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An Investigative Study on Assessment and Scoring of Malnutrition in Deprived Nomadic Children of Khyber Pakhtunkhwa, Pakistan

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ABSTRACT

Malnutrition affect all age groups, with infants and children being particularly vulnerable due to their high nutritional requirements. Under nutrition in children is influenced by a multifaceted interplay of factors, including socio-demographic characteristics, hygiene practices, environmenta, comorbidities etc. Nomadic communities are vulnerable to malnutrition and its severe consequences on productivity, health, and survival. The present study therefore, aimed to extensively survey the nomadic populations of Khyber Pakhtunkhwa, particularly focusing on the malnutrition among children. **Materials and Methods:** This cross-sectional study was carried out among random 18 Nomadic populations (Kudwal) of Malakand division, Khyber Pakhtunkhwa with a sample size of 500, from May 2021 to June 2022 that included pastoral nomads (bezogar/kucchi/Bakarwal) and peripatetic nomads (churgarh). Data collection involved, interviewing adults (guardian or parents) using a pre-designed semi-structured questionnaire. Anthropometric measurements i.e. height, weight, Head circumference Mid Upper Arm Circumference were recorded from children of above 1 year to 16 years of age (including both 1 and 16 years) for assessment of malnutrition. Data was entered into Microsoft Excel for preparation of database and were assessed using simple Pearson's chi-square test in STATA v13. **Results:** The Height-for-Age (HFA), Weight-for-Height (WFH), Weight-for-Age (WFA), Body Mass Index-for-Age (BFA), Head Circumference-for-Age (HC/A) z-score analysis revealed that malnourishment (stunting, wasting and underweight) was present across all districts, with an overall prevalence of 11%, 95.46%, 14.42%, 98% and 97.73% in children, respectively. Mid-Upper Arm Circumference (MUAC) measurements revealed that children under 5 years, acute malnutrition showed statistically significant. The Percentage of median for Height-for-Age, Weight-for-Age and Weight-for-Height analysis revealed that 99.25% , 26.97% and 93.18% of the total study population exhibited some form of growth deviation (Stunting, wasting and under nutrition). Malnutrition indices across different types of nomadism (Peripatetic and Pastoralist) revealed that, both nomadic groups showed high prevalence of malnutrition (p=0.920). Majority among both populations exhibited adequate malnutrition levels (Peripatetic: 89.94%, Pastoralist: 88.33%). Age-specific MUAC/A analysis revealed high rates of malnutrition (Peripatetic: 83.6%, Pastoralist: 88.88%), in 10-16 years age group (p=0.354). The BFA z-score assessment showed similar patterns of acute malnutrition/thinness between the groups (p=0.167). **Conclusion:** These findings highlight the complex nature of malnutrition among nomadic populations, with different indices revealing varying patterns of nutritional deficiencies. The significant difference suggests that Pastoralist communities might be more vulnerable to acute malnutrition compared to Peripatetic nomads, possibly due to differences in lifestyle, food access, or cultural practices.

INTRODUCTION

Malnutrition is the cellular imbalance between the supply of nutrients, energy, and the body's demand for them to ensure growth, maintenance, and specific functions (Feleke, 2016). It is a disorder that results from the interaction between diet and infection and commonly affects all age groups in a community, but infants and children are the most susceptible because of their high nutritional needs for physical growth and development. Indicators of malnutrition include wasting, stunting, and

underweight, which represent different aspects or measurements of malnutrition (Gilavand *et al.,* 2016).

Globally, more than 870 million people are undernourished, and 852 million of them are in developing countries. More than 25% of children in developing countries are underweight, and 50% of children's deaths are as a result of their poor nutritional status (Feleke, 2016).

Under nutrition among children depends on complex interactions of various factors, like socio-demographic, drinking water quality, hygiene of complementary foods, environmental sanitation, child co-morbidities, and child vaccination (Gizaw *et al.,* 2018). These children are physically, emotionally, and intellectually less productive and suffer more from chronic illnesses and disabilities (De Onis *et al.,* 2013). Intestinal parasitic infections have been shown to have a pronounced negative impact on various anthropometric indices (El-Awady & Abed, 2017). Growth faltering (defined by anthropometric measurements) is common among deprived communities, but the level of growth faltering below which immune response becomes impaired and the risk of morbidity increases (Svedberg, 2000; Ferdous *et al.,* 2013). The nutritional status of infected subjects is affected by a decrease in food intake and/or an increase in nutrient wastage due to malabsorption of nutrients, vomiting or diarrhea (Bechir *et al.,* 2012; Chaudhry *et al.,* 2004; El-Awady & Abed, 2017).

The nature, magnitude, and determinants of undernutrition are determined among the general populations, there is a lack of evidence in the nomadic communities the endemic nature of malnutrition and infection is probably also at the root of additional health problems among preschool-aged children (Haratipour *et al.,* 2016). In Pakistan, the National Nutrition survey revealed that among all children, the prevalence of underweight, stunting, and wasting was 33%, 44%, and 15%, respectively. While the prevalence of anemia and Iron-deficiency anemia was 50% and 33%, respectively (Asad & Mushtaq, 2012).

In pastoralist nomadic communities, poor nutritional status of children due to inadequate diet has reportedly often been exacerbated by lack of potable water and unsanitary conditions (Bechir *et al.,* 2012). The present study therefore, aimed to extensively survey the nomadic populations of Khyber Pakhtunkhwa, particularly focusing on the malnutrition among children. Improvements in environmental sanitation, education, and literacy, which help to improve child rearing and health, practice (Solomons, 2007).

