ORIGINAL ARTICLE

Frequency and distribution of co-morbidities in protein energy malnutrition children admitted in nutrition unit DHQ Hospital, District D.I. Khan, Pakistan.

Muhammad Ibrahim[1], Farid Ullah[2], Fawad Ahmed[3], Fazal Ur Rehman[4], Sher Ullah[5], Muhammad Ilyas[6]

ABSTRACT… Objective: To determine frequency and distribution of co-morbidities by type, age groups and gender in PEM children. **Study Design:** Cross-sectional study. **Setting:** Department of Pediatric (Nutrition Unit) and Community Medicine, GMC. **Period:** 15-8-2022, to 30-12-2022. **Material & Methods:** Data for diagnosed PEM cases was retrieved from Nutrition Unit DHQ Hospital DI Khan for which non-probability consecutive sampling technique was used. Research variable was type of comorbidities while demographics variables were age groups and gender. Association of gender and age groups with the presence or absence of co-morbidities in PEM children were found using Chi Square test. **Results:** Out of 400 participants, most frequent co-morbidity was gastroenteritis (GE) in 157(39.3%) patients in which females were 87(55.41%) and males 70(44.58%). 101(64.33%) were in 1–5-year age group and 56(35.66%) in under 1 year. Second to GE was pneumonia with 84(21%) patients in which females were 45(53.57%) and males 39(46.42%). Pneumonia in 1-5 year affected 61(72.61%) and 23(27.38%) patients were less than 1 year. Anemia affected 74(18.5%) patients in which females were 45(60.81%) and males 29(39.18%). 58(78.37%) patients were in 1-5 years and 16(21.62%) in less than 1 year. Other co-morbidities were seen in small number of patients. Difference in age groups were statistically significant at p-value of 0.005006 ($<$0.05) while there was no association of gender with comorbidities at p-value of 0.459344 ($>$0.05). **Conclusion:** Most common comorbidities were GE, pneumonia and anemia and their prevalence was higher in females and 1–5-year age group.

Key words: Co-morbidities, Gastroenteritis, Protein Energy Malnutrition.

INTRODUCTION
"Protein energy malnutrition (PEM) is defined as an unintentional loss of 10% or more of body weight in a period of six months or less and/ or serum albumin levels of less than 3.5 grams per deciliter (g/dl) (Hudson et al., 2000)".[1]

Global Nutrition Report reports 149.2 million children less than 5 years are stunted and 45.4 million are wasted.[2,4] Annually 250,000 people, including, children and adult, die of PEM.[3] Approximately 45% of children under 5 die due to malnutrition.[4] These children mostly belong to middle- and low-income countries.[4] 2016-25 decade is declared as United Nations Decade of Action on Nutrition.[4]

Global prevalence of stunting is as follows: West and Central Africa 32.5%, East and Southern Africa 32.3%, South Asia 31.8%, Middle East and North Africa 15.8%, East Asia and Pacific 13.5%, Latin America and Caribbean 11.3%, Eastern Europe and Central Asia 8.1%, Europe and Central Asia 5.7%, North America 3.2% Western Europe 2.8%.[5,6] In 2020 stunting affected 22% children under 5 globally.[5,6] Two studies on Dera Ismail Khan Children have been conducted whose results are as follows. Out of 1338 school going children - 13.39% underweight, 72.15% normal weight, 8.83% overweight and 5.61% obese.[7] Girls were more underweight (25%) compared to boys (13.22%).[7] In another study 22.95% obese children are identified as having metabolic syndrome. Out of 19.67% were obese

1. MBBS, FCPS, Assistant Professor Pediatric, DHQ Hospital, D.I. Khan.
2. MBBS, FCPS, Assistant Professor Pediatric, DHQ Hospital, D.I. Khan.
3. Final Year MBBS Student, Gomal Medical College, D.I. Khan.
4. MBBS, Demonstrator Community Medicine, Gomal Medical College, D.I. Khan.
5. Final Year MBBS Student, Gomal Medical College, D.I. Khan.
6. Final Year MBBS Student, Gomal Medical College, D.I. Khan.

