PAKISTAN JOURNAL OF HEALTH SCIENCES
(LAHORE)
https://thejas.com.pk/index.php/pjhs
ISSN (E): 2790-9352, (P): 2790-9344
Volume 6, Issue 10 (October 2025)

Original Article

OPEN ACCESS

Maternal Dietary Diversity in Pakistan: Influences of Education, Poverty, and Food Insecurity from a Cross-Sectional Survey

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ARTICLE INFO

Keywords:
Pregnant Women, Dietary Diversity, Food Insecurity, Body Mass Index, Poverty, Maternal Education, Malnutrition

How to Cite:
Habib, I., Haq, Z. U., Imtiaz, A., Khan, M. N., Afaq, S., Fazid, S., Garzon, C., Tanimoune, M., & Ihtesham, Y. (2025). Maternal Dietary Diversity in Pakistan: Influences of Education, Poverty, and Food Insecurity from a Cross-Sectional Survey: Maternal Dietary Diversity: Influences of Education, Poverty, and Food Insecurity. Pakistan Journal of Health Sciences, 6(10), 84-91. https://doi.org/10.54393/pjhs.v6i10.3519

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Received Date: 8th September, 2025
Revised Date: 4th October, 2025
Acceptance Date: 29th October, 2025
Published Date: 31st October, 2025

ABSTRACT

Maternal nutrition strongly influences pregnancy outcomes. In Pakistan, poor dietary diversity and food insecurity remain key drivers of malnutrition, particularly in disadvantaged areas. **Objectives:** To assess dietary diversity, household food insecurity, and nutritional status among pregnant women in Kurram District, Pakistan, and examine their associations with maternal education and poverty. **Methods:** A community-based cross-sectional baseline survey, nested within a non-randomized, cluster-controlled trial (ISRCTN94319790), was conducted in Upper Kurram from January to April 2018, using multi-stage cluster sampling (80 clusters from 12 health facilities) and consecutive home-based enrolment of 1,209 pregnant women (15–49 years). Data were collected via structured questionnaires (HFIAS, MDD-W), standardized anthropometry, and analyzed in Stata 14. **Results:** Mean age was 27.9 ± 5.8 years; 68.9% of women and 24% of husbands were uneducated. Most households were non-poor (87.6%), and 77.4% were food secure (mean HFIAS 4.2 ± 5.2). Dietary diversity was low, with only 13.2% achieving MDD-W ≥5; diets were dominated by cereals (98.4%), low in fruits, vegetables, and animal-source foods. Mean BMI was 24.9 ± 4.5; 4.5% were underweight, 29.8% overweight, and 11.0% obese. In bivariate analyses, food insecurity was more common among women with no formal education, the poorest households, and those consuming <5 food groups (all p<0.001). **Conclusions:** Findings reveal a double burden of malnutrition, with overweight and obesity coexisting with poor dietary diversity. Food insecurity was strongly linked to poverty, low education, and limited dietary diversity. Interventions addressing education, poverty, and dietary diversity are critical to improve maternal nutrition in similar low-resource settings.

INTRODUCTION

Malnutrition remains a major threat to population health, and women of reproductive age are especially vulnerable during pregnancy because of higher nutrient requirements [1, 2]. Improving nutrition in the first 1,000 days, from conception to a child's second birthday, lays the foundation for lifelong health [3]. Yet across many settings, women's diets still fall short: meals are often dominated by staples with limited micronutrient density, and access is shaped by affordability, gender norms, and local food environments [2, 4]. In this context, assessing what women actually eat and how diet quality varies by social conditions is essential for guiding maternal nutrition policy and practice. Dietary diversity, a 24-hour count of distinct food groups, is a practical way to gauge whether pregnant women likely

