless, limitations were also present, such as the sample size and the exclusion of other potential contributing factors like bone mineral density, which may have provided additional insights into the risks associated with knee angular deformities. The study also did not extensively examine the risk of falls in individuals with genu valgum and genu varum, a factor that could have significant implications for understanding the broader impact of these conditions.

For future research, it is recommended to expand the scope of investigation to include a larger population and to explore additional factors such as bone mineral density, the impact on quality of life, and the potential increase in fall risk associated with genu valgum and genu varum. These areas of inquiry could yield comprehensive data that would contribute to a more nuanced understanding of knee angular deformities and inform the development of targeted interventions.

CONCLUSION

The study concluded a discernible gender-based prevalence in knee angular deformities, with genu varum more common among males and genu valgum more frequent in females. While the relationship between BMI and the Q-angle of the left knee was not significant, a notable correlation was observed with the right knee, suggesting that the effects of BMI may be laterally specific. These findings have implications for clinical assessment and intervention strategies, emphasizing the need to consider gender and BMI in the management and treatment of knee deformities. Future research should incorporate a broader demographic and additional risk factors to fully understand the impact and etiology of genu valgum and genu varum, potentially influencing preventative healthcare measures and rehabilitation practices.

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Journal of Health and Rehabilitation Research 2791-156X JHRR

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