



Acute Diarrhea: Risk Factors and Electrolytes Disturbances in Children of Age 2 Months to 5 Years

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Authors' contributions

This work was carried out in collaboration among all authors. Author NR designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AL, AAJ, HS, ANJ, FRM and AA managed the analyses of the study and managed the literature searches and data collection. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JPRI/2022/v34i30B36077

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/86222>

Original Research Article

Received 02 February 2022

Accepted 11 April 2022

Published 13 April 2022

ABSTRACT

Objectives: Objectives of this study are to determine the risk factors in children with acute diarrhea and to determine the electrolytes disturbances in children with acute diarrhea.

Methodology: A study was conducted at Paediatric Department, PMCH Nawabshah. Total 246 patients, meeting the inclusion criteria were enrolled into the study by using non-probability consecutive sampling technique. A written informed consent was taken from attendant to include their child into the study. Children were admitted to in-patient department and serum sodium and serum potassium levels were evaluated through collection of venous blood sample. Risk factors were explored by clinical history and relevant physical examination. All of the data was recorded on pre-designed proforma. Data was entered into statistical package SPSS version 21 for statistical analysis.

Results: Total 246 children were recruited into the study out of which, 160(65%) were males and 86(35%) were females. The median age (in years) was 1.5 with IQR: 0.75 – 2.63. Majority of the children were from rural area (80.1%). The prevalence of risk factor 'incomplete vaccination' was high among all risk factors (98.78%). Prevalence for lack of tap water supply, use of bottle feed, lack of breast feed and use of prelacteal feed were 86.58%, 82.5%, 78.05% and 17.1% respectively. The most common electrolyte imbalance was hyponatremia (55.28%) followed by hypokalemia (43.90%), hypernatremia (13.01%) and hyperkalemia (10.16%).

Conclusion: Diarrhea impacted serum electrolytes and children developed dehydration especially hyponatremia and hypokalemia. Therefore, serum electrolytes should be closely monitored among children with diarrheal illness and timely managed with necessary interventions. The frequent risk factors of acute diarrhea were non-compliance to vaccine program, exclusive breastfeeding, and lack of potable water. The findings of current study suggest to give education to care givers so they may properly take care of their offspring. Potable water should be available and used to avoid consequences of utilizing unsafe water.

Keywords: Acute diarrhea; children; electrolytes; Nawabshah.

1. INTRODUCTION

Diarrhea is the major reason for morbidity and mortality in children all over the world and still accounts for > 2 million deaths annually worldwide and associated with impaired cognitive and physical development in developing countries [1-3]. Diarrheal disease stands as second major reason for death in developing countries accounting for yearly 760,000 mortalities and 1.7 million morbidities among children [4]. The disease burden is excessively high for children belonging to low and middle-income countries. Infants are particularly at high risk of developing diarrheal disease and a high percentage of deaths occur in first two years of life. Globally, most of the deaths as a result of diarrhea occur in South Asia and Africa [5]. Worldwide, diarrheal disease accounts for 26.93% mortalities among children of age below 5 years and nearly 90% of these deaths occurred in Sub-Saharan Africa and South Asia [6]. 16% of child mortalities occur due to diarrheal disease in Pakistan [7]. Approximately 24 million children in Pakistan are below the age of 5 years and yearly 3 to 4 episodes of diarrhea occur per children on average that account for nearly 120 million episodes yearly [8].

The risk factors contribute for acute diarrhea in children are not well characterized although remain important cause for mortality and morbidity. However, studies conducted to evaluate the frequency of acute diarrhea and characteristics of population shows agreement in a view that demographic, socioeconomic, and clinical determinants strongly impact the disease frequency and its criticality [9]. Various risk factors have been identified in earlier studies that

include male gender, low educated mothers, younger age, early weaning, seasonal pattern, young aged mothers, lacking of potable water, poor practices of water storage, poor hand washing practices, use of transported water and un-treated water, poor practice for garbage disposal, short time for boiling water, presence of feces in the yard and unsystematic discarding of child feces [10].

Socio-economic factors such as overcrowding (35%) [11], poor sanitation (23%) [11], low body weight (22%) [11], and failure to breast feed (lack of breast feed) exclusively for the first 6 months of life (17%) [11], lack of complete vaccination (44%) [11], lack of tap water supply (52%), low family income (80%) [11], use of prelacteal feed (50%) [11], bottle feeding (40.8%), malnutrition (78%) [12], area of residence (urban (39%) or rural (61%)) [11] and parental educational status (illiterate (44%) and literate (56%)) [11] are associated with diarrheal diseases in early infancy in former literature. The study by Shazma, et al [13] observed that women who were found to be not educated were 76.5%, while elementary passed were 14.4%, women who achieved matriculation and intermediate combined were 8.3%, there were only 17% of women who practice washing their hands before feeding while 19.3% women did not washed their hands. The mothers who were fond of washing hands after using toilet was 85.2%, 14.4% were those who occasionally washed their hands and their income per family was around 5000 to 20,000 per month. Whilst immunization among children, fully immunized were 46%, partially immunized were 35% and no immunization status was of 19% individuals. The oral rehydration management results in reduction of

complications and mortality from diarrheal disorders [14].

