



# Genu Valgum Relation with Sociodemographic Factors in a sample of Iraqi Children Attending Sadr Al Qanat Center for Prosthetics and Orthotics

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## ABSTRACT:

### BACKGROUND:

Genu valgum is a deformity resulting from the separation of ankles when the medial faces of the knees are in contact while the patella and the hallux turn to the anterior direction.

### OBJECTIVE:

To evaluate the features of genu valgum and the associated sociodemographic factors in children and assess the association between these factors and the type of the genu valgum.

### PATIENTS AND METHODS:

A cross-sectional study was conducted at Sader Al-Qanat Center for Prosthetics and Orthotics, a tertiary referral center in Baghdad/Iraq during the period from January to December 2022. A convenient sampling method was adopted to enrol 60 patients aged 2-14 years with genu valgum who attained the Sader Al-Qanat Orthoses and Prostheses Center.

### RESULTS:

More than half of the patients 31 (51.7%) were male. About 42 (70%) of the patients were at the age of  $\leq 6$  years. Regarding body mass index, 41.7% of the patients had normal weight, 36.7% had overweight, and 21.6% of them were obese. Most patients were walking at the age of  $< 18$  months (83.3%). About 76.7% of the patients presented with the disease at the age of  $< 6$  years. Family history was presented in 11.7%. Most patients did not have pes planus (93.3%), presented with symmetrical deformity (95.0%) and had an intermalleolar distance of  $< 8$  cm (90%), Genu valgum was physiological in 91.7% of the patients.

### CONCLUSION:

Male patients, patients with an age of  $< 6$  years, obese or overweight, and those without family history constituted more than half of the sample. The genu valgum was symmetrical and physiological in most patients. Most patients had an intermalleolar distance of  $< 8$  cm. There was a significant association between the genu valgum and overweight or obesity and age at walking.

**KEYWORDS:** Genu valgum, sociodemographic factors, Iraqi children.

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## INTRODUCTION:

Genu valgum or valgus knee is part of the coronal plane deformities of the lower extremity. It results from the separation of ankles when the medial faces of the knees are in contact while the patella and the hallux turning to the anterior direction<sup>(1)</sup>. Genu valgum is a common disorder that can lead to further complications which affect the quality of life of the patients<sup>(2)</sup>. In Iraq, the recorded prevalence was 0.1%<sup>(3)</sup>. There are generally two types of genu valgum: physiological and pathological, with the pathological form being much less common<sup>(4)</sup>. During the growth phase

from ages 2 to 11, a slight valgus deformity of 5–10° is considered physiological and may persist beyond this age, varying between individuals and depending on their constitution<sup>(5,6)</sup>. Physiological genu valgum in childhood is associated with an intermalleolar distance of up to 8 cm, the greatest distance being observed between 3 and 4 years, disappearing gradually after the age of 7-8 years<sup>(7,8)</sup>. Pathologic genu valgum is a disorder that typically develops in early adolescence and does not resolve naturally<sup>(9)</sup>. It has been noted that children with pathological genu valgum have

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tibiofemoral angles outside of the two standard deviations, although this changes with age<sup>(4,8,10)</sup>. Some hypotheses proposed that overweight and obese children would be more likely to display genu valgum<sup>(11)</sup>. Obesity produces mechanical overload to the locomotor system and postural misalignment with the anteriority of the mass center, resulting in foot functional modifications and an increase in mechanical demands to adapt to the new body scheme<sup>(1)</sup>. Pathologic genu valgum can be idiopathic, posttraumatic, metabolic like renal osteodystrophy hypophosphatemic rickets, and vitamin D deficiency, neuromuscular like poliomyelitis, infectious like osteomyelitis, or generalized inherited disorders<sup>(8,10)</sup>. Anyhow, there is not always an obvious cause of genu valgum<sup>(12)</sup>. Most people have no functional impairments and are asymptomatic. Prior to this ailment, flat feet and sporadic foot and knee pain may occur<sup>(7,8)</sup>. Genu valgum may result in anterior knee pain, circumduction gait, patellofemoral instability, and difficulty running<sup>(13)</sup>. The assessment of genu valgum is mainly dependent on the clinical exam including observation of gait and measurement of the tibiofemoral angle and intermalleolar distance<sup>(10)</sup>. In addition, the simplest method for diagnosing genu valgum is standard X-ray imaging. In such cases, the X-ray would show a normal physis, epiphysis, and metaphysis, but an abnormally tilted horizontal axis<sup>(4,14)</sup>.

