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"COMPARATIVE ANALYSIS OF TRADITIONAL AND MODERN DIETARY PATTERNS ON EARLY ONSET OF MENARCHE"

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ABSTRACT

Menarche is the crucial phase in every girl's life. Diet plays an important role in the menarche, in it's after and before phase. The modern dietary patterns influence the menarche timing which leads to hormonal imbalances, PCOD/PMOS or thyroid issues. The traditional dietary patterns helps the women to achieve the normal timing of menarche. To analyse the impact of traditional dietary patterns and modern dietary patterns on the early onset of menarche. The study assess the difference between the traditional dietary patterns and modern dietary patterns and their effect on early onset of menarche. The study also aims to the biological, environmental and social conditions along with the dietary patterns on the age of menarche. A cross-sectional study was conducted among 200 adolescent girls aged 9-19 years using a structured food frequency questionnaire. Data collected included demographic details, menstrual history, lifestyle factors, early life factors, traditional dietary pattern, modern dietary pattern, and dietary behaviour and environment. Descriptive statistics and Inferential statistics such as ANOVA, multiple regression, and Spearman's correlation analysis were applied to summarise the data and determine diet based differences and its relation to timing of menarche and key variables. The analysis revealed that age at menarche was significantly associated with multiple lifestyle and dietary variables. A significant positive correlation was observed with traditional dietary score ($r = 0.240$, $p = 0.001$), indicating that greater adherence to traditional dietary patterns is associated with correct onset of menarche. Conversely, modern dietary score demonstrated a significant negative correlation ($r = -0.183$, $p = 0.010$), suggesting that increased consumption of modern dietary

components is associated with earlier onset of menarche. BMI also exhibited a weak but statistically significant negative correlation (r = -0.159, p = 0.024), implying that higher adiposity may contribute to earlier pubertal onset. Among lifestyle factors, physical activity (r = 0.188, p = 0.008) and sleep duration (r = 0.158, p = 0.025) were positively associated with age at menarche, indicating a potential protective role. However, screen time and stress did not show statistically significant associations. The current study highlights the necessity of traditional dietary patterns among modern dietary patterns in order to achieve a correct menarche timing and avoid further complications in women. Lifestyle factors, genetics BMI ,physical activity and sleep timings also has the effect on menarche timing. Traditional dietary patterns have the positive impact on girls and has correct menarche timing. Whereas the modern dietary patterns has the negative effect on the girls and the earlier menarche timing with complications.

KEYWORDS: Menarche, Traditional diet, Modern diet, Complications, Adolescents.

INTRODUCTION

Menstrual Cycle and Menarche

The menstrual cycle is a series of cyclical physiological changes that prepare the female body for ovulation and potential pregnancy. Menstruation, characterized by cyclic vaginal bleeding, is regulated by coordinated hormonal interactions within the hypothalamic-pituitary-ovarian (HPO) axis. Menarche, the onset of the first menstrual period, typically occurs during adolescence, with a global median age of approximately 12.4 years. Following menarche, menstrual cycles gradually become regular, usually ranging from 21–45 days with bleeding lasting 3–7 days. The cycle involves follicular, ovulatory, and luteal phases, regulated by endocrine, autocrine, and paracrine mechanisms that coordinate follicular development, ovulation, and endometrial remodeling (Dhanalakshmi K. Thiyagarajan et al., 2024; Mihm et al., 2016).

Mechanism

The menstrual cycle consists of two major phases: the follicular/proliferative phase and the luteal/secretory phase. During the follicular phase, follicle-stimulating hormone (FSH) promotes follicular growth and stimulates the production of estradiol and inhibin B, leading to the selection of a dominant follicle. Concurrently, estradiol promotes endometrial proliferation and modifies cervical mucus to facilitate sperm transport. Ovulation occurs following the luteinizing hormone (LH) surge triggered by elevated estradiol levels. During

the luteal phase, progesterone secreted by the corpus luteum prepares the endometrium for implantation by enhancing glandular development and vascularization. In the absence of fertilization, progesterone and estradiol levels decline, resulting in endometrial shedding and the onset of menstruation (Itriyeva et al., 2022).