It is common that children with diarrhea suffer from electrolyte imbalance and dehydration [15]. The existence of various types of electrolyte disturbance leads to significant increase in deaths among children with acute diarrhea [16]. Electrolyte disorders may remain unrecognized but timely identification along with proper index of suspicion and thorough review of common electrolyte disturbance is mandatory to ensure their monitoring and correction [17]. Various studies had shown different proportions and prevalence for electrolyte disturbance among children with diarrhea overall as 53.8%, followed by hyperkalemia 26.9% & hyponatremia 17.3%, hyponatremia, hypokalemia and hypochloremia were present in 10.6%, 8%, and 10.6% cases respectively [18-20]. The acute diarrhea leads to complications varying from the volume reduction and electrolyte disturbance to renal failure because of acute tubular necrosis in children with dehydration [21]. A study done in urban Karachi noted 37% prevalence of acute diarrhea [22], while the study conducted in rural part of province reported acute diarrhea as 51% [23], whereas the study done in Sudan found 25% prevalence of acute diarrhea among children [24]. The reported prevalence for hyponatremia and hypokalemia in acute diarrhea by Ahmad MS, et al was 11% and 8% respectively [18].

Objectives of this study are to determine the risk factors in children with acute diarrhea and to determine the electrolytes disturbances in children with acute diarrhea.

2. METHODOLOGY

A study was conducted at Paediatric Department, PMCH (Nawabshah). Total 246 patients, meeting the inclusion criteria were enrolled into the study by using non-probability consecutive sampling technique. A written informed consent was taken from attendant to include their child into the study. Children were admitted to in-patient department and serum sodium and serum potassium levels were evaluated through collection of venous blood sample. Risk factors were explored by clinical history and relevant physical examination. All of the data was recorded on pre-designed proforma. Data was entered into statistical package SPSS version 21 for statistical analysis.

3. RESULTS

Total 246 children under age of five were recruited into the study, out of which 160(65%) were male. While female participants were 86(35%). Median age of the patients was 18 months with (IQR: 7.00 – 30.00). In years, the median age of was 1.5 (IQR: 0.75 – 2.63). Majority of the participants were male 160(65%). 197(80.1%) patients came from rural area and patients from urban area were 49(19.9%). Out of 246 parents, 199(80.9%) were illiterate. On the other hand, parent who completed their primary and secondary education were 32(13%) and 15(6.1%) respectively.

Average serum level observe for participants was 140mmol/L with standard deviation of 3.40mmol/L. Mean serum potassium was 2.93mmol/L with 0.420mmol/L standard deviation. The average body temperature of children was 98.98±0.832°F. Median duration of disease was 4 days (IQR: (3.00 – 5.00). 171(69.5%) children presented with the complaint of vomiting. Most of the patients 169(68.70%) initially presented with general conditions. Physical sign of dry mouth, sunken eyes and skin turgor was shown by 107(43.49%), 43(17.47%) and 25(10.16%) children respectively.

Total 246 children were included in the study who were presented with acute diarrhea, out of them, hyponatremia and hypernatremia was observed in 136(55.28%) and 32(13.01%) patients respectively. 108(43.90%) children were observed as hypokalemic at the time of admission and only 25(10.16%) patients were hyperkalemic.

Patients were observed for presence of risk factors. The commonest risk factor observed in patients was incomplete vaccination. 243(98.78%) children had incomplete history of vaccination which was very alarming situation as incomplete vaccination also increases the risk for development of other infectious diseases. The second frequent risk factor that was identified during this study was lack of water supply. 213(86.58%) families had lacking of tap water supply which means that families might be borrowing or sharing water from other sources that may put children to higher risk for development of disease. The third observed risk factor was use of bottle feed. 203(82.52%) mothers were giving bottle feed to provide meal to their child. 192(78.05%) mothers didn't

practiced or not practicing breast feed continuously. Use of prelacteal feed was also low. 42(17.1%) mothers admitted that they used prelacteal feed for their child (Table 1).

159(99.4%) male child had incomplete history of vaccination. On the other hand, 84(97.7%) female child also presented with status of incomplete vaccination.

