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RELATIONSHIP OF THE BMI VISCERAL FAT AND SUBCUTANEOUS FAT WITH THE LOWER EXTREMITY DEFORMITIES AMONG SCHOOL-GOING CHILDREN

Nimisha Singh Kushwaha
Department of Physical Education, Chhatrapati Sahu Ji Maharaj University, Kanpur.

Prof. Nishan Singh Deol, Panjabi University,Patiyala

Dr.S.K.S. Yadav
Head, Department of Physical Education, Chhatrapati Sahu Ji Maharaj University, Kanpur.

Dr. Prabhakar Pandey
Department of Physical Education, Chhatrapati Sahu Ji Maharaj University, Kanpur.

Mr. Abhishek Mishra
Department of Physical Education, Chhatrapati Sahu Ji Maharaj University, Kanpur.

Mr. Saurabh Tiwari
Department of Physical Education, Chhatrapati Sahu Ji Maharaj University, Kanpur.

ABSTRACT:

Aim: To assess analyze the relationship between BMI, visceral Fat, subcutaneous Fat and lower extremity deformities (flat foot, knock knees, and bow legs) among school-going children of urban and rural areas in Uttar Pradesh. Material and Methods: Five Hundred randomly selected boys students aged 13-17 years from grades 9 to 12 across four major divisions of Uttar Pradesh: Kanpur, Lucknow, Allahabad, and Agra. The aim was to include a diverse sample from both public and private educational institutions. Data collection was carefully scheduled to minimize any disruption to the regular academic activities of the participating schools. The research team coordinated closely with school administrations to develop a data collection timetable that aligned with each institution's weekly agenda. By coordinating with schools and adhering to their schedules, the research team was able to create a smooth, efficient data collection process that maintained the integrity of both the research and the schools' regular educational activities. The Pearson's product moment correlation coefficient was used to measure the relationship between BMI, visceral Fat, subcutaneous Fat and lower extremity deformities among school-going children of urban and rural areas in Uttar Pradesh. The level of significance was set at 0.05.**Results:** The results have shown the values of coefficients of correlation of selected body composition (BMI) with selected lower extremity of School going boys were: Flat Foot (0.230) & Bow Leg (0.139). In case of Visceral Fat were: Flat Foot (0.129) & Bow Leg (0.116). And A significant relationship was found between the Subcutaneous Fat and the selected lower extremity of School going boys i.e. Flat Foot (0.233). **Conclusion:** Flat foot was more prevalent among children with higher body composition values, particularly in urban areas, but the overall differences in deformity prevalence based on location were not as pronounced as expected.

Key words: BMI, Visceral Fat, Subcutaneous Fat

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INTRODUCTION:

The term "fitness" is commonly used in daily conversations, but its meaning extends beyond appearance. Fitness reflects the body's ability to cope with life's stresses and challenges, serving as a representation of vitality and overall health. It's much more than just looking good—it is about building resilience and strength, which enables individuals to navigate life's obstacles without feeling overwhelmed. In a sense, fitness is like a superpower that helps individuals manage life's demands (American Council on Exercise, 2020). Just as a car requires regular maintenance to function well, the human body needs exercise to perform optimally. Physical activity enhances cardiovascular health, strengthens muscles, and increases endurance. It's like giving the body a regular dose of revitalization, keeping it in prime condition **(Mayo Clinic, 2021).**

Fitness is not just about physical activity; it encompasses the mind, body, and spirit. Alongside regular exercise, individuals should prioritize self-care activities, such as meditation, yoga, or engaging in hobbies that bring joy. These activities create a balanced, holistic approach to fitness that enriches various aspects of life (National Institutes of Health, 2019). "Bones play an integral role in the body by providing structure, protecting vital organs, anchoring muscles, and storing essential minerals like calcium. Maintaining bone health is crucial from an early age, but it is equally important to sustain this care as we grow older. Bone formation and maintenance are lifelong processes that require continuous attention" (National Osteoporosis Foundation, 2009) Building Strong Bones During Childhood and Adolescence Childhood and adolescence are critical times for bone development, as bones grow and reach their peak strength and density during these periods. Regular physical activity, particularly weight-bearing exercises like running or dancing, paired with a calciumrich diet, helps ensure that bones develop to their full potential **(American Academy of Pediatrics, 2018)**

Types of Postural Deformities

Common postural deformities include flat foot (Pec Planus), knock knees (Genu Valgum), and bow legs (Genu Varum). Each of these conditions affects the alignment of the legs and can have a significant impact on a child's movement and posture (**Bindal, 2010**).