Early Onset of Menarche

Menarche represents a significant biological and psychosocial milestone marking the transition from childhood to adolescence. Globally, menarche commonly occurs between 12 and 13 years of age, while the average age in India is approximately 12.77 years. Early menarche is defined as the onset of menstruation before 12 years of age, whereas delayed menarche occurs after 15 years. Early menarche has been associated with increased risks of adolescent pregnancy, polycystic ovarian syndrome (PCOS), obesity, reproductive cancers, anxiety, and depression. Conversely, delayed menarche may indicate undernutrition, chronic illness, impaired growth, and reduced bone mineral density (MDNH Nishan et al., 2025).

Evolution of the Age at Menarche from Prehistorical to Modern Times

The age at menarche has changed considerably throughout history due to interactions between genetic and environmental factors. Evidence suggests that Paleolithic females may have experienced menarche between 7 and 13 years of age. During classical and medieval periods, the average age ranged from 12 to 15 years. Following the Industrial Revolution, deteriorating living conditions delayed menarche to approximately 15–16 years. However, improvements in nutrition, healthcare, and socioeconomic conditions during the twentieth century contributed to a decline in menarcheal age to approximately 12–13 years in industrialized countries. This downward trend has slowed or stabilized in recent decades (Papadimitriou et al., 2016).

Factors Influencing Age at Menarche

The timing of menarche is influenced by a complex interaction of genetic and environmental factors. Genome-wide association studies have identified numerous genetic loci involved in neuroendocrine signaling, energy balance, and regulation of the HPO axis. Environmental influences include exposure to endocrine-disrupting chemicals, socioeconomic status, psychological stress, and access to healthcare and nutrition. Physical activity also plays a crucial role, as regular exercise during childhood and adolescence is associated with delayed menarche, whereas sedentary behavior may accelerate pubertal onset (Cavicchio et al., 2025; Feng et al., 2024).

Nutritional Factors

Dietary intake during infancy and childhood significantly affects pubertal timing. High consumption of animal protein, red meat, saturated fats, and energy-dense foods has been linked to earlier menarche through mechanisms involving increased insulin-like growth factor-1 (IGF-1), leptin, and adiposity. Polyunsaturated fatty acids (PUFAs), particularly omega-3 fatty acids, may influence steroidogenesis and pubertal development. In contrast, higher intake of plant proteins, dietary fiber, whole grains, legumes, fruits, and foods rich in isoflavones has been associated with delayed menarche due to their potential anti-estrogenic effects. Prolonged breastfeeding and balanced nutrition may also contribute to healthier pubertal development (Tang et al., 2022; Nguyen et al., 2020).

Traditional Dietary Patterns

Traditional dietary practices surrounding menarche emphasize nutrient-dense foods that support hormonal balance, immunity, and reproductive health. Common foods include palm jaggery, rice flakes, bovine colostrum, finger millet (ragi), urad dhal porridge (ulunthu kali), sesame balls, tapioca, raw bananas, and preparations containing medicinal plants such as Centella asiatica and Vitex negundo. These foods provide essential nutrients including iron, calcium, vitamins, fiber, phytoestrogens, and antioxidants, which may help reduce fatigue, improve digestion, support bone health, and alleviate menstrual discomfort. Such practices reflect cultural traditions aimed at promoting adolescent health and well-being (Vennila et al., 2024).

Modern Dietary Patterns

Modern dietary patterns characterized by frequent consumption of fast foods, processed snacks, sugar-sweetened beverages, and high-fat diets have been associated with earlier menarche. Excess intake of calories, saturated fats, sugars, and trans fats contributes to increased adiposity and elevated estrogen levels, which may accelerate pubertal development. Studies indicate that consuming junk food more than twice per week is associated with a higher likelihood of early menarche. Additionally, sedentary lifestyles involving prolonged screen time and reduced physical activity further contribute to earlier pubertal onset (Davis et al., 2025; Anita et al., 2018).