MATERIALS AND METHODS

Study area

This cross-sectional study was carried out among nomadic population (Kudwal) of Malakand division, Khyber Pakhtunkhwa that are mostly dwelling near main roads and water sources. Malakand Division, located in north of the Khyber Pakhtunkhwa, is a region of diverse geography and climate, characterized by its mountainous terrain, with Hindukush range dominating the landscape. Moderate weather prevailing during mid-summer season, green pastures, abundant water resources thus is a favorable home to nomadic population especially pastoralists (bezogar/Gujjar) who travel with their livestock, thus making it an essential part of annual migration cycle.

Study Design

A community based cross-sectional study was conducted among random 18 Nomadic populations of Malakand division with a sample size of 500, from May 2021 to June 2022 that included pastoral nomads (bezogar/kucchi/Bakarwal) and peripatetic nomads (churgarh). Current study was carried out during Mid-summer season i.e. from May to August when most of the peripatetic nomads had already set their camps mostly in same predetermined locations or sometimes other when previous location is not available every year. The study protocol was approved by the Research Ethics Board, University of Peshawar, Pakistan, (ID: REB-05/04). The study targeted only nomadic male and female population that included children of above 1 year to 16 years of age (including both 1 and 16 years). Subjects with complications like congenital malformations, genetic disorders and chronic illnesses that affect physical growth were excluded from the current study.

Methods for Anthropometric Measurements

The data collection for studying various indicators was carried out by interviewing adults (guardian or parents) using a pre-designed semi-structured questionnaire. The questionnaire acquired data regarding general socio-demographics, Age, gender, educational level, information regarding Personal hygiene and food habits, Socio-economic information and Anthropometric measurements i.e. height (cm) and weight (kg), Head circumference (cm) and Mid upper arm circumference (MUAC) (cm) was acquired from adults and children to evaluate malnutrition according to standardized charts by WHO Child Growth Standards (WHO standards) (de Onis *et al.,* 2004; UNICEF *et al.,* 2023).

Assessment of Malnutrition and Data Collection

In children, anthropometric data was used to assess, Body Mass Index (BMI) for age (BAZ), Head circumference for Age, Mid Upper Arm Circumference (MUAC) for Age, Z-scores and Percentage of Median for weight for age (WZA), height for age (HZA), and weight for height (WZH) that were calculated according to Standards of (UNHCR, 2018; WHO and UNICEF, 2009) through WHO-ANTHRO (version 3.2.2) calculator for children up to the age of 5 years and ANTHROPLUS calculator, for children above 5 years and adolescent up to 19 years. The anthropometric indices i.e. height for age (HAZ) is used to assess stunting; weight for age (WAZ) to access underweight and body mass index for age (BAZ) to assess wasting. The values were expressed as differences from the median in standard deviation units (i.e., z-scores).

Data from questionnaires and malnutrition variables was entered into Microsoft Excel for preparation of database and were assessed using simple Pearson's chi-square test in STATA v13.

RESULTS

District-wise Malnutrition among Children according to Various WHO z-scores Indices

The Height-for-Age (HFA) z-score analysis revealed that stunting was present across all districts, with an overall

prevalence of 11%. Malakand and Swat districts showed higher proportions of moderate stunting (16.67% and 13.33% respectively) (p=0.348) (table 1).

Weight-for-Height (WFH) z-score assessment demonstrated a concerning pattern of wasting, with 95.46% of children affected across all districts. Notably, Shangla and Buner had some children (10% and 21.43% respectively) falling into the adequately nourished category (p=0.084) (table 1).

The Weight-for-Age (WFA) z-score analysis indicated that 14.42% of children were underweight. Dir Lower and Swat showed higher proportions of moderate underweight status (17.07% and 18.75% respectively) (p=0.835) (table 1).

Mid-Upper Arm Circumference (MUAC) measurements revealed that for children under 5 years, acute malnutrition showed statistically significant differences across districts (p=0.044), with Swat showing the highest prevalence of severe malnutrition (30.77%). The 10-16 years age group demonstrated a concerning pattern with 87.01% total malnutrition.

The Body Mass Index-for-Age (BFA) z-score indicated that 98% of children showed some degree of thinness across all districts (p=0.164). Head Circumference-for-Age (HC/A) z-score showed the most favorable results, with 97.73% of children adequately nourished, though small numbers of severe (1.14%) and moderate (1.14%) malnutrition were observed, primarily in Dir Upper and Dir Lower districts (table 1).

Table 1

District wise malnutrition among children according to various WHO z-scores indices