History of incomplete vaccination was not found to be associated with parent education ($p=1.00$). Among illiterate parent, 196(98.5%) parents admitted that their child vaccination was not completed while all parents who were educated till primary and secondary responded that they didn't follow the vaccination completely for their child.

Similarly, being the residential of either rural or urban area had no impact on vaccination status had child ($p=0.488$). Among rural and urban residents, 195(99.0%) and 48(98.0%) children had incomplete vaccination history. None of the demographic variable i.e. gender, parent education and place of residence was found to

be associated with vaccination status of child (Table 2).

Among female child, 75(87.2%) mother fed them with bottle which was higher than male. 128(80.0%) parent admitted that they using bottle to feed the baby. 32(20.0%) parent didn't use bottle feed for male child which was higher than female. 11(12.8%) female child were not fed by using bottle. However this difference of proportion was not to be significant ($p=0.156$) and the intuition of bottle feeding was independent of the gender of the child.

Use of bottle feeding was more prevalent among illiterate parents as compared to those parents who were primary and secondary pass. 166(83.4%) illiterate parents used bottle feeding method. On the other hand, 25(78.1%) practiced bottle feeding. No use of bottle feed was high among parents who availed primary education only. 7(21.9%) didn't use bottle feeding for their child while no use of bottle feed among secondary and illiterate educated parents was 20% and 16.6% respectively. However there was no evidence of significant association of feed with parent education ($p=0.739$).

Table 1. Association of Risk Factor 'Incomplete Vaccination' with Demographic Variables

Variables	History of Incomplete Vaccination		P-value
	Yes Frequency (%)	No Frequency (%)	
Gender of child			
Male	159 (99.4)	1 (0.6)	Fisher (0.280)
Female	84 (97.7)	2 (2.3)	
Parent education			
Illiterate	196 (98.5)	3 (1.5)	Fisher (1.00)
Primary	32 (100)	0 (0)	
Secondary	15 (100)	0 (0)	
Residence			
Rural	195 (99.0)	2 (1.0)	Fisher (0.488)
Urban	48 (98.0)	1 (2.0)	

Table 2. Association of Risk Factor 'Use of Bottle Feed' with Demographic Variables

Variables	Use of bottle feed		P-value
	Yes Frequency (%)	No Frequency (%)	
Gender of child			
Male	128 (80.0)	32 (20.0)	0.156
Female	75 (87.2)	11 (12.8)	
Parent education			
Illiterate	166 (83.4)	33 (16.6)	0.739
Primary	25 (78.1)	7 (21.9)	
Secondary	12 (80.0)	3 (20.0)	
Residence			
Rural	161 (81.7)	36 (18.3)	0.511
Urban	42 (85.7)	7 (14.3)	

Table 3. Association of Risk Factor 'Lack of Breastfeeding' with Demographic Variables

Variables	Lack of Breast Feeding		P-value
	Yes Frequency (%)	No Frequency (%)	
Gender of child			
Male	124 (77.5%)	36 (22.5%)	0.777
Female	68 (79.1%)	18 (20.9%)	
Parent education			
Illiterate	156 (78.4)	43 (21.6)	0.512
Primary	26 (81.3)	6 (18.8)	
Secondary	10 (66.7)	5 (33.3)	
Residence			
Rural	152 (77.2)	45 (22.8)	0.498
Urban	40 (81.6)	9 (18.4)	

Table 4. Association of Risk Factor 'Use of Prelacteal Feed' with Demographic Variables

Variables	Use of Prelacteal feed		P-value
	Yes Frequency (%)	No Frequency (%)	
Gender of child			
Male	29 (18.1)	131 (81.9)	0.550
Female	13 (15.1)	73 (84.9)	
Parent education			
Illiterate	31 (15.6)	168 (84.4)	0.404
Primary	7 (21.9)	25 (78.1)	
Secondary	4 (26.7)	11 (73.3)	
Residence			
Rural	32 (16.2)	165 (83.8)	0.488
Urban	10 (20.4)	39 (79.6)	

Among urban residents, use of bottle feeding was 85.7% which was more prevalent as compared to rural residence but this difference was not huge because 81.7% rural residents were also practicing bottle feed. The data showed no evidence of significant associated of practice of bottle feeding with residence ($p=0.511$) i.e. practice was bottle feeding was independent of the fact that parents were residents of either rural or urban (Table 3).

68(79.1%) mother of female child confessed that they didn't practiced breastfeeding properly and there lacking of breastfeeding. Proportion of male mothers who admitted that there was lacking in breastfeeding was 124(77.5%) which was almost alike to female mothers proportion. Thus, it could be concluded that improper breastfeeding of child was independent of gender of child. Data also didn't show the evidence of association of two factors ($p=0.777$).