DOI: https://doi.org/10.54393/pjhs.v6i10.3519

meet nutrient needs [5]. The FAO MDD-W uses 10 groups; intake of ≥5 denotes minimum diversity and proxy's micronutrient adequacy [2]. Maternal undernutrition remains prevalent in low- and middle-income countries (LMICs), with approximately 20% of women in Asia and 10% in Africa having a low body mass index; deficiencies of key micronutrients (iron, folate, calcium, vitamins A and D) are also widespread [6]. Conversely, overweight and obesity are rising, and women of reproductive age in Pakistan face a double burden of malnutrition [7]. Maternal malnutrition affects the health and well-being of both mothers and offspring [8]. Addressing it is essential for human capital, socioeconomic development, and long-term economic growth [9]. Regionally, Pakistan shows the coexistence of undernutrition with rising overweight and obesity in women of reproductive age, with Khyber Pakhtunkhwa (KP) and the newly merged districts exhibiting persistent structural disadvantages (low female literacy, limited services) [1]. Provincial data indicate substantial household food security alongside micronutrient gaps (NNS 2018) [7], while analyses from Peshawar link poverty and food insecurity across urban and rural households [10]. Urban studies (e.g., Islamabad/Rawalpindi) report comparatively higher dietary diversity during pregnancy, underscoring socioeconomic and educational gradients within Pakistan [5]. Most recent evidence from Karachi shows that dietary diversity was alarmingly low in pregnant women [11]. Comparable findings from neighboring LMIC contexts show low women's dietary diversity and strong associations with household food insecurity and maternal education [12, 13], alongside programmatic evidence on nutrition and food access during the first 1,000 days [14]. Together, these patterns highlight the need for district-level data from tribal settings such as Kurram to inform locally appropriate maternal nutrition strategies. Despite national and provincial reports, district-level evidence from KP's newly merged tribal districts is scarce, and large surveys (PDHS 2017–18; NNS 2018) may mask local heterogeneity in women's diet quality and food access [15]. Upper Kurram was purposively selected due to a culturally feasible setting for women-focused fieldwork, with community receptivity and established female health-worker networks enabling reliable household access and data collection [16]. In addition, undernutrition among pregnant and lactating women (PLWs) in Kurram exceeds the national average (NNS 2018) [7], highlighting an at-risk district within KP's newly merged areas. Coupled with very low female literacy and constrained services [16], these conditions plausibly shape dietary intake and food security differently than urban centers [5]. Generating baseline, community-based estimates of dietary diversity trends, food insecurity situation, and nutritional status in this tribal setting addresses a critical evidence gap and provides operational inputs for provincial strategies and social protection programming [17, 18]. Improving the diversity of diets is one approach to enhance micronutrient nutrition for women of reproductive age and promote sustainable, healthy diets; this can contribute to the Sustainable Development Goals and the World Health Assembly's 2030 nutrition-specific targets [2].

Despite national surveys reporting on maternal nutrition and food security in Pakistan, district-level evidence from Khyber Pakhtunkhwa's newly merged tribal districts remains limited. Large-scale datasets such as PDHS and NNS may mask local heterogeneity in dietary practices, education-related disparities, and poverty-linked food access constraints. Moreover, few studies have concurrently examined dietary diversity, household food insecurity, and maternal nutritional status within a single analytical framework in tribal settings like Upper Kurram. This evidence gap restricts context-specific planning and targeting of nutrition-sensitive and social protection interventions in these structurally disadvantaged regions. This study aims to assess dietary diversity, food insecurity, and nutritional status of pregnant participants in Kurram District. To fill a district-level evidence gap for KP's tribal districts and to inform targeting and counselling priorities under ongoing provincial nutrition and social protection initiatives.

METHODS

This study conducted a community-based cross-sectional baseline survey in Upper Kurram from January to April 2018, nested within a non-randomized, cluster-controlled trial (ISRCTN94319790). Using multistage cluster sampling, 80 clusters were drawn from 12 health-facility catchments, and 1,209 pregnant women (15–49 years) were enrolled consecutively during home visits. Trained staff administered the Household Food Insecurity Access Scale (HFIAS) and the Minimum Dietary Diversity for Women (MDD-W) and obtained standardized anthropometry. Analyses were performed in Stata 14 with descriptive and bivariate tests (chi-square; $\alpha=0.05$); proportions are reported with one decimal, and BMI category estimates include 95% confidence intervals (Wilson method). The study complied with the Declaration of Helsinki and local regulations, with approval from the KMU Ethics Review Board (Ref DIR/KMU-EB/SP/000427-28-08-2017). Trained female staff provided information in Pashto/Urdu (objectives, procedures, risks/benefits, privacy, voluntariness). Participation was voluntary, with the right to decline/withdraw anytime. Written consent was obtained; for non-literate participants, forms were read with an impartial witness, and consent was recorded by thumbprint plus witness signature. For participants <18