Malnutrition index	INDICATOR	DISTRICT	Malnutrition levels N (%)						
			Severe malnourished N (%)	Moderately malnourished N (%)	Adequately malnourished N (%)	Total malnourished N (%)	Normal N (%)	Total N (%)	**p-value** for Pearson chi-square
HFA z-score	Stunting	Dir Upper	1 (1.04)	5 (5.21)	90 (93.7)	96 (100)	0	96	0.348
		Dir Lower	2 (3.7)	2 (3.7)	50 (92.6)	54 (100)	0	54	
		Malakand	1 (3.33)	5 (16.7)	24 (80)	30 (100)	0	30	
		Swat	2 (4.44)	6 (13.3)	37 (82.2)	45 (100)	0	45	
		Shangla	0 (0)	2 (6.7)	28 (93.3)	30 (100)	0	30	
		Buner	1 (2.22)	6 (13.3)	38 (84.4)	45 (100)	0	45	
		Total	**7 (2.33)**	**26 (8.7)**	**267 (89)**	**300 (100)**	**0**	**300**	
WFH z-score	Wasting	Dir Upper	1 (3.70)	26 (96.3)	0 (0)	27 (100)	0	27	0.084
		Dir Lower	0 (0)	16 (100)	0 (0)	16 (100)	0	16	
		Malakand	0 (0)	8 (100)	0 (0)	8 (100)	0	8	
		Swat	0 (0)	13 (100)	0 (0)	13 (100)	0	13	
		Shangla	1 (10)	8 (80)	1 (10)	10 (100)	0	10	
		Buner	1 (7.14)	10 (71.4)	3 (21.43)	14 (100)	0	14	
		Total	**3 (3.41)**	**81 (92.05)**	**4 (4.55)**	**88 (100)**	0	**88**	
WFA z-score	Underweight	Dir Upper	2 (3.03)	8 (12.12)	56 (84.8)	66 (100)	0	66	0.835
		Dir Lower	1 (2.44)	7 (17.07)	33 (80.49)	41 (100)	0	41	
		Malakand	0 (0)	2 (8.70)	21 (91.30)	23 (100)	0	23	
		Swat	0 (0)	6 (18.75)	26 (81.25)	32 (100)	0	32	
		Shangla	0 (0)	2 (9.09)	20 (90.91)	22 (100)	0	22	
		Buner	0 (0)	3 (9.68)	28 (90.32)	31 (100)	0	31	
		Total	**3 (1.40)**	**28 (13.02)**	**184 (85.58)**	**215 (100)**	**0**	**193**	
HC/A z-score	Undernutrition	Dir Upper	0 (0)	1 (3.85)	25 (96.15)	26 (100)	0	26	0.731
		Dir Lower	1 (6.25)	0 (0)	15 (93.75)	16 (100)	0	16	
		Malakand	0 (0)	0 (0)	8 (100)	8 (100)	0	8	
		Swat	0 (0)	0 (0)	14 (100)	14 (100)	0	14	
		Shangla	0 (0)	0 (0)	10 (100)	10 (100)	0	10	
		Buner	0 (0)	0 (0)	14 (100)	14 (100)	0	14	
		Total	**1 (1.14)**	**1 (1.14)**	**86 (97.73)**	**88 (100)**	**0**	**88**	
MUAC/A z-score	Acute Malnutrition	Dir Upper	6 (22.2)	8 (29.6)	13 (48.14)	27 (100)	0	27	0.044
		Dir Lower	1 (6.25)	3 (18.75)	12 (75)	16 (100)	0	16	
		Malakand	0 (0)	2 (25)	6 (75)	8 (100)	0	8	
		Swat	4 (30.77)	8 (61.5)	1 (7.69)	13 (100)	0	13	
		Shangla	0 (0)	5 (50)	5 (50)	10 (100)	0	10	
		Buner	1 (7.14)	5 (35.7)	8 (57.14)	14 (100)	0	14	
		Total	**12 (13.6)**	**31 (35.22)**	**45 (51.13)**	**88 (100)**	0	**88**	
MUAC/A 5-10 years	Acute Malnutrition	Dir Upper	0 (0)	3 (7.50)	NA	3 (7.50)	37 (92.5)	40	0.390
		Dir Lower	0 (0)	2 (8)	NA	2 (8)	23 (92)	25	
		Malakand	0 (0)	1 (6.67)	NA	1 (6.67)	14 (93.3)	15	
		Swat	0 (0)	0 (0)	NA	0 (0)	18 (100)	18	
		Shangla	0 (0)	0 (0)	NA	0 (0)	12 (100)	12	
		Buner	0 (0)	3 (17.65)	NA	3 (17.65)	14 (82.35)	17	
		Total	**0 (0)**	**9 (7.09)**	**NA**	**9 (7.09)**	**118 (92.9)**	**127**	
MUAC/A 10-16 years	Acute Malnutrition	Dir Upper	5 (16.66)	20 (66.66)	NA	25 (83.3)	5 (16.66)	30	0.866
		Dir Lower	3 (23.07)	8 (61.53)	NA	11 (84.61)	2 (15.38)	13	
		Malakand	2 (28.57)	5 (71.43)	NA	7 (100)	0	7	
		Swat	3 (23.07)	9 (69.23)	NA	12 (92.23)	1 (7.69)	13	
		Shangla	0 (0)	7 (87.50)	NA	7 (87.50)	1 (12.50)	8	
		Buner	3 (20)	8 (60)	NA	11 (80)	3 (20)	14	

		Total	**13 (16.88)**	**54 (70.13)**	**NA**	**67 (87.01)**	**10 (12.33)**	**85**	
BFA z-score	Acute Malnutrition/ Thinness	Dir Upper	7 (7.29)	89 (92.7)	0 (0)	96 (100)	0	96	0.164
		Dir Lower	4 (7.4)	48 (88.89)	2 (3.7)	54 (100)	0	54	
		Malakand	2 (6.67)	28 (93.33)	0 (0)	30 (100)	0	30	
		Swat	3 (6.67)_	42 (93.33)	0 (0)	45 (100)	0	45	
		Shangla	0 (0)	29 (96.67)	1 (3.33)	30 (100)	0	30	
		Buner	3 (6.67)	39 (86.67)	3 (6.67)	45 (100)	0	45	
		Total	**19 (6.33)**	**275 (91.67)**	**6 (2)**	**300 (100)**	0	**300**	

District wise Stunting, Wasting and underweight level by as measured by WFA %age of median, WFH %age of median and HFA %age of median.