Correspondence Address:
Dr. Fawad Ahmed
Gomal Medical College, D.I. Khan.
fawad.ahmed.792740@gmail.com

boys and 3.27% were girls.[8]

According to National Nutrition Survey Pakistan 2018, prevalence of malnutrition is more in boys than girls and among them urban areas are more affected.[9],[10] Obesity follows same trend in both genders irrespective of locality.[9],[10] Prevalence of Malnutrition (Children under Five) is as: Stunted 40.2%, Wasted 17.7% Overweight 9.6%, Underweight 28.9%.[9],[10]

In Asia 70% of children are malnourished.[11] In Lahore prevalence of PEM is 52.8% out of 400.[11] Prevalence of PEM according to an Indian study by Narendra K. Bagri et al. is 57.2% which resulted in overall mortality of 38.8%.[12]

PEM is divided into following types: Kwashiorkor (protein malnutrition predominant), Marasmus (deficiency in calorie intake) and Marasmic kwashiorkor (having both protein and calories deficiency).

Malnutrition is broadly subdivided into 4 subcategories: wasting, stunting, underweight, and deficiencies in vitamins and minerals.

We don't know frequency and distribution of co-morbidities in PEM children in District D.I. Khan, Pakistan. Relevant research documents regarding our research problems cannot be retrieved through online search via different search engines and databases for these problems.

Rationale of our study is that this present study is first attempt to determine frequency and distribution of co-morbidities in PEM children in District D.I Khan, Pakistan.

Objectives of our research project were to determine frequency of co-morbidities by type, age groups and gender in PEM children in sample and population.

MATERIAL & METHODS

This cross-sectional study was conducted in Departments of Pediatric (Nutrition Unit) and Community Medicine, GMC, D.I Khan, Pakistan from Aug-15th, 2022, to Dec-30th, 2022. This project

was approved by "Ethical Review Committee of GMC" (5442/Research). Target population was children up to age of 5 years in District D.I. Khan. Non-probability consecutive sampling technique was used. Population at risk of District D.I. Khan was 313,068 (census 2017).[13] For year 2022, it is estimated to be around 357,866.[14],[15] According to Rao soft sample size calculator, for population of 357,866 with confidence interval of 95%, margin of error 5% and response rate of 50%, our sample size should have to be at least 384. Data for PEM was retrieved from Nutrition Unit DHQ Hospital DI Khan.

Research variable of study was types of co-morbidities in PEM children admitted in Nutrition Unit DHQ Hospital, D.I Khan. Demographic variables were age groups with two attributes (Under 1 year and 1 to 5 years) and sex with two attributes (Male & Female). Distribution of sample was analyzed through descriptive statistics i.e., percentages, frequencies and distribution for population was analyzed through inferential analysis by estimation of population parameter including confidence intervals for proportions at 95% confidence level using normal approximation method through an online statistical calculator "Statistics Kingdom". Association of gender and age groups with the presence or absence of co-morbidities in PEM children were found using Chi Square test.

Inclusion and Exclusion Criteria

Inclusion criteria for sample collection was all pre-diagnosed patients of PEM up to 5 years of age for both males and females. No subject was excluded.
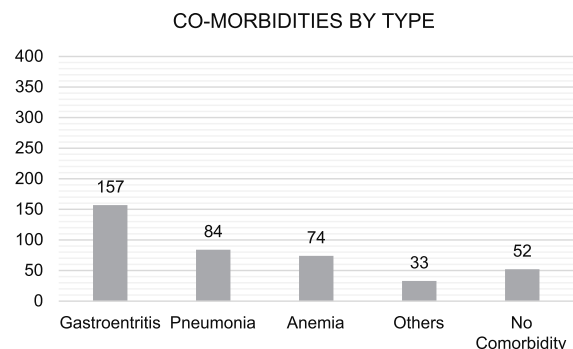

Figure-1. Distribution of co-morbidities by type

Name of Co-Morbidities	Sample Statistics	95% CI for Proportion	
	Frequency (%)	Lower	Upper
Comorbid Cases	348 (87%)	83.70	90.30
Comorbidity Free Cases	52 (13%)	9.70	16.30
Gastroenteritis	157 (39.3%)	34.46	44.24
Pneumonia	84 (21.0%)	17.17	25.39
Anemia	74 (18.5%)	14.88	22.73
Non-Focal Pyrexia	4 (1.0%)	0.32	2.71
Febrile Fits	6 (1.5%)	0.61	3.40
Tuberculosis	1 (.3%)	0.01	1
Urinary Tract Infections	21 (5.3%)	3.35	8.03
Meningitis	1 (.25%)	0.6	3.4