### AIM OF THE STUDY:

To evaluate the features of genu valgum and the associated sociodemographic factors in children and assess the association between these factors and the type of the genu valgum.

### PATIENTS AND METHODS:

**Study design and setting:** A cross-sectional study was conducted at Sader Al-Qanat Center for Prosthetics and Orthotics, a tertiary referral center in Baghdad/Iraq during the period from January to December 2022.

**Sampling method:** A convenient sampling method was adopted to enrol 60 patients aged 2-14 years with genu valgum who attained the Sader Al-Qanat Center for Prosthetics and Orthotics.

Exclusion criteria included patients who had a structural abnormality of lower limbs other than genu valgum, patients with deformity of lower limbs due to trauma, and patients who were agitated or unwilling for anthropometric measurements.

**Data collection:** The data was collected through two steps. The first step included the history of the patients which constituted age, gender, age at walking, age at presentation, and family history of genu valgum. The second step included examination of the patients which constituted weight, height, examination of the feet about the symmetry of the genu valgum, the presence of pes planus, intermalleolar distance, tibiofemoral angle, and type of genu valgum (physiological or pathological). According to the weight and height, the body mass index (BMI) was calculated according to the formula:  $BMI = \text{weight (Kg)} / (\text{height (m)})^2$ <sup>(15)</sup>.

The World Health Organization (WHO) Standard Age and Sex-Specific Growth Reference charts were used for defining overweight and obesity<sup>(16)</sup>. Interpretation of cut-offs include<sup>(17)</sup>:

- Overweight:  $>+1$  SD (equivalent to BMI 25 kg/m<sup>2</sup> at 19 years).
- Obesity:  $>+2$  SD (equivalent to BMI 30 kg/m<sup>2</sup> at 19 years).

Pes planus, also known as flat foot, is one of the most commonly seen foot deformities. It is characterized by a very low or absent arch, which is the main supportive structure of the foot<sup>(18)</sup>. The tibiofemoral angle is defined as the angle between the anatomical axis of the femur with the anatomical axis of the tibia<sup>(19)</sup>. The Intermalleolar distance was measured by using a ruler while the tibiofemoral angle was measured by using a goniometer which is a device that measures an angle or permits the rotation of an object to a definite position.

**Statistical analysis:** Microsoft Excel software (version 2016) and the Statistical Package for Social Science (version 26) were used for data collection and analysis. Continuous data were presented as mean ( $\pm$  SD). Categorical data were presented as proportions, the Chi-Square test was used to investigate the statistical significance of the difference between two proportions. A P-value of less than 0.05 was considered statistically significant.

### RESULTS:

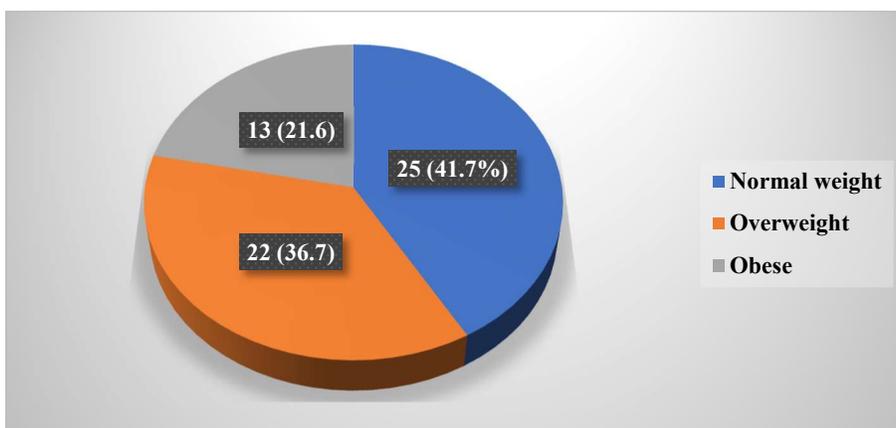
A total of 60 patients were enrolled in the current study. More than half of the patients 31 (51.7%) were male. A total of 42 (70%) of the patients aged  $\leq 6$  years, as shown in table 1.

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**Table 1: Gender and age distribution of the patients with genu valgum.**

| Gender and Age |        | N  | %    |
|----------------|--------|----|------|
| Gender         | Male   | 31 | 51.7 |
|                | Female | 29 | 48.3 |
| Age (years)    | ≤6     | 42 | 70.0 |
|                | >6     | 18 | 30.0 |

Regarding BMI, 41.7% of the patients had normal weight, 36.7% had overweight, and 21.6% of them were obese (Figure 1)



**Figure 1: Distribution of the patients according to the body mass index.**

Most patients were walking at the age of <18 months (83.3%). About 76.7% of the patients presented with the disease at the age of < 6 years. Family history of genu valgum was presented in 11.7% (Table 2).