DOI: https://doi.org/10.54393/pjhs.v6i10.3519

years, parent/guardian consent and assent were obtained. Interviews were private; data were de-identified (unique IDs) and securely stored. No clinical interventions or specimens were collected; only aggregate, de-identified results are reported. Eligible participants were resident pregnant women, aged 15-49 years, in their first trimester. The required sample was estimated using the single-proportion formula: $n_o = Z^2 p(1-p)/d^2$ assuming a 95% confidence level (Z = 1.96), expected prevalence *p=.40*, and precision d=0.04, yielding no ≈ 576 [19]. To adjust for multi-stage cluster sampling, a conservative design effect (DEFF = 2.0) was applied, giving n ≈ 1,152. Allowing for an estimated 5% non-response, the final target was 1,210, closely matching the achieved sample of 1,209 (30). Post-hoc Open Epi analysis indicated >90% power (α = 0.05, two-sided) to detect an approximate 19% prevalence difference between women consuming milk/milk products (n=488; 40.4%) and non-consumers (n = 721; 59.6%) [21]. A multi-stage cluster approach was applied to screen and register the study participants. A total of 122 clusters were formed in the catchment areas of selected health facilities (n=12) in Upper Kurram. Each cluster comprised, on average, 100-150 households based on the Lady Health Workers (LHWs) catchment area. Households were identified and selected based on the polio micro planning data of the Expanded Program on Immunization (EPI). Clusters (n=80) were randomly selected from the total clusters. A consecutive sampling technique was used to select the participants from selected clusters. Pregnant women aged 15–49 years registered with LHWs in the selected clusters were identified. The data collection teams visited the households in selected clusters and met the household members to enroll the eligible participants, using a social mapping approach. All the eligible participants (pregnant women) in the selected household were approached and enrolled in the study with appropriate written informed consent. Fewer than 3% of the Pregnant women refused participation, and reasons for non-participation were documented. This cross-sectional survey was conducted from January to April 2018 to assess the baseline characteristics of the pregnant women. Before inclusion, informed consent in written form was obtained from study participants after the provision of the information sheet and verbal explanation of the study objectives. Participants were apprised regarding their free will and withdrawal from the study without any reason. They were assured of the confidentiality of the data. The data collected on validated structured questionnaires on dietary diversity and food insecurity, along the basic demographic data. Anthropometric measurements were done following standard procedures as explained below. The questionnaires on the Household Food Insecurity Access Scale instrument (HFIAS-instrument) and Minimum Dietary Diversity for Women (MDD-W) were translated into Pashto and Urdu, translated back into English for accuracy, and pre-tested in a pilot survey. This ensured cultural relevance and validity. Information on participants' demographics was recorded, covering age, marital status, household composition, years, and occupation of both women and their spouses. Socioeconomic position was assessed using the Benazir Income Support Program poverty scale. Based on the poverty score, households were categorized into four groups: "Ultra poor (0-11)", "Vulnerable poor (12-18)", "Transitory poor (19-23)", and "non-poor (24-100)" [21]. Data on household food insecurity were collected using the "Household Food Insecurity Access Scale (HFIAS)". Based on the HFIAS score, households were categorized into four levels: "food secure", "mildly food insecure", "moderately food insecure", or "severely food insecure" [22]. "Minimum Dietary Diversity for Women (MDD-W)" was used for collecting data on dietary diversity. Dietary intake was assessed using a 24-hour interviewer-administered recall, minimizing misreporting. Recall bias was further reduced by prompting participants about specific meals, snacks, and seasonal food items. Based on Food and Agriculture Organization (FAO) cut-off points, dietary diversity was poor if less than five food groups were consumed and good if a woman ate at least five food groups in the last 24 hours [2]. Anthropometric measures of the pregnant women included height (cm), weight (kg). Measurements of BMI and MUAC were taken as indicators of maternal nutritional status. Weight was measured using the SECA 2 weighing scale. Height in centimeters was assessed using the standardized UNICEF SECA height boards. SECA weighing scales were calibrated daily. Height boards were standardized. Inter-observer reliability checks were performed weekly for MUAC and height to ensure consistency across data collectors. Maternal nutritional status was assessed using the BMI, calculated as weight in kilograms divided by height in meters squared (kg/m2), and classified under WHO reference values. Women were grouped as underweight if BMI was below 18.5, normal when between 18.5–24.9, overweight for values of 25–29.9, and obese when 30 or above [23]. MUAC was measured with non-stretchable plastic tapes for adults, developed by UNICEF. Pregnant women having MUAC <23 cm were classified as undernourished, and those with MUAC ≥23 cm were considered normal [12]. Data were collected by twenty data collectors. Each data collector was assigned four clusters. They were trained on questionnaires used for data collection and were also briefed on the study background, objectives, and methodology. The data collection process was supervised, and the data were double-checked to ensure the quality data. All the