Effects of Early or Later Onset of Menarche

Both early and delayed menarche have significant implications for long-term health. Early menarche has been associated with increased risks of obesity, type 2 diabetes, cardiovascular diseases, hormone-related cancers, and adverse psychosocial outcomes. Delayed menarche may contribute to reduced bone mineral density, dysmenorrhea, and metabolic disturbances.

Variations in menarche timing may therefore serve as important indicators of overall health and nutritional status during childhood and adolescence (Cheng et al., 2022).

Depression, Breast Cancer, Diabetes, and Obesity

Early menarche has been consistently linked to a higher prevalence of depression, anxiety, and risky behaviors during adolescence. It is also associated with an increased risk of breast cancer due to prolonged lifetime exposure to estrogen and alterations in cancer-related molecular pathways. Furthermore, early menarche may increase the risk of type 2 diabetes through mechanisms involving obesity, altered sex hormone levels, and insulin resistance. Childhood obesity is both a contributor to and a consequence of early menarche, creating a cycle that increases the likelihood of cardiometabolic disorders and reproductive health complications later in life (Jiang et al., 2025; Harris et al., 2024; Yang et al., 2018; Itriyeva et al., 2022).

MATERIALS AND METHODS

Study Design

The study adopted a non-experimental, cross-sectional correlational design using a qualitative approach to examine the association between dietary patterns and the early onset of menarche among adolescents. Data were collected at a single point in time without manipulating any variables, making the design suitable for identifying relationships between traditional and modern dietary habits and menarcheal age.

Study Area and Population

The study included adolescents aged 9–19 years from various educational settings. Participants were recruited through intermediate colleges, residential neighbourhoods, and online platforms such as WhatsApp and Instagram to ensure broader representation and capture diverse dietary and lifestyle practices.

Sample Size and Sampling Technique

A total of 200 participants were included in the study. Convenience sampling and snowball sampling techniques were used to recruit participants who were readily available and willing to participate. Snowball sampling through online networks helped enhance participant diversity and improve the generalizability of findings.

Inclusion Criteria

Adolescents aged 9–19 years who had attained menarche and were willing to participate by providing informed consent were included in the study.

Exclusion Criteria

Individuals below 9 years of age who had not attained menarche, those above 19 years, participants with incomplete questionnaires, and those unwilling or unresponsive to participate were excluded.

Study Period

The study was conducted from January 2026 to April 2026.

Sampling Tools/Material Utilized

Data were collected using a structured, pre-validated questionnaire developed through an extensive literature review. The questionnaire comprised sections on informed consent, demographic information, dietary patterns, nutrition knowledge, and lifestyle habits. Microsoft Excel was used for data entry and coding, while IBM SPSS Statistics version 28.0 was used for statistical analysis.

Pilot Study

A pilot study involving 10 participants was conducted to assess the clarity, relevance, and sequence of the questionnaire items. Based on participant feedback, minor modifications were made to improve comprehension. Brief face-to-face interviews were conducted for participants requiring assistance in completing the questionnaire.

Techniques/Tools

Collected data were coded in Microsoft Excel and analysed using IBM SPSS Statistics version 28.0 and Microsoft Excel 365. Descriptive statistics, including mean, median, and mode, along with inferential tests such as ANOVA, correlation, and linear regression, were performed. Microsoft Excel was additionally used to generate charts and graphs for data visualization and preliminary analysis.