**Table 2: Medical history of patients.**

| History                       | N            | %  |      |
|-------------------------------|--------------|----|------|
| Age at walking                | <18 months   | 50 | 83.3 |
|                               | 18-24 months | 10 | 16.7 |
|                               | >24 months   | 0  | 0.0  |
| Age at presentation           | < 6 years    | 46 | 76.7 |
|                               | 7-10 years   | 11 | 18.3 |
|                               | >10 years    | 3  | 5.0  |
| Family history of genu valgum | Yes          | 7  | 11.7 |
|                               | No           | 53 | 88.3 |

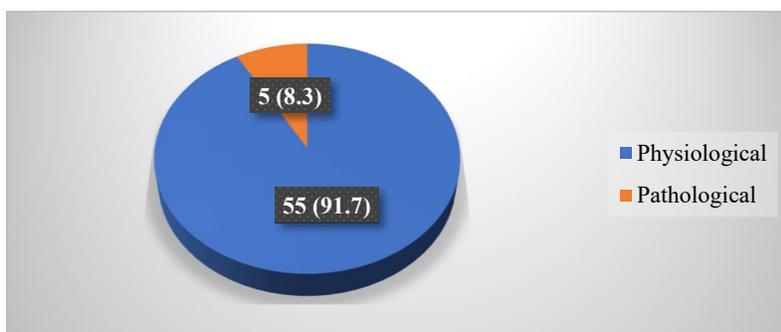
Most patients did not have pes planus (93.3%), presented with symmetrical deformity (95.0%), and had an intermalleolar distance of < 8cm (90%), as shown in table 3.

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**Table 3: Results of the examination.**

| Findings of examination |                           | N            | %    |
|-------------------------|---------------------------|--------------|------|
| Pes planus              | Yes                       | 4            | 6.7  |
|                         | No                        | 56           | 93.3 |
| Deformity               | Symmetrical (bilateral)   | 57           | 95.0 |
|                         | Asymmetrical (unilateral) | 3            | 5.0  |
| Intermalleolar distance | < 8 cm                    | 54           | 90.0 |
|                         | ≥ 8 cm                    | 6            | 10.0 |
|                         |                           | Mean (±SD)   |      |
| Tibiofemoral angle      | Right                     | 12.3 (±3.2)° |      |
|                         | Left                      | 12.4 (±3.4)° |      |

The genu valgum was physiological in 91.7% of the patients while it was pathological in 8.3% of the patients (Figure 2).



**Figure 2: Distribution of the patients according to the type of genu valgum.**

A significant association was obtained between the walking intermalleolar distance and BMI and age at walking (P-values were 0.019 and 0.021, respectively), as shown in table 4.

**Table 4: Association between the malleolar distance and other parameters.**

| Parameters      |               | Intermalleolar distance |          | P-value      |
|-----------------|---------------|-------------------------|----------|--------------|
|                 |               | < 8 cm                  | ≥ 8 cm   |              |
|                 |               | N (%)                   | N (%)    |              |
| Age (years)     | ≤6            | 38 (90.5)               | 4 (9.5)  | 0.851        |
|                 | >6            | 16 (88.9)               | 2 (11.1) |              |
| Body mass index | Normal        | 24 (96.0)               | 1 (4.0)  | <b>0.019</b> |
|                 | Overweight    | 21 (95.5)               | 1 (4.5)  |              |
|                 | Obesity       | 9 (69.2)                | 4 (30.0) |              |
| Age at walking  | <18 months    | 47 (94.0)               | 3 (6.0)  | <b>0.021</b> |
|                 | 18-24 months  | 7 (70.0)                | 3 (30.0) |              |
|                 | >24 months    | 0 (0.0)                 | 0 (0.0)  |              |
| Family history  | Yes           | 6 (85.7)                | 1 (14.3) | 0.688        |
|                 | No            | 48 (90.6)               | 5 (9.4)  |              |
| Pes planus      | Yes           | 4 (100.0)               | 0 (0.0)  | 0.490        |
|                 | No            | 50 (89.3)               | 6 (10.7) |              |
| Deformity       | Symmetrical   | 51 (89.5)               | 6 (10.5) | 0.554        |
|                 | Asymmetrical  | 3 (100.0)               | 0 (0.0)  |              |
| Type            | Physiological | 49 (89.1)               | 6 (10.9) | 0.436        |
|                 | Pathological  | 5 (100.0)               | 0 (0.0)  |              |

### DISCUSSION:

Genu valgum is a frequent lower-limb deformity in children. Although it is frequently asymptomatic, it can cause deformity, tumors, and dysplasia, necessitating a comprehensive approach to management<sup>(20)</sup>.