DOI: https://doi.org/10.54393/pjhs.v6i10.3519

recruited participants in the baseline study were assigned unique IDs to ensure the privacy of the study participants. Data were analyzed and descriptive statistics were generated, with continuous measures expressed as mean ± SD, and categorical measures presented as frequencies and percent distributions. All statistical analysis was performed using STATA software (version 14.0).

RESULTS

Mean BMI was 24.9 ± 4.5; 4.5% were underweight, 29.8% overweight, and 11.0% obese. The mean height was 157.6 ± 5.7 cm, and the mean weight was 61.3 ± 11.2 kg. Figure 1 shows the BMI distribution: 4.5% underweight, 54.7% normal, 29.8% overweight (95% CI 27.3–32.4), and 11.0% obese (95% CI 9.4–12.9), indicating a double burden of malnutrition. The mean MUAC was 26.2 ± 3.3 cm, with 85.0% ≥ 23 cm, figure 1.

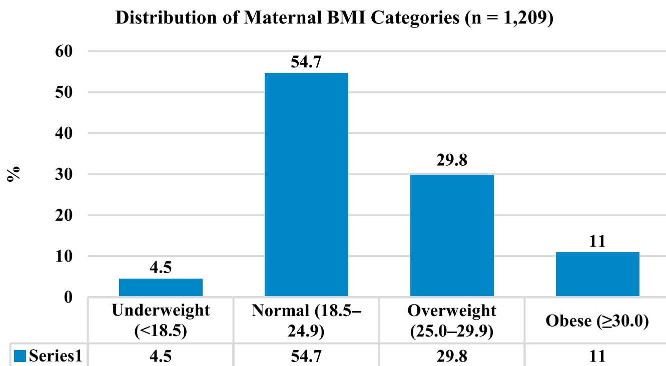

Figure 1: Distribution of Maternal BMI Categories among Pregnant Women in Kurram (n=1,209)

The 1,209 pregnant participants were predominantly 20–30 years (66.4% mean age 27.9 ± 5.8 years), with 68.9% of women having no formal schooling and 24.2% of husbands uneducated. Most households were non-poor (87.6%) and food secure (77.4%, 95% CI 75.0–79.8). Mean HFIAS was 4.2 ± 5.2. Four in five women lived in joint/extended families (83.5%), and nearly one-third of husbands were unemployed (29.3%), table 1.

Table 1: Socio-Demographic, Education, Occupation, Household Composition, Poverty, and Food Security of Pregnant Women (n=1,209)

Variables	n (%) / Mean ± SD
Age Groups	
Mean age	27.9 ± 5.8
<20 Years	75 (6.2%)
20–30 Years	803 (66.4%)
>30 Years	331 (27.4%)
Education (Women)	
No Schooling	833 (68.9%)
1–8 Years	202 (16.7%)
9–12 Years	129 (10.7%)
13–16 Years	45 (3.7%)
Years of Education	2.6 ± 4.3
Husband's Education	
No Schooling	293 (24.2%)
1–8 Years	338 (28.0%)
9–12 Years	467 (38.6%)
13–16 Years	111 (9.2%)
Years of Education	7.2 ± 4.9
Husband's Occupation	
Paid Work	209 (17.3%)
Self-Employed	259 (21.4%)
Non-Paid Work	57 (4.7%)
Unemployed	354 (29.3%)
Abroad	281 (23.2%)
Other	49 (4.1%)
Living Structure	
Nuclear/Single	200 (16.5%)
Joint/Extended	1,009 (83.5%)
Poverty (BISP Scorecard)	
Score	41.5 ± 14.8
Ultra-Poor	6 (0.5%)
Vulnerable Poor	49 (4.1%)
Transitory Poor	95 (7.9%)
Non-Poor	1,059 (87.6%)
Household Food Security (HFIAS)	
HFIAS Score	4.2 ± 5.2
Food Secure	936 (77.4%)
Mild Food Insecurity	145 (12.0%)
Moderate Food Insecurity	51 (4.2%)
Severe Food Insecurity	77 (6.4%)

