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Dietary Diversity, Childcare Practices and Nutritional Status of Pakistani Children: Evidence from a Middle-Income Country

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A B S T R A C T

Objectives: Improved quality of dietary diversity and care practices can play a significant role in alleviating child malnutrition in middle income countries such as Pakistan. Addressing this deficiency, the present study primarily aims to explore the influence of dietary diversity and care practices on children's height-for-age Z-scores (HAZ). Study Design: Multiple Indicator Cluster Survey based cross-sectional study in Pakistan for 2014. Methods: The response variable was Child's nutritional status in the form of HAZ as defined by UNICEF. Multivariate regression analysis was used to perform the analysis. This analysis included children aged 6-36 months (n= 8097). Results: Dietary diversity scores (DDS) and childcare practices (CCP) were found to be associated with child's nutritional status. Other identified significant predictors of HAZ were Child's age, residence, maternal education and wealth index. No subgroup differences in the relationship of DDS/HAZ and CCP/HAZ were observed by interaction analyses. Conclusions: Statistical significant associations of dietary diversity and childcare practices with child's nutritional status was found. This calls for further research in Pakistan to refine DD and CCP composition for children considering different socio-demographic settings before further strategies and recommendations for child growth and development.

Keywords: Childcare practices; Dietary diversity; Nutritional status; Regression; Socio-demographic.

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INTRODUCTION

World health organization and UNICEF documented that dietary diversity (DD) and childcare practices (CCP) are valid and reliable indicators of child nutrition and health [1, 2]. Other socio-demographic factors are also highlighted internationally to have a relationship with child's health and growth. Dietary diversity (DD) is defined as the total of all food groups consumed by a child within 24 hours [3, 4]. Hence, infants and children's nutrient intake is easily measurable by DD as a proxy factor [5]. WHO emphasizes that DD is vitally important to measure child feeding practices [1]. A strong and significant relationship has been proven repeatedly between DD and child growth for different socio-demographic communities [6, 7]. However, not enough research has been conducted to estimate the consistent level of association between CCP and child health for Pakistani children.

Childcare has a complex definition including a range of practices and manners given by primary care provider that supply food and nutrition, health care and psychological support for child's growth and development [8]. Being part of CCP, feeding practices including DDS and other feeding variables measure dietary and nutrition sufficiency and preventive healthcare practices assess adoptive protection from diseases. These practices evaluate child health, growth and development [9]. Earlier in 1999, Ruel *et al* assessed the

significance of child healthcare using composite childcare practices factor and found significant association between child care practices and nutritional status [10].

A significant association between socio-demographic status and health has been demonstrated in public health investigations. Low socio-demographic status is directly and positively related to reduce food security and lessened health care utilization [11]. A graded relationship between maternal education and child nutritional status was found for India and Pakistan [12, 13]. Area of residence (urban/rural) has also been established as a significant predictor of child growth [14].

Improved quality of dietary diversity and child care practices can play a significant role in alleviating child malnutrition in low and middle income countries such as Pakistan; although there is ample discussion on this issue for developed countries, there have been limited research studies to explore the situation of dietary diversity, care practices and nutritional status of children belonging to a specific middle income country. The present paper primarily aims to explore the association of DDS and CCP with child's height-for-age Z-scores (HAZ) in Pakistani children representing conditions of middle income countries. The secondary objective was to examine the deviation of influence of dietary diversity and childcare practices on child's growth for socio-demographically dissimilar subgroups. Improved quality of dietary diversity and child care practices can play a significant role in alleviating child malnutrition in low and middle income countries. Pakistani child represents nutritional status of middle income countries children. The deviation of influence of dietary diversity and childcare practices on child's growth for socio-demographically dissimilar subgroups is studied. Association between dietary diversity separately as a decomposed factor of childcare practices and nutritional status is addressed.

METHODS

Data sources

The most recent UNICEF's Multiple Indicator Cluster Survey (MICS) data for Pakistan collected in 2014 were used for the analysis after official permission of MICS authorities which is available for only two provinces. The Pakistan Bureau of Statistics collected the data for two major provinces including Punjab and Sindh. Electronic Seca scales were used for weight measurements and measuring board was used for height measurements. For height, standing board was used for children older than 24 months and lying height was measured for younger children. The selected participants were those samples who had complete anthropometry data. Hence, 8097 children aged 6-36 months, born to mothers aged 15-49 years were included in this study.

Outcome variable

Child's nutritional status was the response variable for this analysis. Height-for-age Z-scores (HAZ) were used as an indicator of child's nutritional status.