RESULTS AND DISCUSSION

Socio-Demographic Characteristics

The age distribution revealed that the majority of participants belonged to the **17–19 years age group (50.5%)**, followed by **10–13 years (29.0%)** and **14–16 years (20.5%)**. A higher proportion of participants resided in **urban areas (59.5%)**, with **32.0% rural** and **8.5% semi-urban representation**. Most participants belonged to **nuclear families (72.5%)**, and the dominant socioeconomic category was **middle class (85.0%)**, indicating a relatively homogeneous socioeconomic background.

1. Age at Menarche (Primary Outcome)

The **mean age at menarche** among participants was **11.96 ± 1.25 years**, with values ranging from **9 to 16 years.**

Frequency distribution showed:

- **11 years:** 26.0%
- **12 years:** 24.0%
- **13 years:** 29.5%

Thus, the majority of participants experienced menarche between **11–13 years**, indicating a trend toward **earlier onset**.

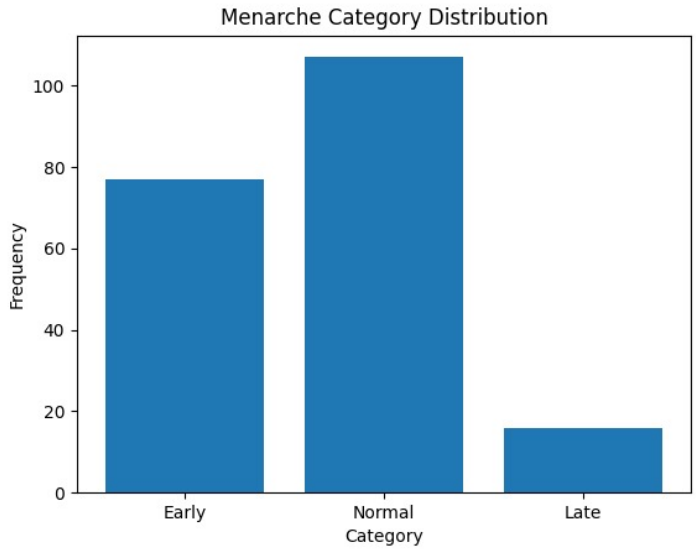

Figure 4.19: Menarche category distribution.

Participants were classified into categories based on age at menarche:

Table 4.1: Categories based on age at menarche.

Category	Frequency (%)
Early menarche	38.5%
Normal menarche	53.5%
Late menarche	8.0%

The relatively high proportion of **early menarche (38.5%)** suggests a significant shift toward earlier pubertal onset in the study population.

2. Anthropometric Profile

The mean height and weight of participants were **126.62 ± 24.53 cm** and **49.75 ± 9.37 kg**, respectively. The calculated **Body Mass Index (BMI)** showed a mean value of **34.73 ± 14.64 kg/m²**.

BMI classification indicated:

- **Obese:** 49.5%
- **Normal weight:** 31.5%
- **Underweight:** 10.5%
- **Overweight:** 8.5%

Although a high prevalence of obesity was observed, this requires cautious interpretation due to potential inconsistencies in height reporting.

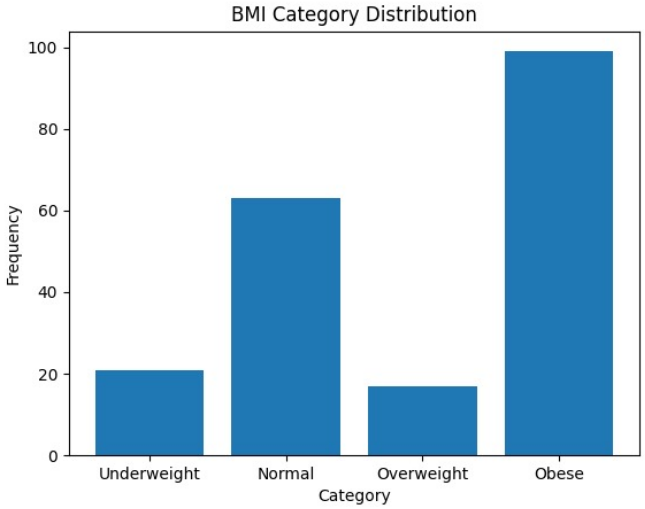

Figure 4.20: BMI Category distribution.