PW = Pregnant Women, HFIAS = Household Food Insecurity Access Scale, BISP = Benazir Income Support Program, SD = Standard Deviation, CI = Confidence Interval. Note: Percentages are to one decimal place. Means are mean ± SD. Food security classification per HFIAS categories. Values are n (%) unless stated, continuous variables are mean ± SD.

Only 13% achieved MDD-W ≥5; cereals were near-universal (98%), while animal-source foods and fruit/vegetable groups were infrequent. Over half of the participants (54%) reported consuming oils and fats, followed by 40% who consumed milk and dairy products, and 35% who ate legumes, nuts, or seeds. Consumption of fish, eggs, flesh meat, and both vitamin-rich and other fruits was very low. The study enrolled 1,209 pregnant women (mean age 27.9 ± 5.8 years). Most had limited schooling: 68.9% of women and 24.0% of husbands had no formal education. Although 87.6% of households were categorized as non-poor and 77.4% were food secure (mean HFIAS 4.2 ± 5.2), diet quality was low. Only 13.2% met MDD-W ≥5, and diets were dominated by cereals (98.4%) with low intake of fruits, vegetables, and animal-source foods (Table 2).

DOI: https://doi.org/10.54393/pjhs.v6i10.3519

Table 2: Dietary Diversity and 24-Hour Food Group Consumption among Pregnant Women (n=1,209)

Variables	Yes, n (%)	No, n (%)
Indicator (Minimum Dietary Diversity for Women)		
Adequate Dietary Diversity (≥5 Food Groups)	159 (13.2%)	1050 (86.8)
Food Groups Consumed in the Previous 24 Hours		
Cereals	1190 (98.4%)	19 (1.6%)
Roots and Tubers	353 (29.2%)	856 (70.80%)
Legumes, Nuts and Seeds	428 (35.4%)	781 (64.6%)
Milk and Dairy Products	488 (40.4%)	721 (59.6%)
Flesh Meat	205 (17.0%)	1004 (83.0%)
Fish	14 (1.2%)	1195 (98.8%)
Eggs	117 (9.7%)	1092 (90.3%)
Dark Green Leafy Vegetables	177 (14.6%)	1032 (85.4%)
Vitamin A Rich Vegetables	294 (24.3%)	915 (75.7%)
Other Vegetables Sources	468 (38.7%)	741 (61.3%)
Vitamin A Rich Fruits	87 (7.2%)	1122 (92.8%)
Other Fruits Sources	220 (18.2%)	989 (81.8%)
Organ Meat	26 (2.2%)	1183 (97.9%)
Oils and Fats	658 (54.4%)	551 (45.6%)

MDD-W = Minimum Dietary Diversity for Women. (Percentages shown are one decimal. Categories reflect reported questionnaire groupings. Values are n (%) unless stated; dietary diversity based on MDD-W (10 food groups; ≥5 indicates minimum diversity).

The MDD-W <5 and household food insecurity were each strongly associated with lower maternal education and poverty (χ^2, p<0.001). Women with no formal schooling were far less likely to achieve adequate dietary diversity (11%) compared with those with ≥9 years of education (24%) (χ^2 = 28.0, p<0.001). Households in the poorest quartile were disproportionately food insecure (42%) compared to non-poor households (19%) (χ^2 = 39.5, p<0.001). Dietary diversity was also strongly linked to food security: women consuming <5 food groups were more often food insecure (60%), whereas those consuming ≥5 food groups reported substantially lower food insecurity (20%) (χ^2 = 87.0, p<0.001), Table 3.