DDS and CCP measurement

The dietary diversity (DD) indicator was created using data from the 24 hours recall of food groups available in the MICS data sets. Based on recommended procedure, the DD indicator was constructed by regrouping food types into seven main categories: (1) dairy products; (2) grains, roots and tubers; (3) flesh foods and organ meats; (4) legumes and nuts; (5) eggs; (6) Vitamin A-rich fruits and vegetables; (7) other fruits and vegetables. The mothers reported child's consumption of 7 food groups. All food groups were coded as 1 for child's consumption and 0 for non-consumption. DD score was obtained by summing up the values of all food groups ranging from 0 to 7 and in subsequent analyses treated as a continuous predictor variable.

CCP score was created by using feeding practice variables and preventive health service utilization. The preventive health care variables were polio vaccination; at birth, polio1, polio2, polio3, BCG vaccination, Pentavalent vaccination; 1^{st} dose, 2^{nd} dose, 3^{rd} dose, measles vaccination; 1^{st} dose, 2^{nd} dose. The feeding practices variables included dietary diversity scores (DDS), breast feeding and frequency of solid or semisolid food. DDS is used as independent predictor variable as well as used to compose CCP. DD score, two other above mentioned feeding variables and health care variables were used to create the child care practices (CCP) score, which was also used as a continuous predictor variable in the analysis. After extensive review of literature, maternal education, urban/rural place of residence, wealth Index, child's sex and child's age were also selected as explanatory variables for this analysis.

Statistical analysis

The authors used the UNICEF basic framework and an extended model to structure the hierarchical multiple regression analyses for child growth and development [2, 15]. The basic framework mentioned food, health and care as most important components influencing child's development. The extended model reclassified the above components as basic, context and resources variables. The multivariate analysis contained four models. The first Model (A) involved the basic characteristics of the child and context variables to establish the effects of these

determinants on HAZ. Model A has the form;

HAZ=a+b_1*child's age +b_2*child's sex+ b_3*place of residence

The second model (B) contained resource variables in the model along with the basic and context variables. Model B has the form;

HAZ= a+b_{1*} child's age +b_2*child's sex+ b_3*place of residence +b_4* maternal education+b_5*

wealth index

Model C introduced the DDS, controlling for basic, context and resource variables. Model C has the form;

HAZ= a+b_{1*} child's age +b_2*child's sex+ b_3*place of residence +b_4* maternal education + b_5* wealth index + b_6 * DDS

The final model (D) introduced CCP score and excluded DDS. Model D has the form;

HAZ= a+b_{1*} child's age +b_2*child's sex+ b_3*place of residence +b_4* maternal education+b_5*

wealth index + b_6 * CCP

Interaction effects of DDS and CCP with other predictor variables were examined as previous studies [7, 10] documented significant interactions of DDS and CCP with other socio-demographic factors.

RESULTS

Characteristics of the study sample

Descriptive statistics were shown in Table 1 and 2. The average HAZ of the children included in the analysis was 1.42 (SD=1.37), the weight-for-age Z-score (WAZ) and weight-for-height Z-score (WHZ) were 1.40 (SD=3.58) and 0.61 (SD=6.72) respectively. The mean age of children was about 19 months. The mean feeding frequency of the child with solid, semisolid or soft food within past 24 h was 3.46. The mean dietary diversity score for a child was 4.00. Breast feeding ratio was below average for the observed data (46.9 %). High immunization rates were observed for this study population. High proportion of children received polio vaccination given at birth (97 %), 97.2% received polio 1, 93.8% received polio 2 and 88.5% received polio 3 vaccination. At the time of birth, BCG vaccination rate was 99.3 %. Additionally, 97.5 % children had vaccinated pentavalent 1, 93.7 % had vaccinated pentavalent 2 and 88.4 % received pentavalent 3. Preventive health care service utilization further showed that 72.6 % children had received measles 1 vaccinations and 45.3 % children had received measles 2 vaccinations. A high proportion of mothers (59.4 %) were rural area resident. While 38% of the mothers were illiterate or having no formal education.

Bivariate statistical analysis

Bivariate statistical analysis was performed to examine the relationship of DDS and CCP with children's nutritional status. A positive association between dietary diversity and child's HAZ (β=0.04, t=6.09, p<0.001) was observed. Statistically significant association between CCP and Children's nutritional status was also found (β=0.02, t=5.00, p < 0.001).

Table 1: Characteristics of the sample (N=8097), continuous variables.

Variables	Mean	SD
Child's HAZ	-1.42	1.37
Child's WAZ	-1.40	3.58
Child's WHZ	-0.61	6.72
Child's age	18.68	8.33
Number of times the child ate solid, semisolid or soft food (previous day)	3.46	1.68
Dietary diversity score for child	4.00	2.09

HAZ, height-for-age Z-scores; WAZ, weight-for-age Z-scores; weight-for-age Z-scores; WHZ, weight-for-height Z-scores.