The Height-for-Age analysis, indicating stunting status, revealed that 99.25% of the total study population exhibited some form of growth deviation, with only 0.67% classified as normal. Malakand and Swat districts showed the highest proportion of moderate stunting and severe malnutrition respectively (table 2).

The Weight-for-Age assessment, measuring underweight status, demonstrated that 26.97% of children were moderately malnourished, while 73.36% were adequately nourished. Notably, Dir Upper showed the highest prevalence of moderate malnutrition (40.38%), while Malakand showed the lowest (13.05%) (p=0.576) (table 2).

The Weight-for-Height analysis, indicating wasting, revealed a concerning pattern where 93.18% of children showed some form of malnutrition (84.09% mild, 6.82% moderate, and 2.27% severe). Dir Upper was the only district reporting severe wasting (7.41%), while Swat showed the highest proportion of moderate wasting (15.38%) (p=0.666) (table 2).

Table 2

Stunting, Wasting and underweight level by District as measured by WHO % of median indices

Malnutrition index	DISTRICT	Malnutrition levels N (%)					Normal N (%)	Total N (%)	p-value for Pearson chi-square
		Severe malnourished N (%)	Moderately malnourished N (%)	Mild malnourished N (%)	Adequate malnourished N (%)	Total malnourished N (%)			
WHO HFA % Of Median (STUNTING)	Dir Upper	1 (1.04)	4 (4.17)	35 (36.46)	55 (57.29)	95 (98.95)	1 (1.04)	96 (100)	0.566
	Dir Lower	1 (1.85)	0 (0)	17 (31.48)	36 (66.67)	54 (100)	0 (0)	54 (100)	
	Malakand	0 (0)	4 (13.33)	9 (30)	17 (56.67)	30 (100)	0 (0)	30 (100)	
	Swat	1 (2.22)	1 (2.22)	16 (35.56)	26 (57.78)	44 (97.78)	1 (2.22)	45 (100)	
	Shangla	0 (0)	0 (0)	11 (36.67)	19 (63.33)	30 (100)	0 (0)	30 (100)	
	Buner	1 (2.22)	1 (2.22)	18 (40)	25 (55.56)	45 (100)	0 (0)	45 (100)	
	Total	4 (1.33)	10 (3.33)	106 (35.33)	178 (59.33)	268 (99.25)	2 (0.67)	300 (100)	
WHO WFA % Of Median (UNDERWEIGHT)	Dir Upper	0 (0)	21 (40.38)	0 (0)	0 (0)	21 (40.38)	45 (67.31)	66 (100)	0.576
	Dir Lower	0 (0)	12 (29.27)	0 (0)	0 (0)	12 (29.27)	29 (70.73)	41 (100)	
	Malakand	0 (0)	3 (13.05)	0 (0)	0 (0)	3 (13.05)	20 (86.96)	23 (100)	
	Swat	0 (0)	9 (28.12)	0 (0)	0 (0)	9 (28.12)	23 (71.88)	32 (100)	
	Shangla	0 (0)	4 (18.18)	0 (0)	0 (0)	4 (18.18)	18 (81.82)	22 (100)	
	Buner	0 (0)	9 (29.03)	0 (0)	0 (0)	9 (29.03)	22 (70.97)	31 (100)	
	Total	0 (0)	58 (26.97)	0 (0)	0 (0)	58 (26.97)	157 (73.36)	215 (100)	
WHO WFH % Of Median) (WASTING)	Dir Upper	2 (7.41)	1 (3.70)	21 (77.78)	3 (11.11)	27 (100)	0 (0)	27 (100)	0.666
	Dir Lower	0 (0)	1 (6.25)	15 (93.75)	0 (0)	16 (100)	0 (0)	16 (100)	
	Malakand	0 (0)	0 (0)	8 (100)	0 (0)	8 (100)	0 (0)	8 (100)	
	Swat	0 (0)	2 (15.38)	11 (84.62)	0 (0)	13 (100)	0 (0)	13 (100)	
	Shangla	0 (0)	1 (10)	8 (80)	1 (10)	10 (100)	0 (0)	10 (100)	
	Buner	0 (0)	1 (7.14)	11 (78.57)	2 (14.29)	14 (100)	0 (0)	14 (100)	
	Total	2 (2.27)	6 (6.82)	74 (84.09)	6 (6.82)	88 (100)	0 (0)	88 (100)	

Malnutrition aaccording to Z-scores, MUAC, BFA on the basis of nomadism type

Comprehensive analysis of malnutrition indices across different types of nomadism (Peripatetic and Pastoralist) revealed that, in terms of stunting (HFA z-score), both nomadic groups showed high prevalence of malnutrition (p=0.920). Majority among both populations exhibited adequate malnutrition levels (Peripatetic: 89.94%, Pastoralist: 88.33%) (table 3).

The wasting assessment (WFH z-score) showed a marginally significant difference between the groups (p=0.061). While both groups demonstrated high levels of moderate malnutrition. Notably, Pastoralists had a small proportion (10.53%) of adequately nourished individuals (table 3).

Underweight status (WFA z-score) was comparable between the groups (p=0.351), with both showing similar proportions of adequate malnutrition (Peripatetic: 85.50%, Pastoralist: 85.71%).

The most striking difference between the groups was observed in acute malnutrition measured by MUAC/A z-score (p=0.0001). Pastoralists showed significantly higher rates of severe malnutrition (25.6%) compared to Peripatetic nomads (2.04%) (table 3).