Table-I Frequency of Co-Morbidities

Name of Co-Morbidity	Sample Statistics		95% CI for Proportion			
	Gender		Male		Female	
	Male	Female	Upper	Lower	Upper	Lower
Comorbid Cases	146(36.5%)	202(50.5%)	31.78	41.22	45.6	55.4
Comorbidity Free Cases	19(4.75%)	33(8.25%)	42.61	52.39	78.78	86.22
Gastroenteritis	70(44.58%)	87(55.41%)	39.66	49.60	50.38	60.32
Pneumonia	39(46.42%)	45(53.57%)	41.46	51.44	48.54	58.52
Anemia	29(39.18%)	45(60.81%)	34.39	44.17	55.81	65.59
Non-Focal Pyrexia	2(50%)	2(50%)	44.99	55.00	44.99	55.00
Febrile Fits	1(16.66%)	5(83.33%)	13.21	20.75	79.22	86.77
Tuberculosis	1(100%)	0(0%)	100	100	0.00	1.1
Urinary Tract Infections	4(19.04%)	17(80.95%)	15.37	23.30	76.68	84.61
Meningitis	0(0%)	1(100%)	0.00	1.1	100	100

Table-II. Distribution of co-morbidities by gender

Name of Co-Morbidity	Sample Statistics		95% CI for Proportion			
	Age Groups		Age Groups			
	Below 1 Year	1-5 Years	Below 1 Year		1-5 Years	
Comorbid Cases	100(25%)	248(62%)	20.76	29.24	57.24	66.76
Comorbidity Free Cases	25(6.25%)	27(6.75%)	3.87	8.62	4.29	9.20
Gastroenteritis	56(35.66%)	101(64.33%)	31.00	40.59	59.39	68.98
Pneumonia	23(27.38%)	61(72.61%)	23.12	32.07	67.91	76.86
Anemia	16(21.62%)	58(78.37%)	17.75	26.04	73.94	82.24
Non-Focal Pyrexia	0(0%)	4(100%)	0.0	1.18	100	100
Febrile Fits	1(16.66%)	5(83.33%)	13.21	20.75	79.22	86.77
Tuberculosis	0(0%)	1(100%)	0.0	1.18	100	100
Urinary Tract Infections	3(14.28%)	18(85.71%)	11.07	18.18	81.80	88.91
Meningitis	1(100%)	0(0%)	100	100	0.00	1.18

Table-III. Distribution of Co-Morbidities by age groups

Gender			Age Groups		
Attributes	Frequency	Percent	Attributes	Frequency	Percent
Male	174	43.5	Below 1 Year	125	31.25
Female	226	56.5	1-5 Year	275	68.75
Total	400	100.0	Total	400	100

Table-IV. Distribution by gender and age groups

|	Comorbid Cases	No Comorbidities	Marginal Row Totals
Male	146 (143.55) [0.04]	19 (21.45) [0.28]	165
Female	202 (204.45) [0.03]	33 (30.55) [0.2]	235
Marginal Column Totals	348	52	400
The chi-square statistic is 0.5475. The p-value is 0.459344. Not significant at p < .05.			
Table-V. Association of gender with comorbidities in PEM children			
	Comorbid Cases	**No Comorbidities**	**Marginal Row Totals**
Below 1 Year	100 (108.75) [0.7]	25 (16.25) [4.71]	125
1-5 Years	248 (239.25) [0.32]	27 (35.75) [2.14]	275
Marginal Column Totals	348	52	400
The chi-square statistic is 7.8772. The p-value is .005006. Significant at p < .05.			
Table-VI. Association of age groups with comorbidities in PEM children			
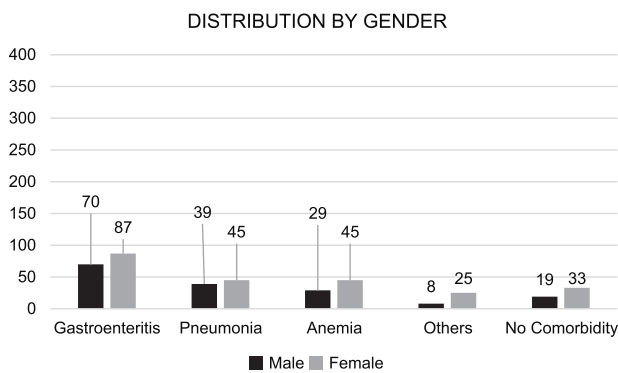
Figure 2 - Distribution of Co-morbidities by Gender
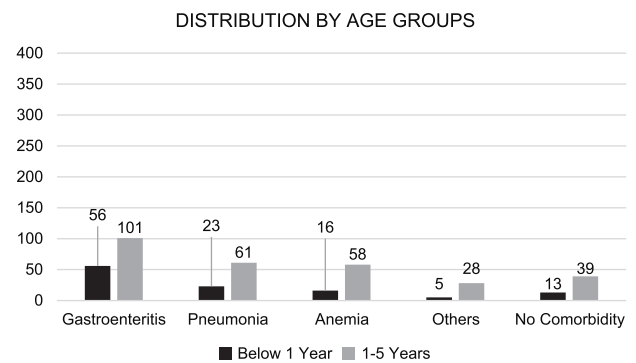
Figure-3. Distribution of co-morbidities by age group
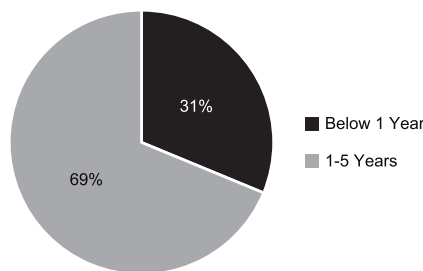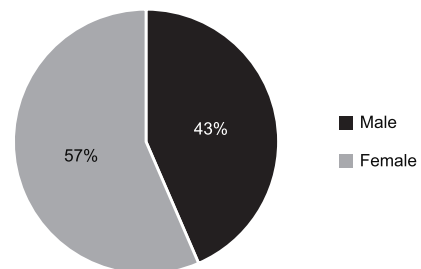