Table 2: Characteristics of the sample (N=8097), categorical variables.

Characteristics	N	Per cent
Still breast feeding (yes)	3796	46.9
Sex of child (Male)	4231	52.3
Female	3866	47.7
Use of preventive health service		
Received polio at birth (yes)	7889	97.4
Received polio 1 (yes)	7872	97.2
Received polio 2 (yes)	75994	93.8
Received polio 3 (yes)	7167	88.5

Received BCG (yes)	8042	99.3
Received pentavalent 1 (yes)	7897	97.5
Received pentavalent 2 (yes)	7589	93.7
Received pentavalent 3 (yes)	7161	88.4
Received measles 1 (yes)	5879	72.6
Received measles 2 (yes)	3671	45.3
Maternal education (No education)	3081	38.1
Primary	2613	32.3
Secondary and higher	2403	29.7
Place of residence (Urban)	3285	40.6
Rural	4812	59.4
Wealth index (Richest)	1506	18.6
Rich	1843	22.8
Middle	1997	24.7
Poor	1617	20.0
Poorest	1134	14.0

Multivariate regression analysis of the determinants of children's nutritional status

Table 3 presented the results of the multivariate regression analyses. Basic and contextual factors were observed to be significant predictors of HAZ in model A. A significant but negative relationship of child's age and place of residence with HAZ was found, only sex of child was observed to be a non-significant factor. Model B analyzed the effects of resource variables in the presence of basic and contextual factors. The resource variables were significant factors of HAZ showing that maternal education and wealth index were positively associated with child's HAZ. The effects of DDS and CCP were tested in last two models and both were found significantly associated with HAZ after controlling for other factors. Child's HAZ was increased by 0.04-unit by a 1-unit increment in DD score. Similarly, Child's HAZ was increased by 0.02-unit by a 1-unit increase in CCP. Using variance inflation factor (VIF), multicollinearity was assessed in the data and no variable evidenced multicollinearity (VIF <3). An interaction analysis was performed to determine whether socio-demographic subgroups influence on the importance of DD and CCP on HAZ. Interaction analysis between DD variable and child's sex, place of residence, maternal education and wealth index was carried out. Moreover, interaction analysis between CCP variable and child's sex, place of residence, maternal education and wealth index was executed. No statistically significant interaction effect was found.

Table 3: Multivariate regression analysis of determinants of nutrational status of children in Pakistan, aged 6-36 months.

	Model I		Model II		Model III		Model IV	
Variables	Coefficients (SE)	t-Statistics	Coefficients (SE)	t-Statistics	Coefficients (SE)	t-Statistics	Coefficients (SE)	t-Statistics
Child's age	-0.03(0.002)	-19.32*	-0.03(0.001)	-19.79*	-0.04(0.002)	-20.48*	-0.04(0.002)	-20.50*
Sex of child Female	0.06(0.03)	1.87	0.06(0.03)	1.98*	0.06(0.03)	2.00	0.06(0.03)	1.96
Place of residence Rural	-0.25(0.03)	-8.20*	0.14(0.03)	4.37*	0.14(0.03)	4.26*	0.13(0.03)	4.03*
Maternal education Primary			0.19(0.04)	5.21*	0.18(0.04)	5.02*	0.18(0.04)	4.90*
Secondary and higher			0.44(0.04)	10.01*	0.42(0.04)	9.46*	0.41(0.04)	9.40*

Wealth index						
Poor	0.22(0.05)	4.35*	0.21(0.05)	4.18*	0.20(0.05)	4.09*
Middle	0.38(0.05)	7.48*	0.36(0.05)	7.14*	0.36(0.05)	7.00*
Rich	0.62(0.06)	11.05*	0.58(0.06)	10.38*	0.57(0.06)	10.17*
Richest	0.92(0.06)	14.30*	0.87(0.06)	13.49*	0.86(0.06)	13.29*
DDS			0.04(0.007)	5.25*		
CCP					0.02(0.004)	5.70*

*Statistically significant at $p<0.001$.