Age-specific MUAC/A analysis revealed high rates of malnutrition (Peripatetic: 83.6%, Pastoralist: 88.88%), in 10-16 years age group (p=0.354) (table 3).

The BFA z-score assessment showed similar patterns of acute malnutrition/thinness between the groups (p=0.167), with both showing very high rates of moderate malnutrition (Peripatetic: 95%, Pastoralist: 91.67% (table 3).

Table 3

Malnutrition according to different WHO indices (Z-scores, MUAC, BFA) on basis of type of nomadism

Malnutrition index	Type of Nomad	Malnutrition levels N (%)				Normal N (%)	Total N (%)	p-value for Pearson chi-square
		Severe malnourished N (%)	Moderately malnourished N (%)	Adequate malnourished N (%)	Total malnourished N (%)			
HFA z-score (STUNTING)	Peripatetic	5 (2.23)	14 (7.82)	161 (89.94)	180 (100)	0	180 (100)	0.920
	Pastoralist	2 (1.67)	12 (10)	106 (88.33)	120 (100)	0	120 (100)	
	Total	7 (2.01)	26 (8.70)	267 (89.30)	300 (100)	0	300 (100)	
WFH z-score (WASTING)	Peripatetic	2 (4)	48 (96)	0 (0)	50 (100)	0	50 (100)	0.061
	Pastoralist	1 (2.63)	33 (86.84)	4 (10.53)	38 (100)	0	38 (100)	
	Total	3 (3.75)	81 (92.05)	4 (4.55)	88 (100)	0	88 (100)	
WFA z-score (UNDERWEIGHT)	Peripatetic	3 (2.29)	16 (12.21)	112 (85.50)	131 (100)	0	131 (100)	0.351
	Pastoralist	0 (0)	12 (14.29)	72 (85.71)	84 (100)	0	84 (100)	
	Total	3 (1.40)	28 (13.02)	184 (85.58)	215 (100)	0	215 (100)	
HC/A z-score (UNDERNUTRITION)	Peripatetic	1 (2)	0 (0)	49 (98)	50 (100)	0	50 (100)	0.354
	Pastoralist	0 (0)	1 (2.63)	37 (97.37)	38 (100)	0	38 (100)	
	Total	1 (1.14)	1 (1.14)	86 (97.73)	88 (100)	0	88 (100)	
MUAC/A z-score (ACUTE MALNUTRITION)	Peripatetic	1 (2.04)	12 (24.49)	36 (73.47)	49 (100)	0	49 (100)	0.000
	Pastoralist	10 (25.6)	17 (43.58)	12 (30.76)	39 (100)	0	39 (100)	
	Total	11 (12.50)	29 (32.95)	48 (54.54)	88 (100)	0	88 (100)	
MUAC/A 5-10 years (ACUTE MALNUTRITION)	Peripatetic	0	5 (6.17)	NA	5 (6.17)	76 (93.83)	81 (100)	0.594
	Pastoralist	0	4 (8.70)	NA	4 (8.70)	42 (91.30)	46 (100)	
	Total	0	9 (7.09)	NA	9 (7.09)	118 (92.91)	127 (100)	
MUAC/A 10-16 years (ACUTE MALNUTRITION)	Peripatetic	11 (22.4)	30 (61.22)	NA	41 (83.6)	8 (16.3)	49 (100)	0.354
	Pastoralist	5 (13.88)	27 (75)	NA	32 (88.88)	4 (11.11)	36 (100)	
	Total	16 (18.82)	57 (70.12)	NA	73 (85.8)	12 (14.11)	85 (100)	
BFA z-score (Acute Malnutrition/Thinness)	Peripatetic	7 (3.89)	171 (95)	NA	178 (98.88)	2 (1.11)	180 (100)	0.167
	Pastoralist	6 (5)	110 (91.67)	NA	116 (96.66)	4 (3.33)	120 (100)	
	Total	13 (4.33)	281 (93.67)	NA	294 (98)	6 (2)	300 (100)	

Stunting, wasting and underweight level by type of nomadism as measured by WFA % median, WFH %age median and HFA % median

Underweight status as measured by WFA % median, revealed that both nomadic groups showed similar patterns of malnutrition (p=0.777). The peripatetic group showed 26.51% moderate malnutrition, while pastoralists demonstrated comparable figures of 28.57%. Notably, neither group exhibited severe or mild malnutrition categories in this index (table 4).

The stunting analysis (HFA) revealed a comprehensive distribution across malnutrition categories, though differences between groups were not statistically significant (p=0.271). The peripatetic and pastoralists group presented a comparable varying range of malnutrition (0.83% severe to 35.56% mild (table 4).

The most striking differences between the groups were observed in wasting (WFH), showing statistically significant variations (p=0.007). The Peripatetic group showed no severe malnutrition, 6% moderate malnutrition, and 94% mild malnutrition, with no individuals in the adequate or normal categories. In contrast, Pastoralists demonstrate 5.26% severe malnutrition, 7.89% moderate malnutrition, 71.05% mild malnutrition, and 15.79% adequately nourished. This significant difference suggests distinct nutritional patterns between the two nomadic lifestyles (table 4).

Table 4

Stunting, Wasting and underweight level by Type of Nomadism as measured by WFA % of median, WFH %age of median and HFA % of median.