Foot Arches

The foot's structure includes three arches: the longitudinal lateral arch, the longitudinal medial arch, and the transverse arch. These arches work together, and failure in one can disrupt the function of the others. The lateral arch, made up of the calcaneus, cuboid bone, and fourth and fifth metatarsals, is rigid and provides body weight support. The medial arch, which includes the calcaneus, talus, navicular, and cuneiform bones, is taller and more flexible, adjusting dynamically as the foot moves. The transverse arch, consisting of the metatarsal bases, cuneiforms, and cuboid bones, helps support the entire foot (Riegger, 1988; McKeon, 2015; Gwani, 2017; Karasick, 1993).

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The Knee Joint

The knee joint is one of the most critical and powerful joints in the human body. It connects the lower leg to the thigh and bears the body's weight during activities like walking, running, sitting, and standing. The tibiofemoral joint, commonly referred to as the knee, is a synovial hinge joint composed of three bones: the femur, tibia, and patella (American Academy of Orthopaedic Surgeons, 2021).

Knee Joint Anatomy

The knee joint is considered one of the most complex joints in the body, functioning as a hinge joint despite appearing simple. It consists of three primary bones: the femur (thighbone), tibia (shinbone), and patella (kneecap). The knee is classified as a synovial joint, meaning it is lined with a fluid-producing membrane called the synovium, which lubricates and nourishes the joint. The smooth layer at the ends of the femur and tibia is known as articular cartilage, which, when damaged, can lead to arthritis (**Brown, 2016**). **Knock Knees**

Knock knees

a condition where the knees come closer together than normal, result from overuse and stress on the ligaments located on the outer side of the knee. As a result, the knees appear close together, while the feet and ankles remain apart. This condition is often caused by poor walking habits and a lack of proper leg posture (**Brown, 2016**).

Bow Legs

Bow legs occur when the knee joints open up beyond their natural alignment, creating a wider-than-normal distance between the knees while the ankles and feet are closer together. This condition is often attributed to poor walking patterns and insufficient attention to maintaining proper posture in the lower limbs (**Brown, 2016**).

OBJECTIVE

- The purpose of this study was to analyze the relationship between BMI, visceral Fat, subcutaneous Fat and lower extremity deformities (flat foot, knock knees, and bow legs) among school-going children of urban and rural areas in Uttar Pradesh.

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METHODOLOGY:

The selection of subjects for this study was conducted in a systematic manner, targeting students from grades 9 to 12 across four major divisions of Uttar Pradesh: Kanpur, Lucknow, Allahabad, and Agra. The aim was to include a diverse sample from both public and private educational institutions, ensuring that the sample represented a broad cross-section of the population in terms of socioeconomic and educational backgrounds.

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A total of 500 boys students were selected for the study. The age of the subjects ranged from 13 to 17 years, aligning with the developmental period when musculoskeletal growth is most prominent and issues related to posture may become more pronounced. This age group was specifically chosen to capture the prevalence of lower limb postural deformities during late adolescence, a critical stage for skeletal development.

The screening process involved the administration of three key clinical assessments: the Knock-Knee Test, the Bowleg Test, and the Wet Foot Print Test (WFPT). These diagnostic tests were conducted to identify the presence of knock knees (genu valgum), bow legs (genu varum), and flat feet (pes planus), respectively. Each participant was evaluated individually, ensuring consistency and accuracy in the assessment of these conditions.

Data collection was carefully scheduled to minimize any disruption to the regular academic activities of the participating schools. The research team coordinated closely with school administrations to develop a data collection timetable that aligned with each institution's weekly agenda. This allowed the research activities, including the clinical assessments and anthropometric measurements, to be conducted during periods designated by the schools, thereby ensuring minimal interference with their day-to-day operations.