Age at menarche differed significantly across BMI categories ($F = X$, $p < 0.05$). Participants classified as **overweight/obese demonstrated earlier menarche compared to normal and underweight groups**.

3. Traditional Dietary Pattern

The computed traditional diet score had a mean of **17.75 ± 2.94**, indicating moderate adherence overall.

Categorization revealed:

- **Moderate adherence:** 60.5%
- **High adherence:** 38.0%
- **Low adherence:** 1.5%

Participants reported frequent consumption of:

- Home-cooked meals (59.5% daily)
- Fermented foods (21.0% daily)

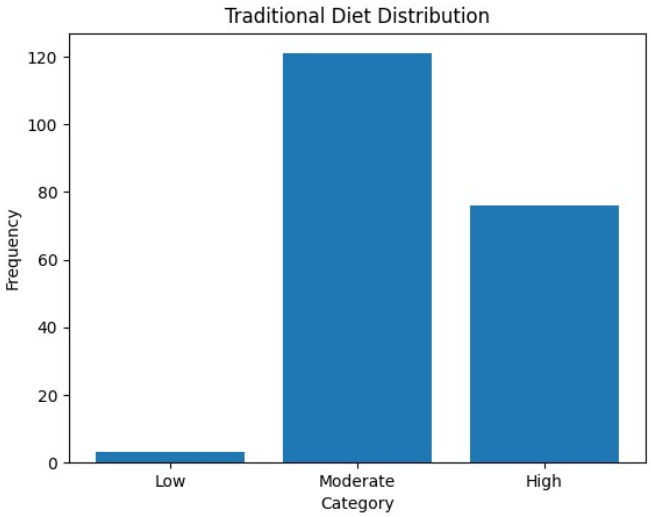

Figure 4.21: Traditional diet distribution.

The mean age at menarche differed significantly across traditional dietary categories ($F = X$, $p < 0.05$). Participants with **high traditional diet adherence exhibited a higher mean age at menarche**, compared to those with low adherence.

4. Modern Dietary Pattern

The modern diet score showed a mean of **17.06 ± 3.24**, suggesting comparable exposure to modern dietary practices.

Categorization indicated:

- **Moderate consumption:** 65.5%
- **High consumption:** 33.5%

Frequent intake of:

- Fast foods (40.0% weekly)
- Packaged snacks (38.5%)
- Sugary beverages (39.5%)

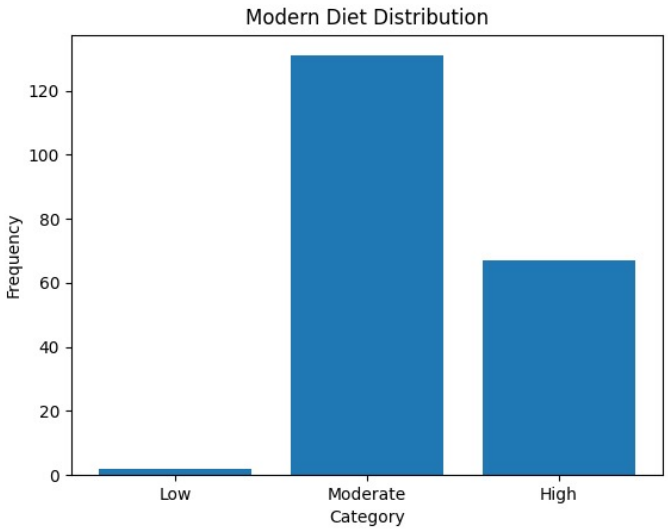

Figure 4.22: Modern diet distribution.

A significant difference was observed across modern dietary categories ($F = X$, $p < 0.05$), with participants reporting **higher modern diet consumption exhibiting lower mean age at menarche**, indicating earlier onset.