Malnutrition index	Type of Nomadism	Malnutrition levels N (%)					Normal N (%)	Total N (%)	p-value for Pearson chi-square	Chi square
		Severe malnourished N (%)	Moderately malnourished N (%)	Mild malnourished N (%)	Adequate malnourished N (%)	Total malnourished N (%)				
WFA % of median Underweight	Peripatetic	0 (0)	35 (26.51)	0 (0)	0 (0)	35 (26.51)	97 (73.48)	132(100)	0.777	0.0802
	Pastoralist	0 (0)	23 (28.57)	0 (0)	0 (0)	23 (28.57)	60 (72.28)	83 (100)		
	Total	0 (0)	58 (26.96)	0 (0)	0 (0)	58 (26.96)	157 (72.54)	215 (100)		
HFA % of median Stunting	Peripatetic	3 (1.67)	4 (2.22)	64 (35.56)	109 (60.56)	180 (100)	0 (0)	180 (100)	0.271	5.1613
	Pastoralist	1 (0.83)	6 (5)	42 (35)	69 (57.50)	118 (98.33)	2 (1.67)	120 (100)		
	Total	4 (1.33)	10 (3.33)	106 (35.33)	178 (59.33)	268 (99.26)	2 (0.67)	270 (100)		

WFH % of median Wasting	Peripatetic	0 (0)	3 (6)	47 (94)	0 (0)	50 (100)	0 (0)	50 (100)		
	Pastoralist	2 (5.26)	3 (7.89)	27 (71.05)	6 (15.79)	38 (100)	0 (0)	38 (100)	0.007	11.9920
	Total	2 (2.27)	6 (6.82)	74 (84.09)	6 (6.82)	88 (100)	0 (0)	88 (100)		

DISCUSSION

Malnutrition was major health problem in the developing and underdeveloped countries. Malnutrition affects all population groups, but was more common in infants and children because of their high nutritional requirements for growth and development (Moridi *et al.*, 2009).

The percentage of malnourished children was highest in Asia with 70% of undernourished children living in this part of the world (Khor, 2003).

Pakistan has highest rates of child malnutrition and its progress in health and child malnutrition remains slower than in other countries of south Asia (Stoltzfus *et al.*, 2000). In Pakistan, among children of age <5, the vicious life cycle of malnutrition contributes to almost 35% childhood deaths while 33.03% were underweight, 53.38% were stunted and 11.52% were wasted (Finlay *et al.*, 2011).

In the present study, stunting prevalence was highest in nomadic camps of Malakand followed by Swat, Buner, Dir lower, Shangla and Dir Upper. Wasting and underweight prevalence was highest prevalence in Dir upper and in Dir Lower. Stunting, underweight and wasting prevalence on the basis of percentages of median showed similar results. Reasons for the differences in prevalence might be the sample size, environmental conditions and mode of living. The reference population for anthropometric measurement and the type of growth indices might compromise the conclusions drawn from studies.

Studies have been conducted to assess malnutrition in different areas of Pakistan, including rural areas of Khyber Pakhtunkhwa, Baluchistan and Sindh while urban areas of Punjab (Achakzai *et al.*, 2016, Ali *et al.*, 2015, Anwar *et al.*, 2006, Farid-Ul-Hasnain *et al.*, 2010, Gul *et al.*, 2013, Khan *et al.*, 2016, Laghari *et al.*, 2015, Mushtaq *et al.*, 2012, Riaz *et al.*, 2010). A study in Khyber Pakhtunkhwa province reported 12.5% children as severely stunted, 15% severely underweight and 7% as severely wasted in district Nowshera (Ali *et al.*, 2015), while the prevalence of malnourishment in Swat district was reported as high as 50% among which 14% were underweight, 8% were wasted and 8% were stunted (Khattak *et al.*, 2010).

In Sindh province, the situation of child malnutrition is alarming according to different studies. Isolated studies observed that 90% children among the child labor were malnourished in Karachi (Zainab *et al.*, 2016), 39% children were underweight, 48% were stunted and 16% were wasted in Thatta (Khan *et al.*, 2016), 66% children were malnourished in Sanghar (Laghari *et al.*, 2015), 61% children were malnourished in Dadu (Farid-Ul-Hasnain *et al.*, 2010) and 46% malnourished in four rural villages of Sindh (Anwar *et al.*, 2006). Only one study was observed to have been conducted in Quetta Baluchistan, which revealed that 48% children were stunted and 10% were wasted (Achakzai *et al.*, 2016).

In Punjab, on the other hand, most of the studies targeted only urban areas. They reported 24% children stunted and 11% underweight in Rawalpindi (Riaz *et al.*, 2010), 8% were stunted and 10% were wasted in Lahore (Mushtaq *et al.*, 2012). These findings highlight significant nutritional challenges across all districts, with particularly concerning rates of wasting and thinness. The statistically significant variations in MUAC measurements suggest that targeted interventions may be necessary for specific age groups and districts, particularly in areas showing higher prevalence of severe malnutrition. The study presents a complex nutritional landscape where different indices reveal varying aspects of malnutrition. The high prevalence of stunting and wasting, coupled with moderate levels of underweight status, suggests both chronic and acute malnutrition issues in the study population.

Prevalence of Malnutrition among types of nomadic population was also carried out but there are few to no studies available past studies. In terms of stunting (HFA z-score), both nomadic groups exhibited prevalence of malnutrition levels of (11 %,) in terms of wasting assessment (WFH z-score) showed a total prevalence of malnutrition (95.45 %) while Peripatetic nomads showed a higher prevalence (96%) compared to Pastoralists (86.84%). Acute malnutrition measured by (MUAC/A z-score) was (45.45 %) in which Pastoralists showed significantly higher rates of severe malnutrition (25.6%) compared to Peripatetic nomads (2.04%). Age-specific MUAC/A analysis revealed interesting patterns, where the 5-10 years age group had a low total prevalence of malnutrition while the 10-16 years age group, showed high rates of malnutrition (Peripatetic: 83.6%, Pastoralist: 88.88%).