Lack of breastfeeding was more prevalent among child whose parents were primary pass as compared to parents who were illiterate and

secondary pass. 26(81.3%) parents who did just primary educated admitted that practice of breastfeeding was not proper. On the other hand, among illiterate and secondary pass educated parents, 156(78.4%) and 10(66.7%) confessed that there was lacking in breastfeeding. However, this difference was not significant ($p=0.512$). The practice of breast feeding was independent of the parent education.

Among urban residents, 40(81.6%) reported that there was lacking in breastfeeding which was more prevalent than rural resident. Among rural resident, 152(77.2%) parents were admitted that there was negligence in breastfeeding. Lacking of breastfeeding was high among both rural and urban residents as compared to those parents who reported that there was no lacking of breastfeeding. This pattern showed that practice of breastfeeding was independent of the area of parent residence and the same phenomenon was evident by data ($p=0.498$). Therefore, the study data showed that there was no association of breastfeeding practice with area of residence of parents.

Among male child, the use of prelacteal feed was 18.1%. On other hand, 13(15.1%) mothers reported that they used prelacteal feed for their child. No of use of prelacteal feed among male and female was 81.9% and 84.9% respectively. This difference of proportion among two groups is not huge. The data also showed the same fact that there was significant no association between use of prelacteal and gender of the born child ($p=0.550$).

Among illiterate, 31(15.6%) parents reported that they used prelacteal feed. The use of prelacteal feed was high among those parents who were just secondary pass as compared to illiterate and secondary pass educated people. While 7(21.9%) illiterate parents and 4(26.7%) secondary pass parents responded positively for the use of prelacteal feed. However, these proportion are not significantly different and use of prelacteal feed was independent of the gender of the child born ($p=0.404$).

The use of prelacteal feed among rural families was 16.2% while 10(20.4%) families from urban area reported that they used prelacteal feed i.e. use of prelacteal feed was high among urban families as compared to families living in rural areas. However, there was no significant association of place of residence with use of prelacteal feed ($p=0.488$) (Table 4).

4. DISCUSSION

Diarrheal disease is regarded as a major cause of mortality among children of age below five years in developing countries; however deaths occurring as a consequence of this disease may be completely avoided [19]. The present study was conducted with an objective to determine the risk factors of diarrhea in our local setting and to determine the prevalence of electrolyte disturbances in children presenting with acute diarrhea.

Only those patients presenting with acute diarrhea were recruited into the present study. In the current study, higher ratio of male was higher than female. 160(65%) were male whereas female children 86(35%). Ahmed et al [20] also reported that more males presented with diarrhea as compared to females. The finding of high male ratio is also consistent with another study conducted in Rawalpindi. Maroof et al [21] reported that 42.4% females and 57.6% males visited out-patient department with complaint of diarrhea during their study. The ratio of male in

both of Pakistani studies may be attributed to the mindset of giving more priority to males as compared to females. However, a study conducted in Nigeria also showed that 55.4% were males and 41.5% were females below 5 years of age presented with diarrhea [22].

It was observed in our study that 108(43.90%) children were found as hypokalemic when serum potassium was investigated at the time of their admission. Shah et al [23] reported the similar result that 46% patients developed hypokalemia. Another comparable frequency of hyperkalemia was reported by Chishti et al [24] who observed 47.5% children were hypokalemic in his study. In contrast to our results, Ahmad et al [18] and Paritama et al [25] found low prevalence of hypokalemia and it was 7.7% and 26.5% respectively. Kamberi et al [26] reported that 33.62% malnourished children who presented with diarrhea were hypokalemic.

In our study, 32 (13.01%) patients were identified as hypernatremic. Saritaet. al [27] found lower frequency for hyponatremic patients that was 7.7%. Our finding is similar to study of Ahmad et al [18] who found 17.3% patients hypernatremic in his study. On the other hand, Babar et al [28] Sarita et al [27] found 4.6% and 4.4% patients as hyperkalemic respectively which is somewhat closer to our study.

5. CONCLUSION

Decreased serum electrolytes have been found as a consequence of dehydration in children especially hyponatremia and hypokalemia. The frequent risk factors of diarrhea among rural population of Sindh found in our study were non-compliance to vaccine / immunization, lack of exclusive breastfeeding and use of potable water. Therefore, the findings of the current study suggest that these immense need to provide education to care givers of children to avoid/lower the prevalence of of existing risk factors.

CONSENT

A written informed consent was taken from attendant to include their child into the study.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:

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