Table 3: Minimum Dietary Diversity (≥5) By Maternal/Household Characteristics (n=1,209)

Variables	Category	Food Insecure, n (%)	Food Secure, n (%)	χ^2	p-Value
Minimum Dietary Diversity (≥5)					
Maternal Education	No Formal Schooling	741 (89.0%)	92 (11.0%)	28.0	<0.001
	≥9 Years of Schooling	223 (76.0%)	70 (24.0%)		
Household food insecurity (HFIAS)					
Poverty Status	Poorest Quartile	63 (42.0%)	87 (58.0%)	39.5	<0.001
	Non-Poor	201 (19.0%)	858 (81.0%)		
Dietary Diversity (MDD-W)	<5 Food Groups	630 (60.0%)	420 (40.0%)	87.0	<0.001
	≥5 Food Groups	32 (20.0%)	127 (80.0%)		

Abbreviations: MDD-W = Minimum Dietary Diversity for Women; HFIAS = Household Food Insecurity Access Scale. Values are n (%). Test: χ^2; p-values two-sided; α = 0.05.

Bars show % by WHO BMI category: BMI from standardized weight/height taken at home visits. 95% CIs: Underweight 54/1209, 3.4–5.8%; Normal 661/1209, 51.9–57.5%; Overweight 360/1209, 27.3–32.4%; Obese 133/1209, 9.4–12.9%. Food insecurity clustered among women with no schooling, households in the poorest category, and those consuming <5 food groups (all p<0.001). Food insecurity was more common among women with no schooling, households in the poorest quartile, and those consuming fewer than five food groups (Figure 2).

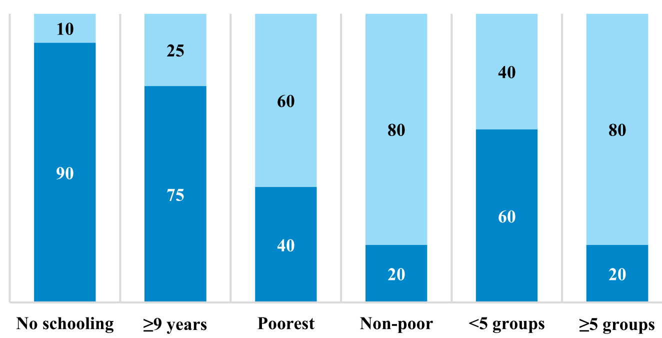

Figure 2: Associations Between Household Food Insecurity and Maternal Education, Poverty Status, and Dietary Diversity

DISCUSSION

This study shows a clear double burden among pregnant women in Upper Kurram: diet quality is poor while excess weight is common, and both patterns align with social disadvantage [17, 24]. Only a small share achieved MDD-W ≥5, indicating limited access to, or low prioritization of, micronutrient-dense foods [2]. At the same time, overweight and obesity suggest greater exposure to energy-dense, nutrient-poor diets that accompany the nutrition transition [7, 24]. Taken together, these findings point beyond food availability to the social and economic conditions that shape what women can purchase, prepare, and consume, underscoring the need for district-level strategies that strengthen diet diversity alongside poverty-sensitive support [16, 10]. Similar trends have been observed in other South-Asian contexts, where maternal dietary diversity significantly reduces with increasing household-level food insecurity during pregnancy and postpartum [14]. Two-thirds of women and one-fourth of husbands had no formal education. These gradients mirror PDHS patterns and underscore education-linked vulnerability in Kurram [14]. The mean poverty score (41.5 ± 14.8) and a high share of non-poor households resemble provincial heterogeneity reported in Peshawar [1], indicating that income alone may not predict women's diet quality in this district. A nationally representative analysis

