



Potential Predictors of Low Bone Mineral Density in Young Unmarried Girls Under 25 Based on Menstrual Status

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Abstract

Bone Mineral Density (BMD) is a crucial indicator of skeletal health, particularly in young women, where a multitude of biological, lifestyle, and environmental factors intersect to shape bone development and maintenance. This study investigates the potential predictors of low BMD among unmarried girls under 25 years of age in Pakistan, with a specific focus on menstrual status and related determinants. Utilizing a cross-sectional study design, data were collected from 240 participants through structured questionnaires and validated assessment tools. The study revealed that irregular menstrual cycles, inadequate dietary intake of calcium and vitamin D, limited physical activity, and high consumption of junk food are significant predictors of low BMD. Among the participants, 56% exhibited menstrual irregularities, and 87.5% reported insufficient calcium intake, while 93 individuals led a sedentary lifestyle. Ethnicity, socio-economic status, and family history of fractures were also analyzed as contributing factors. Statistical analysis demonstrated strong associations between menstrual regularity and BMD levels ($p < 0.05$), with additional significant correlations noted for dietary habits and physical activity levels. This research highlights the alarming prevalence of risk factors for low BMD in young women and underscores the urgent need for early interventions. Public health campaigns promoting balanced diets, regular physical activity, and awareness about menstrual health are imperative to mitigate the risk of future osteoporosis and fractures in this demographic. These findings provide a foundation for developing tailored prevention strategies and call for further longitudinal studies to establish causality. The implications of this research extend to healthcare policy, emphasizing the role of educational and community-based programs in fostering bone health in young women.

Methodology

Study Design

This study used a **cross-sectional design** to explore the relationship between factors like menstrual regularity, dietary intake, physical activity, junk food consumption, fracture history, and ethnicity on bone mineral density (BMD) in unmarried females under 25 years of age residing in Pakistan. The cross-sectional design allows for the assessment of the prevalence of low or normal BMD at a specific point in time.

Population

The study population consisted of **unmarried females under 25 years of age** living in Pakistan. The choice of this population was based on the aim to investigate factors influencing BMD during a critical period of bone development before peak bone mass is achieved.

Sample Size and Sampling Technique

A total of **240 participants** were included in the study. The sample was selected using **stratified random sampling** to ensure that the sample was representative of different **ethnic groups** and **socio-economic statuses** within the population. Stratification helped to control for confounding variables related to ethnicity and socio-economic factors, which are known to influence health outcomes.

The sampling process was as follows:

Stratification: Participants were grouped based on two factors:

Ethnicity: To represent diverse cultural backgrounds that may influence dietary habits and lifestyle.

Socio-economic Status (SES): To account for varying access to resources, such as nutrition, healthcare, and physical activity.

Random Selection: Within each stratum, participants were randomly selected to minimize bias.

Inclusion Criteria

Unmarried females aged under 25 years.

Residents of Pakistan.

Exclusion Criteria

History of chronic illnesses unrelated to bone mineral density (BMD).

Use of medications that affect bone health (e.g., corticosteroids, anticonvulsants, etc.).

Data Collection

Data were collected using two primary methods:

Structured Questionnaires: A comprehensive questionnaire was developed to capture information on participants' menstrual history, dietary habits, physical activity, junk food consumption, fracture history, and socio-economic status. The questionnaire was pre-tested on a small sample to ensure clarity, comprehensiveness, and reliability.