DISCUSSION

This study investigated the influence of DDS and CCP on children's HAZ in the presence of basic, contextual and resource confounding factors as proposed by the UNICEF. The deviation of influence of dietary diversity and childcare practices on child's growth for socio-demographically dissimilar subgroups was also examined. Regarding the first objective, association between DDS and HAZ was observed initially which remained substantial after considering levels of other basic, context and resource factors. Moreover, CCP was also found strongly associated with child's HAZ in the multivariate analysis. With regard to the second objective, interaction analyses evidenced no significant difference in the DD/HAZ and CCP/HAZ relation due to different subgroups on the basis of socio-demographic features. The finding on the DDS/HAZ association is consistent with former studies in the literature. Amugsi *et al.* observed a positive influence of DDS on children's nutritional status in Nigeria and Democratic Republic of Congo [16]. A study by Sealey-Potts and Potts in Tobago also found a significant association between DDS and nutrient adequacy rates [17]. Arimond and Ruel conducted an extended study to examine the association between dietary diversity and HAZ by using data from 11 countries and evidenced that there is a significant relationship between dietary diversity and child's nutritional status in Ethiopia, Mali, Rwanda, Zimbabwe, Cambodia, Nepal, and Colombia regardless of a child's sociodemographic profile. The findings of the study also suggested that diet quality can be measured by dietary diversity [7]. Previous studies reported significantly positive relationship between DD and child's nutritional status also in Kenya [18], Haiti [19], China [20] and Philippines [21]. Conversely, some other studies conducted in Ghana, Kenya, Mozambique [16] and Niger [22] did not find a significant association between dietary diversity and child's nutritional status concluding that child's nutritional status may not be effectively influenced by DD in these settings. However, despite different methodological techniques and domains, most studies observed significantly positive association between DD and nutritional status suggesting robustness of this relationship.

The finding on the significant association between CCP and HAZ is in line with former studies [14, 23, 24] for a range of countries and populations with different dietary and health care patterns. Amugsi *et al* observed significantly positive association between CCP and HAZ in Ghanaian children, after controlling for other confounders [14]. Range *et al* used deviant technique to examine the relationship between CCP and nutritional status and found significant influence of care practices on children's nutritional status in Bangladesh [23]. A study by Iram et al in Pakistan empirically quantified the important determinants of nutritional status of preschoolers. Interestingly, Childcare practices were found significant but negatively associated with nutritional status. However, the study was limited to employ child calorie adequacy ratio as a proxy of nutritional status [24]. The validity of association between childcare practices and child's nutritional status was proven by the fact that most studies reported the significantly positive influence of CCP on nutritional status, in spite of diversity in socio-demographic settings and analyses approach.

This study used the UNICEF framework for childcare to highlight the important factors that affect childcare and development. The analysis posits that child growth is determined not only by dietary diversity but access to health services and other social facilities is also important. The present investigation decomposed CCP to enable separate analyses of dietary diversity features of childcare. This indicates that for optimum child health and development, strategies should not be restricted only to the provision of dietary diversity but must also focus the promotion of health care and high quality care practices utilization.

Analyses of interaction terms did not formulate significant results in this observed data, indicating that no subgroup affect the importance of DD and CCP on child's nutritional status. Arimond and Ruel conducted a study in 11 countries

to examine main as well as confounding effects of dietary diversity and other factors on child's nutritional status. They observed that the results of interaction analyses were not consistent across countries and no significant interactions were found in 4 countries. The study found contrary results for some other countries where older children were more likely to benefit from better dietary diversity compared to younger children whereas stronger association between DD and HAZ among younger children or those from urban areas was also reported for only one country [7]. The finding regarding confounding effect on the relationship of CCP/HAZ is in line with a previous study. Amugsi *et al.* conducted interaction analyses and observed no subgroup deviation on the association between CCP and HAZ. Another former study found opposite findings suggesting stronger association between CCP and nutritional status for children of less educated mothers and/or belonging to poorer families compared to other subgroups [10]. Dissimilar interaction results may be due to the difference in local diet patterns, available health facilities and sample composition.

The main strength of this study is the utilization of reliable and authentic nationally representative cross-sectional data for analysis to make it possible to generalize these findings to entire Pakistan and other middle income countries. Another important strength of this study is that DDS has also been examined separately as decomposed factor of CCP which explained the well-defined relationship between DDS and nutritional status.

A limitation of this analysis is the inclusion of variables used to create CCP. The analysis has home-based reasonable feeding and care practices variables but the access to health care services, household hygiene and environmental variables was not so much sufficient. Additional research is essential to address the construction of universally applicable comprehensive components of childcare practices.

CONCLUSIONS

The current study used multiple regression analyses to estimate the effects of child DD and CCP on child's HAZ and observed significantly positive effect of DD and CCP on child's HAZ after considering other important socio-demographic determinants of child care. All components of dietary diversity and composite childcare practice might be considered to ameliorate nutritional status for optimizing the children care quality in Pakistan. This calls for research to address the methodological problems related to the composition of dietary diversity and care practices indicators as not enough literature is available for low and middle income countries.

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