DOI: https://doi.org/10.54393/pjhs.v6i10.3519

from Bangladesh likewise found that maternal education, household wealth, and urban residence were positively linked with higher dietary diversity scores [25], underscoring that economic and educational empowerment are key determinants of maternal diet quality. Food security was relatively high (77.4%), similar to KP in NNS 2018 (70.9%) [7], yet the local diet remained cereal-heavy with low fruit/vegetable and animal-source intake. In Kurram, subsistence agriculture and livestock may buffer availability (10), but national PDHS figures (54.6% food secure) and our HFIAS mean (4.2 ± 5.2; comparable to Bangladesh 3.3 ± 4.1) indicate that household access does not translate into diverse diets [14]. This is consistent with recent Pakistani data highlighting that dietary monotony persists even in urban settings despite nominal food security [11]. Consistent with prior work, food security here reflects more than availability, intertwining with education, occupation, wealth, and household structure [10]. The BMI profile, with few underweight but more than one-third overweight/obese, parallels national shifts between NNS 2011 and 2018 (undernutrition ↓; overweight/obesity ↑) and similar KP-NMD patterns [24]. Evidence from Pakistan and Ethiopia also shows substantial overweight among women of reproductive age, plausibly driven by urbanization, poor quality energy-dense foods, and constrained physical activity, while undernutrition persists in poorer/rural groups [26, 27]. Only 13.2% achieved MDD-W ≥5, confirming poor dietary diversity despite apparent household food security; MDD-W is a validated proxy for micronutrient adequacy [28]. Diets were cereal-dominant with low intake of fruits, vegetables, and animal-source foods, patterns seen in Ethiopia [12], though some Ethiopian settings report higher diversity [22], likely reflecting socioeconomic and seasonal differences. By contrast, Rawalpindi reported high diversity (89%) [5], reinforcing the role of education and affluence, notably limited in Kurram [11]. Maternal nutrition knowledge tracks with education and income and likely contributes to these disparities [21]. Stratified analyses highlight inequities: food insecurity and low dietary diversity were concentrated among women with no schooling and in poorer households, a pattern reported in Pakistan and comparable LMICs [10, 13]. The co-occurrence of food insecurity and limited diversity suggests a reinforcing cycle, where constrained resources reduce both access to and utilization of nutrient-dense foods. Collectively, evidence from South Asia underscores that household food insecurity, low income, and limited education jointly restrict maternal dietary diversity and nutritional well-being [14, 25]. Addressing these structural barriers is essential to improving maternal and child nutrition outcomes. Providing district-level evidence from a tribal setting, these findings support targeted counselling (dietary diversity, budget-sensitive food choices) paired with social protection to improve women's diet quality [7, 10]. Programmatically, coupling women's education and counselling with poverty-sensitive food access (cash/in-kind and market facilitation via BISP/health platforms) is likely needed to shift both diet diversity and excess BMI in similar KP-NMD districts [17]. This study benefits from a large, community-based sample, standardized home-visit measurements, and use of validated tools (MDD-W and HFIAS), enhancing internal validity. However, the cross-sectional design limits causal inference. Dietary intake was based on a single 24-hour recall conducted between January and April, so seasonal and recall bias cannot be excluded. BMI during pregnancy may not reflect pre-pregnancy adiposity; MUAC was included as a complementary indicator. Finally, the analysis is primarily bivariate, and residual confounding may remain despite stratified assessment.

This study has certain limitations, including its cross-sectional design, which precludes causal inference between education, poverty, food insecurity, and maternal nutritional outcomes. Dietary intake was assessed using a single 24-hour recall, which may not reflect habitual intake or seasonal variation. Additionally, the analysis was primarily bivariate and did not adjust for potential confounders through multivariable modeling. Future longitudinal and multicenter studies incorporating seasonal dietary assessments, multivariable analyses, and evaluation of intervention impacts are warranted to better understand pathways linking socioeconomic disadvantage with maternal diet quality and nutritional status in tribal and low-resource settings.

CONCLUSIONS

Pregnant women in Upper Kurram face a double burden of malnutrition, with low dietary diversity and excess weight shaped by education and poverty, despite nominal food security. These findings support a shift from food availability to diet quality. We recommend integrating dietary-diversity counselling into routine ANC and LHW contacts, aligned with locally affordable foods, and using this district-level evidence to inform the remodeling of BISP Nashonuma, including diet-quality-sensitive transfers, seasonal top-ups, and routine monitoring of MDD-W and MUAC.

Authors' Contribution

Conceptualization: IH, ZUH
Methodology: IH, ZUH, SF
Formal analysis: IH, ZUH, SF
Writing and Drafting: IH, AI, MNK, SA, SF, CG, MT, YI
Review and Editing: IH, AI, MNK, SA, SF, CG, MT, YI, ZUH

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

Source of Funding

The author received no financial support for the research, authorship and/or publication of this article.

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