Figure 4 - Distribution of Age Groups

Figure 4 - Distribution of Gender

RESULTS

Out of 400 participants, 174(43.5%) among them were males and 226(65.5%) were females (Table-IV, Figure-5). 125(31.25%) of whom were under 1 year and 275(68.75%) were in 1-5 years (Table-IV, Figure-4). 348(87%, 95%CI: 83.70-90.30) Patients were comorbid with different comorbidities and 52(13%, 95%CI: 9.70-16.30) patients were free of any comorbidity (Table-I, Figure-1).

Most frequent co-morbidity was gastroenteritis (GE) affecting 157(39.3%, 95%CI:34.46-44.24) patients (Table-I, Figure-1). GE was more prevalent in females 87(55.41%, 95%CI:50.38-60.32) than males 70(44.58%, 95%CI:39.66-49.60) (Table-II, Figure-2). GE was reported more in 1–5-year age group in 101(64.33%, 95%CI:59.39-68.98) compared to under 1 year age group 56(35.66%, 95%CI:31.00-40.59) (Table-III, Figure-3).

Second most common co-morbidity was pneumonia in 84(21%, 95%CI:17.17-25.39) (Table-I, Figure-1) which affected females

45(53.57%, 95%CI:48.54-58.52) more than males 39(46.42%, 95%CI:41.46-51.44) (Table-II, Figure-2). Pneumonia was higher in 1-5 age groups 61(72.61, 95%CI:67.91-76.86) than in under 1 year age group 23(27.38%, 95%CI:23.12-32.07) (Table-III, Figure-3).

Anemia affected 74(18.5%, 95%CI:14.88-22.73) (Table-I, Figure-1) which is more in females 45(60.81%, 95%CI:55.81-65.59) than males 29(39.18%, 95%CI:34.39-44.17) (Table-II, Figure-2). Anemia appeared more in 1-5 years age group 58(78.37%, 95%CI:73.94-82.24) than in under 1 year age group 16(21.62%, 95%CI:17.75-26.04) (Table-III, Figure-3).

Other co-morbidities (Non-Focal Pyrexia, Febrile Fits, Tuberculosis, UTI and meningitis) were seen in small number of patients (Table-I, Figure-1).

Chi-square test of association was used to asses any statistically significant association of age groups and gender with comorbidities in PEM children. Difference in age groups were statistically significant at p-value of 0.005006 (<0.05) (Table-VI) while there was no association of gender with comorbidities at p-value of 0.459344 (>0.05) (Table-V).

DISCUSSION
PEM is grave challenge for world especially for low-income countries. PEM is not only associated with co-morbidities and mortality but also with sky rocketing health costs. Michael Müller etal. in their book "Mangelernährung in Deutschland" claims that malnutrition costs Germany 9 billion Euros annually.[16] Intensity of problem is such that UNO allocated first MDG to it. Our study emphasizes the problem in D.I. Khan.