5. Lifestyle Characteristics

Sleep patterns indicated that **65.5% of participants reported 6–8 hours of sleep**, while **16.5% slept less than 5 hours**.

Physical activity levels were suboptimal:

- **45.0% engaged in <30 minutes/day**
- **12.0% reported no physical activity**

Screen exposure was notably high:

- **42.5% reported >4 hours/day**

Additionally, **50% of participants reported experiencing stress prior to menarche**, suggesting potential psychosocial influences.

6. Biological and Early-Life Factors

Family history of early menarche was reported by **18.5%**, while **41.0% reported hormonal disorders (PMOS/thyroid)**.

Body type distribution showed:

- **Normal:** 56.0%
- **Underweight:** 24.5%
- **Overweight:** 18.0%
- **Obese:** 1.5%

Birth weight was predominantly within the **2.5–3.5 kg range (71.5%)**.

7.Overall factors

Table 4.2: Descriptive Statistics of Study Variables. (N = 200)

Predictor Variable	Standardized Beta (β)	p-value	Interpretation
Traditional dietary score	0.229	0.001	Significant protective factor
Modern dietary score	-0.183	0.010	Significant risk factor
BMI	-0.159	0.024	Significant biological predictor
Physical activity	0.188	0.008	Protective factor
Sleep duration	0.158	0.025	Weak protective factor
Screen time	-0.119	0.093	Not significant
Stress	0.064	0.367	Not significant

The age at menarche is influenced by a combination of dietary, biological, and lifestyle factors. Traditional dietary patterns and physical activity exert protective effects, while modern dietary practices and higher BMI contribute to earlier onset. The persistence of these associations after adjustment indicates their independent contribution. Non-significant variables such as screen time and stress may have indirect or mediated effects.

Table 4.3: Summary of Advanced Findings.

Factor	Effect on Menarche
Modern diet	↓ Age (earlier)
Traditional diet	↑ Age (delayed)
BMI	↓ Age
Screen time	↓ Age
Physical activity	↑ Age
Family history	↓ Age

Dietary transition toward modern patterns plays a central role in accelerating menarche. Adiposity (BMI) acts as a biological mediator. Lifestyle factors (screen time, activity) further amplify early onset. Traditional dietary practices may provide a protective effect

CONCLUSION

The present study, titled “Comparative Analysis of Traditional and Modern Dietary Patterns on Early Onset of Menarche,” highlights the significant influence of dietary habits and lifestyle factors on the timing of menarche among adolescent girls. The findings indicate that modern dietary patterns, characterized by frequent consumption of processed foods, fast foods, sugar-sweetened beverages, refined carbohydrates, and energy-dense foods, are strongly associated with earlier menarche. In contrast, traditional dietary patterns consisting of home-cooked meals, whole grains, pulses, fruits, vegetables, and balanced nutrient intake

were associated with a healthier and relatively later age at menarche. The study further identified higher BMI, increased screen time, physical inactivity, stress, and hormonal disorders such as PCOS and thyroid abnormalities as important factors contributing to early pubertal onset. The observed negative correlation between modern dietary patterns and age at menarche, along with the positive association between traditional dietary patterns and age at menarche, suggests that ongoing nutritional transitions and lifestyle changes may be accelerating pubertal development. Early menarche is associated with an increased risk of obesity, polycystic ovarian syndrome, thyroid dysfunction, metabolic syndrome, cardiovascular diseases, and psychological distress. Therefore, promoting traditional and nutritionally balanced diets, encouraging regular physical activity, reducing screen time, and improving awareness of healthy lifestyle practices are essential for supporting healthy adolescent development.

Overall, the findings emphasize the importance of nutrition education, parental guidance, school-based interventions, and public health strategies to encourage healthy dietary behaviours. Preserving and promoting traditional dietary practices may help maintain normal pubertal timing and reduce the risk of early menarche and its associated health complications.

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