A correlation coefficient (r) was computed for continuous variables such as body mass index (BMI), visceral fat and subcutaneous fat in order to provide an analysis of the links that exist between body composition data and postural abnormalities. The level of significance chosen to test the hypothesis was 0.05.

Table 1

Correlation between Independent Variable (BMI) and Dependent Variables (selected Lower Extremity*)* of School going Urban and Rural Boys

Body Composition	Lower Extremity	Corr.(r) =	Sig.
BMI	Flat Foot	-.230**	.000
	Bow Leg	.139**	.002
	Knock knee	-.024	.590

***. Correlation is significant at the 0.05 level (2-tailed).**

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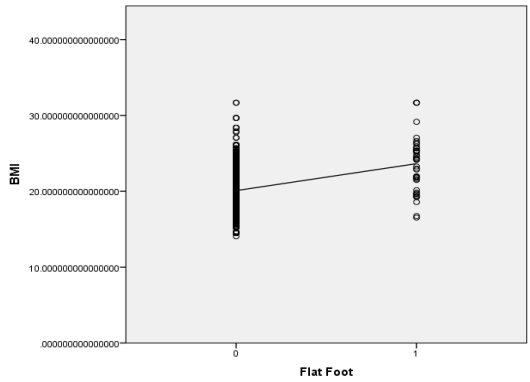
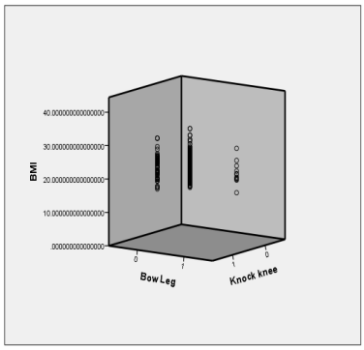
Table 1 shows the relationship of selected body composition (BMI) with selected lower extremity of School going boys. A significant relationship was found between the BMI and Flat Foot & Bow Leg of School urban and rural boys at .05 level of significance.

On the other hand no significant relationship was found between the BMI and the selected lower extremity of School going urban and rural boys i.e. Knock Knee at .05 level of significance.





Graphical presentation of Lower BMI, Bow Leg and Knock Knee Variables School going boys urban and rural areas of Uttar Pradesh is presented in figure – 1

Table 2
Correlation between Independent Variable (Visceral Fat) and Dependent Variables (selected Lower Extremity) of School going Urban and Rural Boys

Body Composition	Lower Extremity Variables	Corr.(r) =	Sig.
Visceral Fat	Flat Foot	.129**	.004
	Bow Leg	-.116**	.009
	Knock knee	.052	.249

***. Correlation is significant at the 0.05 level (2-tailed).**

Table 2 shows the relationship of selected body composition (Visceral Fat) with selected lower extremity of School going urban and rural boys. A significant relationship was found between the Visceral Fat and the selected physical variables of throwers i.e. Flat Foot and Bow Leg at .05 level of significance.

On the other hand no significant relationship was found between the Visceral Fat and the selected lower extremity of School going urban and rural boys i.e. Knock Knee at .05 level of significance.

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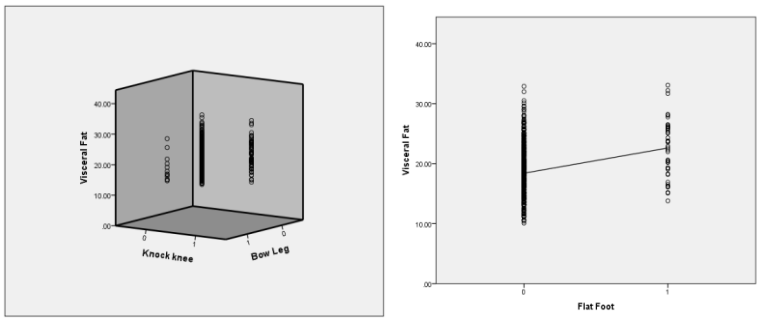


Graphical presentation of Visceral Fat, Bow Leg and Knock Knee variables School going boys urban and rural areas of Uttar Pradesh is presented in figure – 2

