DISCUSSIONS
6. DISCUSSION

Acute diarrhoeal diseases have been recognised as one of the major causes of morbidity and mortality amongst the underprivileged communities in the developing countries. It has been estimated that about 1/3rd of deaths under 5 years of age were due to diarrhoeal diseases.

Diarrhoea in neonates and young infants (<3 months of age) is an important contributor to early infant morbidity and mortality. The advent of oral rehydration therapy (ORT) has revolutionised the management of acute diarrhoea even in this age group.

Preterm constitute 18.6% among cases and the rest were term neonates in our study. Preterm babies showed a proportionately significant higher risk for developing diarrhoea. This may be because they are immunologically incompetent, poor first line defense mechanism and more prone to infection and thereby develop diarrhoea. Gestational age of less than 37 weeks is the risk factor identified for the development of diarrhoea in the neonatal period.

Gastric motility, secretion and digestive enzymes in the gut were seen by 20 weeks of gestation. Active transport of aminoacids and glucose can also be seen at around this gestational age. It is well known that the development of organs and their functions follow a biological clock modulated by environmental influences. Since the preterm babies showed immaturity of the gut and organs systems. They are more prone to develop diarrhoea especially on formula feeds rather than on breast feeds.
Males were more than females in our study and in agreement with other studies. Prevalence of diarrhoea incidence the two sexes was the same. Such findings have been reported by others also. Arora et al. on the other hand, reported considerably higher prevalence for female children than males. Rotavirus diarrhoea is known to occur predominantly among male children. Whether this could be due to more exposure and more care for the male child or lack of immunity is not clearly understood.

More than 3/4 of cases were living under bad housing conditions in our study also in agreement with others. They were at proportionately higher risk to develop diarrhoea when compared to those living in good housing environment. This may be due to unclean environment, poor sanitation and less living spaces, sharing of latrines, unclean water supply, and over crowding.

A significantly higher prevalence of diarrhoea was seen among children belonging to families living in poor environmental sanitation leading to fly breeding. These findings were also observed by Rao et al., Tiwari et al. and Agarwal et al.

8.5% were delivered at home, the rest were delivered at hospital. This indicates alertness of the society to utilise the services of the hospital. Similarly observation has been made from rural Bilbies, Egypt in which author identified household factors - number of children under four years of age, number of persons per household, incidence of diarrhoea in other family member were associated with infantile diarrhoea.
78.4% of cases were delivered by natural vaginal delivery and the rest were delivered by instrumental delivery in our study. Instrumental delivery is a significant risk factor when compared to natural vaginal delivery for diarrhoea in neonates. Newborns delivered by Cesarean section were also found to have an increased frequency of loose stools. This also could be due to the invariable introduction of bottle feeds during the first 24 hours as many mothers are sedated and unable to lactate satisfactorily during this period as described in studies from JIPMER, Pondicherry\textsuperscript{23}.

75.4% of cases belong to low socio-economic status in our study and neonates born to parents of low socio-economic status are found to be more at risk to develop diarrhoea as seen in studies by others\textsuperscript{24,25}. Low socio-economic status and poor environmental hygiene, coupled with lack of health education in mothers contribute largely to a higher incidence of diarrhoea as seen in studies by Daral et al.,\textsuperscript{254} and studies from low income traditional area of Ilorin, Nigeria\textsuperscript{255}. Where diarrhoeal incidence decreases with the child’s age while households with a separate kitchen had a significantly lower incidence of diarrhoea than those with out a kitchen. This finding emphasis the importance of good hygiene in reducing the risk of having diarrhoea.

12.7% of cases were from rural areas and the rest were from urban areas in our study and indicate easy approach and easy access to the nearby hospital.

Mothers of 81.4% of cases did not follow hand washing practices before feeding the babies in our study. Mothers not washing their hands with soap and water before feeding the babies and after disposal of excreta expose
their babies to a higher risk to develop diarrhoea. This is explained that by washing their hands before feeding their babies will definitely prevent the micro organisms entering into the neonatal gut. In a study from two poor Bangladesh communities one rural and one urban they found that ideas about cleanliness generally are not based on Germ theory. Cleanliness is viewed in a larger socio relation context of purity Vs impurity. Washing may not effectively interrupt transmission of micro organisms. Soap is recorded as a cosmetic rather than an agent for removal of micro organisms. On the contrary, in a study from Indonesia, sixty five mothers from Balai Lua, Central Lombok, Indonesia were given soap and water and explained the process of faecal-oral route of diarrhoea transmission. This very simple health message was repeated and reinforced fortnightly to members of their family, suffering from diarrhoea. Children of these mothers, experienced a 89% reduction in diarrhoea episodes compared to a control period before the intervention and this of course was seen in older children. Reduction in diarrhoeal episodes was attributed to improved hygiene practices.

21.6% of cases belong to birth order 3 and 4 and the rest belong to birth order 1 and 2 indicates the society is very well following the small family norms. Studies by others showed higher incidence of loose stools among the newborns of multiparous mothers having more than two babies. There was supplementation of top feeds among them when the mother has gone for sterilization.

