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Frequency of Genu Valgum and Genu Varum and its Association with Age, Gender, BMI and Knee Angular Deformities in Young Adults.

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ABSTRACT

Background and Objectives: Genu valgum is a skeletal disorder characterized by the inward alignment of the knee joint and outward deviation of the femur and tibia, leading to lateral mechanical axis changes and associated pain. Genu varum is a deformity where the lower leg bows inward, giving the leg an archer's bow appearance. The prevalence of genu valgum varies across different populations. : Our aim is to check the association between age, gender, BMI, and the frequency of knee angular deformities (Genu Valgum and Genu Varum) in young adults.

METHODOLOGY: Three hundred and nine young adults who routinely \came to their university at Green International, Comsats, Superior, University of Lahore and University of Management and Technology were examined in this cross-sectional investigation. With a mean age of 27.5 ± 4.611 years, it was discovered that the participants' age, gender, BMI and knee angular deformities are associated with genu varum and genu valgum.

RESULTS: This study concluded that the frequency of genu varum is 35.27% and genu valgum is 34.95% in significant association with age, gender, BMI, and knee angular deformities. The correlation between genu valgum and genu varum with age, gender, BMI, and knee angular deformities in young adults is entirely independent of the age and gender.

CONCLUSION: The correlation between genu valgum and genu varum with age, gender, BMI, and knee angular deformities in young adults is entirely independent of the age and gender.

KEYWORDS: Q-angle, Genu Valgum, Genu Varum, BMI, Inteknee distance, Intermalleolar distance.

INTRODUCTION

Genu valgum is a skeletal disease causing pain due to lateral deviation of the femur and tibia, resulting from a change in the mechanical axis (1). Genu varum is a varus deformity characterized by a bowing at the knee, resulting in a medially tilted lower leg resembling an archer's bow (2). Genu valgum, a rare abnormality in knee osteoarthritis cases, is prevalent globally, with incidence varying by region. In Iran, it's found in 28% (3) of obese high school females, while in Brazil, it's 7.1% (4). Genu varum, a leg bowing condition, has varying global incidence rates, ranging from 2.53% to 16.33% across different populations, according to various studies (5). Improper knee position can lead to recurrent stress on ligaments and capsule structures, causing Genu valgum (6). Fibular hypertrophy in achondroplasia may lead to genu varum, but studies show no significant correlation between the severities of the issue (7). Genu valgum is classified into three types based on severity: Type I (10 degrees), Type II (11-20 degrees), and Type III (21-30 degrees). Genu varum is categorized into four levels based on the space between legs when standing with legs closed: Level 1 (<2.5 cm), Level 2 (2.5-5.0 cm), Level 3 (5.0-7.5 cm), and Level 4 (>7.5 cm) (8). Risk factors for genu valgum include male sex, younger age, shorter implantation, overcorrection, and high growth velocity post-implant removal, common in cerebral palsy patients (9). The knee, the largest joint in the human body, consists of soft tissues like ligaments, tendons, capsular structures, and bony components

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like the femur, tibia, fibula, and patella. It also includes menisci, nerves, and blood vessels from the femoral and popliteal arteries (10).

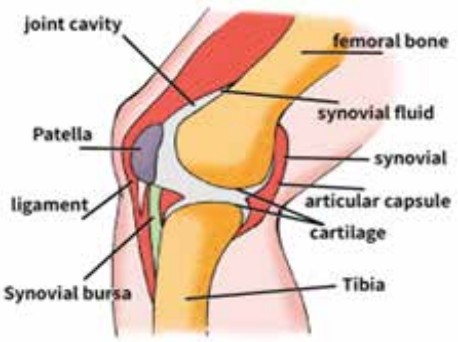

Figure 1. Knee joint structure (11)

Genu varum, a mechanism causing increased medial mechanical axis deviation, leads to abnormal forces across the knee joint, affecting contact pressures and force transmission within the knee compartments (12). Biomechanical studies show that genu varum affects pelvic, hip, and knee kinematics during activities like stair walking, increasing the risk of articular impairments due to lower limb malalignment (13). The Q angle, crucial for genu varum alignment, can be as low as 9 degrees in severe cases, such as pediatric patients with substantial genu varus (14). The study found that genu varum patients have a lower BMI, while genu valgum patients have a greater BMI (15). The inter-knee distance is crucial for monitoring lower limb alignment during walking, as it affects joint loading and osteoarthritis progression. Technological advancements like mechanical axis markers and ultrasound-based devices improve knee joint alignment precision during surgeries. Maintaining appropriate spacing between knee and hip implants prevents strain peaks and reduces fracture risks (16). The inter malleoli distance, a measure of the distance between the internal malleolus and the ground, is used to analyze leg-length discrepancy and quantify body segments (17).