The first finding of the current study was that males constituted 31 (57.1%) of the sample. In comparison, the same finding was obtained in another study that was done by Angelos et al. in Greece as 49 out of 78 patients were male<sup>(21)</sup>. In contrast, another study that was done by Walker et al. revealed that more than half of the patients in the sample were female<sup>(22)</sup>. In another study that was done by Attiq et al in Pakistan, there was a balanced distribution of males and females<sup>(2)</sup>. This discrepancy might be related to the effect of other causes rather than gender in the occurrence of genu valgum.

The current study revealed that most of the patients had an age of  $\leq 6$  years. In agreement, Peter et al. reported that most of the patients with genu valgum had an age of  $< 6$  years, most of these cases are physiological and resolved by 6 years<sup>(23)</sup>. This finding might be related to the fact that most of the genu valgum cases are physiological.

In the current study, those who started walking at the normal age ( $< 18$  months) constituted the largest proportion of the sample. Most of the patients did not have a family history of genu valgum. In comparison, one out of 12 patients with genu valgum had family had at least one family member with genu valgum as revealed in another study that was done by Peter et al. in the United States<sup>(23)</sup>.

An important finding of the current study was that more than half of the patients were obese or overweight. The same findings were obtained in another study that was done by Walker et al. reported that most of the patients were obese<sup>(22)</sup>. In agreement, Jankowicz et al. revealed that children who are obese or overweight were more likely to develop genu valgum<sup>(24)</sup>. In Brazil, Maria et al. concluded that obese and overweight children had an extra chance of having genu valgum<sup>(1)</sup>.

In the current study, genu valgum was due to physiological causes in most of the patients. In comparison, Nagendrappa et al. revealed that most of the genu valgum in children with an age of  $< 6$  years were due to physiological causes and mostly resolved by the age of 6 -7 years<sup>(25)</sup>.

According to the results of the current study, about 6.7% of the patients had pes planus. Stolzman et al.

reported that the pes planus prevalence among children with obesity ranged widely, the association between pes planus and genu valgum might be related to the association of both of them with overweight and obesity<sup>(26)</sup>.

Most of the patients had symmetrical (bilateral) deformities. This agreed with the results of another study that was done by Walker et al.<sup>(22)</sup>. These results were expected as most cases were physiological genu valgum.

In the current study, the mean of the right tibiofemoral angle was  $12.3 (\pm 3.2)^\circ$  and the left tibiofemoral angle was  $12.4 (\pm 3.4)^\circ$ . In comparison, they were greater than what was obtained in another study that was done by Walker et al. as the mean tibiofemoral angle was  $9.7 \pm 5.4$ . This might be related to the difference in the severity of deformity among the participants<sup>(22)</sup>.

Intermalleolar distance of  $< 8$  cm was presented in most of the patients. In comparison, the same results were obtained in another study that was done by Maria et al. in Brazil<sup>(1)</sup>.

There was a significant association between the intermalleolar distance and body mass index and age at the presentation while no significant association was obtained with age, gender, family history, symmetry, type of genu valgum, and the presence of pes planus. In agreement, the same results were obtained in another study that was done in Brazil as a significant association was obtained between the intermalleolar distance and BMI, while no significant association was obtained between the intermalleolar distance and age or gender<sup>(1)</sup>. This finding was related to the proven mechanical effect of obesity on the locomotor system.

The limitation of this study was that it took into consideration the clinical assessment of the patients without investigation like hormonal or mineral investigations that could contribute to the BMI and genu valgum.

### CONCLUSION:

Male patients, patients with an age of  $< 6$  years, obese or overweight, and those without family history constituted more than half of the sample. The genu valgum was symmetrical and physiological in most patients. Most patients had an intermalleolar distance of  $< 8$  cm with a right tibiofemoral angle of  $12.3 (\pm 3.2)^\circ$  at the right leg and  $12.4 (\pm 3.4)^\circ$  at the left leg. There was a significant association between the genu valgum and overweight or obesity and age at walking.

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