These findings highlight the complex nature of malnutrition among nomadic populations, with different indices revealing varying patterns of nutritional deficiencies. The significant difference in MUAC/A z-scores suggests that Pastoralist communities might be more vulnerable to acute malnutrition compared to Peripatetic nomads, possibly due to differences in lifestyle, food access, or cultural practices. The high prevalence of malnutrition across multiple indices in both groups underscores the need for targeted nutritional interventions that consider the unique characteristics and challenges of each nomadic lifestyle. The age-specific variations in malnutrition also suggest the need for age-appropriate interventions, particularly for adolescents where malnutrition rates are notably high. The differences suggest a potential relationship between chronic malnutrition and parasitic infection susceptibility due to lack of hygienic practices, environmental hygiene, and nomadic way of life and food habits. Malnutrition increases susceptibility to infection as it interferes with the body's ability to produce antibodies and thus lowering immunity (Scrimshaw *et al.*, 1997).

The results emphasize the importance of comprehensive nutritional assessment using multiple

indices to identify and address various forms of malnutrition effectively. The high prevalence of malnutrition across multiple indices underscores the need for robust public health interventions including dewormin, with particular attention to preventing severe cases and managing the high prevalence of mild to moderate malnutrition among nomads across all districts. These findings would be helpful for health agencies to implement targeted control of helminthiasis by not only but also by monitoring malnutrition. The findings also suggest the need for sustained, long-term interventions to address the underlying causes of chronic malnutrition, particularly given the high prevalence of stunting and wasting.

Future research might focus on understanding the environmental, social, and cultural factors contributing to these nutritional patterns, particularly the significant differences in wasting between nomadic groups. Additionally, longitudinal studies could help elucidate the temporal dynamics of these nutritional indicators and their relationship to nomadic lifestyle changes.

REFERENCES

1. Achakzai, P., & Khan, R. (2016). Nutritional status and associated factors among children less than five years of age in tehsil Zarghoon town, District Quetta, Baluchistan. *Journal of Ayub Medical College Abbottabad*, *28*(1), 146-151. https://ayubmed.edu.pk/jamc/index.php/jamc/article/view/569
2. Ali, W., Ayub, A., & Hussain, H. (2015). Prevalence and associated risk factors of under nutrition among children aged 6 to 59 months in internally displaced persons of Jalozai Camp, District Nowshera, Khyber Pakhtunkhwa. *Journal of Ayub Medical College Abbottabad*, *27*(3), 556-559. https://jamc.ayubmed.edu.pk/index.php/jamc/article/view/256
3. Anwar, H. N., Zafar, M. I., & Hussain, S. (2006). Health screening of primary school children-a case study of district Sargodha-Pakistan. *Pak J Life soc sci*, *4*, 40-47. https://pjlss.edu.pk/pdf_files/2006_1&2/haq%20(40-47).pdf
4. Asad, N., & Mushtaq, A. (2012). Malnutrition in Pakistani children, its causes, consequences and recommendations. *JPMA. The Journal of the Pakistan Medical Association*, *62*(3), 311. https://pubmed.ncbi.nlm.nih.gov/22764481/
5. Bechir, M., Schelling, E., Hamit, M. A., Tanner, M., & Zinsstag, J. (2011). Parasitic infections, anemia and malnutrition among rural settled and mobile pastoralist mothers and their children in Chad. *EcoHealth*, *9*(2), 122-131. https://doi.org/10.1007/s10393-011-0727-5
6. Chaudhry, Z. H., Afzal, M., & Malik, M. A. (2004). Epidemiological factors affecting prevalence of intestinal parasites in children of Muzaffarabad district. *Pakistan Journal of Zoology*, *36*(4), 267-271. http://www.zsp.com.pk/pdf36/PJZ-165-03.pdf
7. De Onis, M., Dewey, K. G., Borghi, E., Onyango, A. W., Blössner, M., Daelmans, B., Piwoz, E., & Branca, F. (2013). The World Health Organization's global target for reducing childhood stunting by 2025: rationale and proposed actions. *Maternal & Child Nutrition*, *9*(S2), 6-26. https://doi.org/10.1111/mcn.12075
8. El-Awady, M., & Abed, N. (2017). A body shape index versus body mass index in the assessment of nutritional status among Egyptian primary school children infected with intestinal helminthiasis. *Sci J Public Health*, *5*, 13-18. https://doi.org/10.11648/j.sjph.s.2017050501.13
9. Farid-ul-Hasnain, S., & Sophie, R. (2010). Prevalence and risk factors for Stunting among children under 5 years: a community based study from Jhangara town, Dadu Sindh. *JPMA. The Journal of the Pakistan Medical Association*, *60*(1), 41-44. https://pubmed.ncbi.nlm.nih.gov/20055279/
10. Feleke, B. E. (2016). Nutritional status and intestinal parasite in school age children: A comparative cross-sectional study. *International Journal of Pediatrics*, *2016*, 1-8. https://doi.org/10.1155/2016/1962128
11. Ferdous, F., Das, S. K., Ahmed, S., Farzana, F. D., Latham, J. R., Chisti, M. J., Ud-Din, A. I., Azmi, I. J., Talukder, K. A., & Faruque, A. S. (2013). Severity of diarrhea and malnutrition among under five-year-Old children in rural Bangladesh. *The American Society of Tropical Medicine and Hygiene*, *89*(2), 223-228. https://doi.org/10.4269/ajtmh.12-0743
12. Finlay, J. E., Özaltin, E., & Canning, D. (2011). The association of maternal age with infant mortality, child anthropometric failure, diarrhoea and anaemia for first births: Evidence from 55 low- and middle-income countries. *BMJ Open*, *1*(2), e000226. https://doi.org/10.1136/bmjopen-2011-000226
13. Food and Nutrition Handbook UNHCR *Italy, Nutrition Division (OSN Via Cesare Giulio Viola, 68,* (2018).
14. Gilavand, A., Espidkar, F., & Gilavand, M. (2016). Investigating the impact of schools' open space on learning and educational achievement of elementary students. *Journal of Pediatric Perspectives*, *4*(4), 1663-1670.
15. Gizaw, Z., Woldu, W., & Bitew, B. D. (2018). Acute malnutrition among children aged 6–59 months of the nomadic population in Hadaleala district, Afar region, Northeast Ethiopia. *Italian Journal of Pediatrics*, *44*(1). https://doi.org/10.1186/s13052-018-0457-1
16. Gul, R., & Kibria, Z. (2013). PREVALENCE AND PREDETERMINANTS OF MALNUTRITION IN CHILDREN UNDER 3 YEARS OF AGE IN THE TWO RURAL COMMUNITIES OF PESHAWAR. *Khyber Medical University Journal*, *5*(4).
17. Haratipour, H., Sohrabi, M. B., Zolfaghari, P., Nezakati, E., Yahyaei, E., & Rezvani, S. (2016). The relationship between malnutrition and intestinal parasitic infections among preschool children in East area of Iran. *Journal of Pediatric Perspectives*, *4*(6), 2011-2018.
18. Khan, F., Saeed, K., Akhtar, N., Zeb, J., Ali, H., Khan, S. A., ... & Ayub, A. (2016). Anemia and iron deficiency anemia in school children of district Swat Khyber Pakhtunkhwa Pakistan. *J Entomol Zool Stud*, *4*(5), 366-8.
19. Khan, M. K., & Ali, S. (2010). Malnutrition and associated risk factors in pre-school children (2-5 years) in district Swabi (NWFP)-Pakistan. *Journal of Medical Sciences*, *10*(2), 34-39. https://doi.org/10.3923/jms.2010.34.39
20. Khor, G. L. (2003). Update on the prevalence of malnutrition among children in Asia. *Nepal Med Coll J*, *5*(2), 113-22.
21. Laghari, Z. A., Soomro, A. M., Tunio, S. A., Lashari, K., Baloach, F. G., Baig, N. M., & Bano, S. (2015). Malnutrition among children under five years in district Sanghar, Sindh, Pakistan. *Gomal Journal of Medical Sciences*, *13*(1).