The research aims to understand the prevalence and risk factors of genu valgum and genu varum in young adults, thereby aiding in the prevention and treatment of knee angular deformities. The study's operational definitions include: Genu valgum and genu varum are knee conditions with significant biomechanical and functional consequences, necessitating early detection and effective management to mitigate long-term effects. The Q-angle, formed by the lines connecting the ASIS to the patella midline and tibial tuberosity, is a critical metric for knee alignment and patellar tracking, with normal values varying and emphasizing the need for accurate measurement. BMI, a numerical measure based on an individual's weight and height, categorizes them into different weight groups, helping identify health risks associated with being underweight, normal weight, overweight, or obese. Inter-knee distance (IKD), the distance between the medial portions of the knees, is essential for diagnosing and determining the severity of genu valgum, offering insights into knee alignment and aiding in therapeutic decision-making. Similarly, intermalleolar distance (IMD), the distance between the inner ankle bones, is a key metric for diagnosing and assessing genu valgum, providing crucial information for managing knee angular abnormalities.

METHODOLOGY

A six-month cross-sectional study with 309 participants from Green International University, University of Lahore, Comsats University of Islamabad, Superior University, and the University of Management and Technology was conducted. This study aims to study young adults aged 20-35, both male and female, who are healthy and willing to participate. Exclusions include children, older adults, and those with deformities, pathologies, or surgeries. Participants were informed about the research study, given explicit consent, and assured of confidentiality. They were also assured of the study's purpose and potential harm. This commitment to safety and well-being reflects the ethical integrity of the research process. Data was collected through questionnaires, medical tools like goniometers, measuring tapes, and height and weight scales, including Q-angle, intermalleolar and inter-knee distance, and BMI calculation. Normal Q angle ranges from 1 to 21 degrees, with greater angles being genu varum and less than 1 degree being genu valgum. By measuring the interknee distance, with a distance exceeding 3 being considered genu varum. Genu valgum is a gap of over 8 in women and 4 in men between the two medial malleoli, measured using a measuring tape. The statistical analysis of the data was conducted using IBM SPSS Statistics version 27.Continuous variables are provided as means (standard deviations), whereas categorical variables are expressed as numbers (percentages).

RESULTS

The study involved 309 young adults. Baseline characteristics for young individuals include an average age

of young adults were 309 and mean age was 27.5 with SD was ±4.611. The study involved a total of 309 participants, comprising 162(53.1%) males and 147(46.9%) females with an average height of 5.48 units (SD = ±0.316). The mean weight of 63.29 units (SD = ±10.697). The result showed that the mean BMI was 23.46 with SD was ±4.296. In term of mean Intermalleolar Distance, the mean Intermalleolar Distance was 5.53 units (SD =± 2.885). The study revealed a mean Q-angle of 15.33 with an SD of ±5.492 and the mean Interknee Distance (IKD) of 3.54 and a standard deviation (SD) of ±2.172.

Table 1. Demographics of study participants

Parameters	Means ± S.D	Tests
Age	27.5 ± 4.611	Independent t-test
Gender	Frequency Male Female 162(53.1%) 147(46.9%)	Independent t-test
Height	5.48 ± 0.316.	Independent t-test
Weight	63.29 ± 10.697	Independent t-test
BMI	23.46 ± 4.296.	Independent t-test
Q Angle	15.33 ± 5.492	Independent t-test
Interknee distance	3.54 ± 2.172	Independent t-test
Inter malleolar distance	5.53 ± 2.885	Independent t-test

Table 2. Questionnaire related data

Parameters	Physical activity		Smoking		Knee injury		Genu varum		Genu valgum	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Frequency	230	79	90	219	140	169	115	194	113	196
Percentage (%)	74.43	25.56	29.12	70.87	45.30	54.69	37.21	62.78	36.56	63.43
Test	Independent t-test		Independent t-test		Independent t-test		Independent t-test		Independent t-test	

The study revealed that out of 309 participants, 230 engaged in physical activities, while 79 did not engage in any physical activity, with 113 having genu valgum, 115 having genu varum, and 81 having normal knee curvature. The study revealed that 104 participants experienced rare or no pain, 123 occasionally experienced pain, 77 frequently experienced pain, and 5 consistently experienced knee pain. 147 participants experienced pain severity ranging from 1-3, 115 from 4-6, and 47 from 7-10. 104 participants had no impact, 130 had mild impact, 52 had moderate impact, and 23 had severe impact on knee angular deformity. The result showed that 90 participants were smoking and 219 participants were not smoking. The study revealed that 140 participants experienced knee injuries, while 169 participants did not experience any knee injuries.