In our study GE is most frequent co-morbidity in PEM children which can be endorsed from study by Ubesie etal. which indicates GE (Diarrhea) in 48(72.2%) patients compared to ours in 157(39.3%).[17] This data when compared with recent data indicates that GE as a co-morbidity in PEM has decreased significantly. This argument is also supported by Dechenla Bhutia.[18] Arun Kumar Arya etal. also reports of GE in

73(36.5%).[19] Study by Desire Banga etal. in 2020 showed GE in 73(21.56%, 95%CI:17.40-26.44) which also indicates that world is progressing towards improvement regarding PEM.[20] Diarrhea is also reported as most common co-morbidity by Chala Diro etal.[21] Arun Kumar Arya etal. also reports of Acute respiratory tract infections in 53(26.5%).[19] Study from Faisalabad reports diarrhea in 10(21.7%).[22] In our results next most frequent co-morbidity is pneumonia. Study by Desire Banga etal. reported pneumonia in 127(37.35%, 95%CI:32.23-42.75) patients which is higher than ours 84(21%, 95%CI:17.17-25.39) (Table-I).[20] Study by Ubesie etal. reported pneumonia in 11(16.7%).[17] Corkins etal. reports chronic pulmonary disease in 23.3%(95%CI:22.4-24.1).[23] Anemia is consistent with other studies being 61(17.94%, 95%CI:14.09-22.52) in Uganda by Desire Banga etal. compared to ours 74(18.5%, 95%CI:14.88-22.73).[20] A study on African pre-school children reports of anemia in malnourished children as 57.53% (95%CI 47.05-68.01).[24] Corkins etal. also reports anemia in 34.9% (95%CI 33.4-36.3) patients.[23] Arun Kumar Arya etal. also reports of TB in 43(21.5%), UTI in 8(4%) and meningitis in 15(7.5%).[19] Other co-morbidities were seen in very small number of patients which is consistent to study by Desire Banga etal.[20]

In distribution according to gender GE is most common complication and more prevalent in females 87(55.41%, 95%CI:50.38-60.32) than males 70(44.58%, 95%CI:39.66-49.60) (Table-II). No relevant articles could be found to have GE and PEM data. Pneumonia is second complication to cripple children which is more common in females 45(53.57%, 95%CI:48.54-58.52) than males 39(46.42%, 95%CI:41.46-51.44) (Table-II). Khalid Elsayh etal. reported pneumonia in 19 female and 16 male out of 35 diagnosed malnutrition cases.[25] Anemia in malnourished children is more prevalent in females 45(60.81%, 95%CI:55.81-65.59) than males 29(39.18%, 95%CI:34.39-44.17) (Table-II). Stephan Ehrhardt etal. established no association between sex and anemia in PEM Children.[26] But Onis etal. established that girls in developing countries suffer more than boys due socio-cultural barriers.[27] No relevant papers could

be obtained for remaining minor co-morbidities distribution by gender.

In distribution by age group also GE is most frequent and is occurring more in 1-5 years age group. Search for relevant documents to compare our results met with no success. Pneumonia is also more prevalent in 1-5 years age group. Anemia too is more prevalent in 1-5 years age group 58(78.37%, 95%CI:73.94-82.24) as in study by Melku etal. reporting anemia in preschool children 44.17%(95%CI:37.19-51.15%) compared to 22.19%(95%CI:17.54-26.83%) in school-aged children.[28] Other co-morbidities (Non focal Pyrexia, febrile fits and UTI) are also more prevalent in age group 1-5 years. Only single case of TB and meningitis appeared being more in 1-5 years age group and under 1 year age respectively. TB also appeared in small number of patients in study by Desire Banga et al. in just 17(5%, 95%CI:3.03-8.03).[20]

CONCLUSION
Most common complications were GE, pneumonia and anemia and their prevalence was seen higher in females and 1–5-year age group.

LIMITATIONS
One of our limitations include sampling technique which is non-probability sampling technique the results can't be generalized to population. It is hospital record-based study which isn't primarily designed for research so data isn't standardized, duplicate admission rates also pose problem and population at risk can't be identified. Also, in record-based study all desired variables aren't available, so we had to limit our study to recorded variables.

SIGNIFICANCE
After knowing frequency and distribution of co-morbidities in PEM children in District D.I. Khan we can recommend to service providers (government and NGOs) to allocate their resources optimally to combat PEM. Further, this investigation will help in further research by providing baseline data. After conducting this research, we will be able to compare frequency and distribution of co-morbidities in PEM children in District D.I. Khan

with other districts in Pakistan as well as with distribution and frequency of co morbidities in PEM children on national level.
**Copyright© 11 Nov, 2023.**

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AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Muhammad Ibrahim	Data collection, Supervision, Analysis.	
2	Farid Ullah	Data collection, Supervision, Proof reading.	
3	Fawad Ahmed	Data analysis, Manuscript preparation, Data entry.	
4	Fazal Ur Rehman	Data entry, Proof reading.	
5	Sher Ullah	Data entry, manuscript preparation.	
6	Muhammad Ilyas	Proof reading, Literature search.	