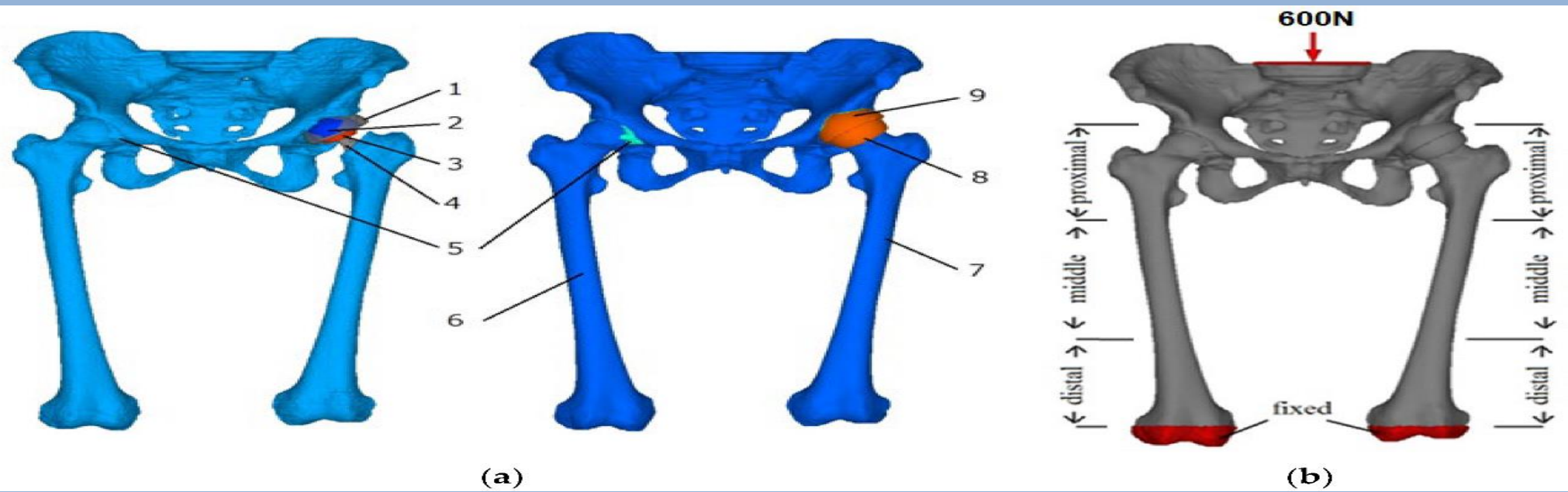
It included both closed and open-ended questions for detailed responses.

Validated Scales: Standardized and validated scales were used to assess dietary calcium and vitamin D intake, physical activity levels, and socio-economic status. These scales were adapted to the cultural context of Pakistan.

Bone Mineral Density (BMD) Assessment:

BMD was measured using **dual-energy X-ray absorptiometry (DXA)**, the gold standard for assessing bone density.

DXA scans were performed at a local healthcare facility by trained radiologists. Participants with a BMD score of less than -1.0 standard deviations were classified as having low BMD, while those with a score of -1.0 or above were classified as having normal BMD.



Conclusion

In summary, low BMD in young, unmarried girls under 25 years is influenced by multiple factors, including irregular menstrual cycles, inadequate calcium and vitamin D intake, and sedentary lifestyles. The findings emphasize the importance of early intervention, targeted health campaigns, and lifestyle modifications to improve bone health and prevent future bone-related disorders in young females. With the growing prevalence of osteoporosis and related conditions globally, addressing these modifiable risk factors in the younger population is critical to reducing the burden of bone health issues in the future.

Results

This section presents the findings of the study on Bone Mineral Density (BMD) in unmarried females under 25 years of age residing in Pakistan. The results are categorized into demographic information, BMD classification, lifestyle and dietary habits, menstrual history, medical and family history, and statistical analysis.

Demographics

The demographic characteristics of the participants are summarized below. A total of **240** participants were included in the study, with a breakdown by

ethnicity and socio-economic status:

Ethnicity	Frequency (N)	Percentage (%)
Urdu	101	42.08
Sindhi	80	33.33
Punjabi	17	7.08
Balochi	3	1.25
Total	240	100

Socio-Economic Status	Frequency (N)	Percentage (%)
Upper Class	49	20.42
Middle Class	191	79.58
Total	240	100

BMD Classification	Frequency (N)	Percentage (%)
Normal	131	54.58
Overweight	60	25.00
Obese	9	3.75
Total	240	100

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