Table 3. Association of genu valgum with variables

Variables	Association value	P- value
Age	17.795[a]	0.274
Gender	1.067[a]	0.302
Height	17.696[a]	0.408
Weight	98.797[a]	0.000
BMI	39.190[a]	0.019
Q- Angle	221.019[a]	0.000
Interknee distance	278.566[a]	0.000
Intermalleolar distance	205.806[a]	0.000
Knee angular deformities	42.115[a]	0.000
knee injury	8.977[a]	0.003

Table 4. Association of genu varum with variables

Variables	Association value	P- value
Age	44.468[a]	0.000
Gender	0.108[a]	0.742
Height	16.316[a]	0.502
Weight	101.928[a]	0.000
BMI	41.063[a]	0.012
Q- Angle	256.082[a]	0.000
Interknee distance	280.515[a]	0.000
Intermalleolar distance	231.309[a]	0.000
Knee angular deformities	7.276[a]	0.064
knee injury	1.679[a]	0.195

DISCUSSION

The study involved 309 participants, with a mean age of 27.5 years with SD ±4.611, primarily young adults. The low standard deviation suggests a homogeneous sample, potentially reducing confounding variables and increasing the internal validity of the findings, as the mean age is similar to previous studies (18).The study's findings are more generalizable to young adults due to their higher likelihood of engaging in physical activities that may exacerbate knee angular deformities. The study found a slightly higher proportion of males (162, 53.1%) than females (147, 46.9%), providing a more representative sample of young adults and allowing for examination of potential gender differences in knee angular deformities (19).

The study found that the majority of participants had a normal BMI, with a mean of 23.46(SD = ±4.296), which falls within the World Health Organization's normal weight range. This homogeneity may reduce confounding variables and enhance the internal validity of the findings. The study examines knee angular deformities based on participants' BMI, as obesity is a risk factor for genu valgum and genu varum. Further analysis will explore the relationship between BMI, weight, and deformities (2).

The study found a mean intermalleolar distance (IMD) of 5.53 centimeters (SD =± 2.885), among participants,

indicating moderate knee angular deformity. The mean IMD ranged from 2.885 to 2.885, indicating moderate variation in knee alignment, which is expected due to natural variations. The study examines the relationship between BMI, age, gender, and knee angular deformities using IMD values, categorizing participants as genu valgum or genu varum, and examining associations with other variables (20).

The Q-angle analysis showed a mean Q-angle of 15.33 degrees (SD = ±5.492), indicating moderate knee angular deformity, specifically genu valgum. The range of values indicated varying severity levels, with a moderate variation in Q-angle values, indicating natural variation in knee alignment among individuals (2).The study examines the relationship between BMI, age, gender, and knee angular deformities using Q-angle values. A Q-angle of 15.33 degrees suggests a tendency towards genu valgum, potentially impacting knee pain and osteoarthritis development, which will be further explored (21).

The study found a moderate degree of knee angular deformity among participants, with a mean IKD of 3.54 centimeters (SD = 2.172), and moderate variation in IKD values, indicating natural variation in knee alignment among individuals, as indicated by the standard deviation of ±2.172. The study examines the relationship between BMI, age, gender, and knee angular deformities using IKD values. A mean IKD of 3.54 centimeters suggests a tendency towards genu varum, potentially impacting knee pain and osteoarthritis development, with further analysis exploring these relationships. The study found that 230 participants (74.4%) were physically active, indicating a high level of physical activity for overall health. This may be due to the age range of the sample, or concerns about knee health. The comparison between physically active and inactive participants may provide insights into the links between physical activity, BMI, age, gender, and knee angular deformities. Knee alignment also showed a diverse distribution of curvatures (20).

The study found a high prevalence of knee angular deformities among participants, with a slightly higher prevalence of genu varum. Factors such as genetic predisposition, hormonal influences, and mechanical stress may contribute to these deformities. However, a significant proportion of participants had normal knee curvature, suggesting potential protective factors. Pain severity varied, with 47.6% experiencing mild, 37.2% experiencing moderate, and 15.2% experiencing severe pain. The study found that a significant proportion of participants experienced some level of pain, with a slightly higher prevalence of mild pain. The high proportion of moderate to severe pain (52.4%) may be related to factors like knee angular deformities, high BMI, and physical activity levels. Nearly half of the sample experienced mild pain, suggesting unexplored pain perception or coping mechanisms (22).

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CONCLUSION

This study concluded that the 113 participant have genu valgum and 115 participants have genu varum. Frequency of genu varum is 35.27% and genu valgum is 34.95% in significant association with age, gender, BMI, and other knee angular deformities. The relationship between genu valgum and genu varum in young adults is completely independent of age, gender, BMI, and knee angular abnormalities.

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Authors Contributions:

Saman Bukish: Substantial contributions to the conception and design of the work.

Alisha-tu-Zahra: Design of the work and the acquisition. Drafting the work.

Saleh Mushtaq: Final approval of the version to be published.

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