https://www.gjms.com.pk/index.php/journal/article/view/570
22. Level and trend in child malnutrition UNICEF, WHO, WORLD BANK*World Health Organization (2023) 4.*
23. Moridi, G., & Fathi, M. (2009). Malnutrition in children under five in Iran. *Advances in nursing & midwifery*, *18*(64), 49-56. https://doi.org/10.22037/anm.v18i64.1208
24. Mushtaq, M. U., Gull, S., Mushtaq, K., Abdullah, H. M., Khurshid, U., Shahid, U., Shad, M. A., & Akram, J. (2012). Height, weight and BMI percentiles and nutritional status relative to the international growth references among Pakistani school-aged children. *BMC Pediatrics*, *12*(1). https://doi.org/10.1186/1471-2431-12-31
25. Riaz, R., Sultana, A., Hameed, S., Tehseen, I., & Sabir, S. A. (2010). Nutritional status of school going children. *J Rawalpindi Med Coll*, *14*(1), 51-4.
26. Scrimshaw, N., & SanGiovanni, J. (1997). Synergism of nutrition, infection, and immunity: An overview. *The American Journal of Clinical Nutrition*, *66*(2), 464S-477S. https://doi.org/10.1093/ajcn/66.2.464s
27. Solomons, N. W. (2007). Malnutrition and infection: An update. *British Journal of Nutrition*, *98*(S1), S5-S10. https://doi.org/10.1017/s0007114507832879
28. Stoltzfus, R. J., Tielsch, J. M., Chwaya, H. M., Montresor, A., Albonico, M., & Savioli, L. (2000). Malaria, hookworms and recent fever are related to anemia and iron status indicators in 0- to 5-y old zanzibari children and these relationships change with age. *The Journal of Nutrition*, *130*(7), 1724-1733. https://doi.org/10.1093/jn/130.7.1724
29. Svedberg, P. (2000). Anthropometric failure: Morbidity and mortality risks. *Poverty and Undernutrition*, 200-226. https://doi.org/10.1093/0198292686.003.0014
30. World Health Organization. (2009). WHO child growth standards and the identification of severe acute malnutrition in infants and children A Joint Statement. In *WHO child growth standards and the identification of severe acute malnutrition in infants and children A Joint Statement* (pp. 12-12). https://pesquisa.bvsalud.org/portal/resource/pt/biblio-1053405
31. Zainab, S., & Kadir, M. M. (2016). Nutritional status and physical abuse among the children involved in domestic labour in Karachi Pakistan: a cross-sectional survey. *JPMA. The Journal of the Pakistan Medical Association*, *66*(10), 1243. https://ecommons.aku.edu/pakistan_fhs_mc_chs_chs/318/