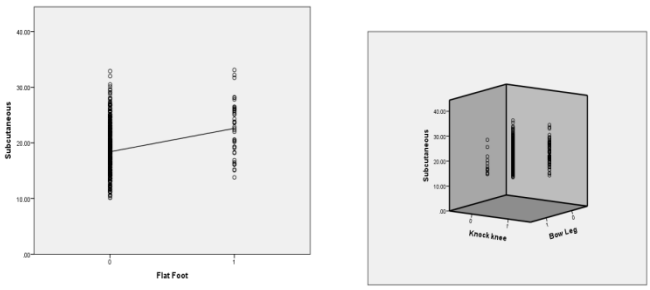
Table 3
Correlation between Independent Variable (Subcutaneous Fat) and Dependent Variables (selected Lower Extremity*)* of School going Urban and Rural Boys

Body Composition	Lower Extremity Variables	Corr.(r) =	Sig.
Subcutaneous Fat	Flat Foot	-.233**	.000
	Bow Leg	.073	.104
	Knock knee	-.077	.084

***. Correlation is significant at the 0.05 level (2-tailed).**

Table 3 shows the relationship of selected body composition (Subcutaneous Fat) with selected lower extremity of School going boys. A significant relationship was found between the Subcutaneous Fat and the selected lower extremity of School going boys i.e. Flat Foot at .05 level of significance.

On the other hand no significant relationship was found between the Subcutaneous Fat and the selected lower extremity of School going boys i.e. Bow Leg and Knock Knee at .05 level of significance.



Graphical presentation of Subcutaneous Fat, Knock Knee and Bow Leg variables School going boys urban and rural areas of Uttar Pradesh is presented in figure – 3

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DISCUSSION OF FINDINGS:

BMI and Lower Extremity Correlation

The results show a significant negative correlation between BMI and flat foot in both boys and girls, which aligns with previous studies that have found excess body weight can lead to flat foot in children due to increased pressure on the feet (Dowling et al., 2001). The relationship between BMI and bow leg is positively correlated in boys but not significant in girls, indicating potential differences in the impact of body weight on lower extremity alignment between genders. This result is consistent with studies that suggest boys and girls develop differently in terms of musculoskeletal structures (Powers et al., 2003).

Visceral Fat and Lower Extremity Correlation:

The study reveals a significant positive correlation between visceral fat and flat foot in boys, while a negative relationship is noted with bow leg. These findings suggest that visceral fat may contribute to lower extremity issues, supporting literature that links abdominal obesity with musculoskeletal problems (Singh et al., 2010). However, the lack of significant correlation between visceral fat and knock knee in both boys and girls indicates that factors other than visceral fat may be more influential in the development of this condition.

Subcutaneous Fat and Lower Extremity Correlation:

Subcutaneous fat shows a significant negative correlation with flat foot in both boys and girls. This finding suggests that fat stored under the skin may have an influence on lower extremity biomechanics, contributing to flat foot, a conclusion supported by previous research linking obesity with foot deformities in children (Riddiford-Harland et al., 2011). However, no significant correlation is found between subcutaneous fat and bow leg or knock knee, indicating that subcutaneous fat does not play a major role in these conditions.

CONCLUSION:

1. The results of the study reveal significant relationships between body composition variables and the prevalence of lower extremity deformities among school-going children in both urban and rural areas of Uttar Pradesh. Notably, BMI was significantly correlated with two specific deformities: a negative correlation with flat foot ($r = -0.230$, $p < 0.01$) and a positive correlation with bow legs ($r = 0.139$, $p < 0.01$). This suggests that children with higher BMI are more likely to develop bow legs, while those with lower BMI are more prone to flat foot. However, no significant correlation was observed between BMI and knock knees ($r = -0.024$, $p = 0.590$), indicating that BMI may not be a critical factor for this deformity.
2. Furthermore, while urban children generally exhibited higher mean values for body composition variables compared to rural children, the differences in the prevalence of deformities between urban and rural areas were not uniformly significant. Flat foot was more prevalent among children with higher body composition values, particularly

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in urban areas, but the overall differences in deformity prevalence based on location were not as pronounced as expected.

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