Mothers of 16% of cases were suffering from obstetric wound sepsis in our study. Presence of maternal sepsis is a significant risk factor for diarrhoea in neonate. She may not be able to provide appropriate care to their
babies in the form of love and affection. Moreover, studies by Ananthakrishna et al.,23 showed that 43.7% of mothers were treated for sepsis with antibiotics and only 14.7% their babies developed diarrhoea.

33.5% of cases were given prelacteal feeds in our study. Neonates given prelacteal feeds had a higher risk of developing diarrhoea. It is explained that the pre-lacteal feeds given either in the form of glucose water or sugar water or milk from animals sources (eg. cow, donkey, goats) given in unclean unsterilized utensils which may infect the neonate and lead to diarrhoea or the animal would have been suffering from sepsis. It has been shown by studies from Nigeria that neonates who were put on prelacteal feeds of glucose water instead of colostrum during their three day stay in the maternity ward in Nigeria were found to be exposed to plethiora of micro organism. The majority of neonates receiving colostrum had significantly lower bacterial counts than those fed on glucose water (p<0.001). The early initiation of colostrum feeding to neonates where portable water is not readily available will suppress the proliferation of bacteria in the neonates.258

43.2% of cases had treatment for diarrhoea before admission into the hospital. Neonates who had treatment with antibiotics before admission to the nursery is presumed to be at risk for developing diarrhoea. It is possible that antibiotics alter microbial flora in the intestine and hasten bowel transit time.23

71.2% of cases had breast feeds and others were fed with top feeds in our study. Grulee et al13 demonstrated the protective role of breast feeding in the classical study of 20,000 infants. Cunningham et al.,15 Fallot's et al259 have
demonstrated that breast-fed babies are less prone to development of enteral and other infections in a community setting. Fallot et al., showed that the incidence of breast feeding in hospitalized infant was 11% compared to the expected figures of 25.2% in the community in some of the groups, thus, suggesting that breast-fed infants were less prone to the development of serious illness requiring hospitalization.

64.8% of cases were fed with bottle and the incidence of breast fed were more than top fed babies in our study but in contrast, by the studies by Harfouche found higher incidence of diarrhoea in top fed babies than in breast babies. Breast milk alone however can not give 100% protection when environmental insult is very strong. But studies by others showed no difference was observed the incidence, frequency and consistency of the stools the breast and top fed babies. Breast feeding is being encouraged actively to combat the high morbidity and mortality associated with diarrhoeal diseases. Numerous studies have demonstrated that the children who are breast fed have a lower incidence of severe diarrhoea than children who are bottle fed. The breast feeding appears primarily to be associated with protection against shigellosis and Cholera. Breast feeding may protect against rotavirus only if the intestinal mucosa is continuously bathed with antibody and other anti infective components of breast milk, so that sporadic or low volume feeds might be ineffective. In the neonatal period, breast feeding has been associated with a decreased risk of infection and with the excretion of lesser quantity of virus but these infections regardless of breast feeding status rarely lead to disease.
62.3% cases weighed less than 2500 gms on admission in our study. Neonates weighing < 2500 gm are more at risk to develop diarrhoea when compared to neonate weighing >2500 gm. These LBW neonates are at a potentially higher risk to develop sepsis leading to diarrhoea. This is supported by a study of Tessema et al48. In contrast studies by Nurjannah et al270, where out of 3367 babies born and followed only 135 babies, had diarrhoea of which 106 babies were weighing ≥ 2500 gms.

9.3% of cases had umbilical sepsis. 15.4% of cases had diarrhoea within first week of life and others had diarrhoea after one week of life and this is attributed, following gut colonisation, the diarrhoea sets in after a week of life.

Severe dehydration (12.8%), some dehydration (40.6%) and no dehydration (46.6%) were seen in the our babies - respectively whereas studies by others270 noted 60.7% of moderate dehydration, 23.0% of severe dehydration. 1.4% of babies developed diarrhoea in natural delivery whereas 11.4% of diarrhoea of the instrumental delivery babies less than 37.9% and more than 2500 were 16.9%. Early identification of children at high risk of diarrhoea associated dehydration would be of great value to health care workers in developing countries. To identify prognostic factors for life-threatening dehydration, a case-control study among under-2-year-olds in Porto Alegre, Brazil271 was carried out. The associations were particularly strong (P less than 0.001) for the child’s age, birth weight and other anthropometric indicators, birth interval, and feeding mode. In terms of their sensitivity and specificity, however these prognostic factors were not as affected as early signs and symptoms for predicting the outcome of the episodes.
80.9% of the cases had acute watery diarrhoea and this may be due to ETEC infection and rotavirus enteritis. The rest had semi solid stools, mixed with mucus and blood and this may be due to salmonella infection. 30.5% of the cases had foul smelling loose stools. Vomiting is a prominent part of illness (44%) in our study where other studies showed in 51.9% which is also confirm by findings of Daral D.S et al.\textsuperscript{254}

Fever was noticed in 15.3% cases of our study. Whereas other studies report 40.7% of cases with fever.\textsuperscript{254}

36.4% of the cases had positive stools for reducing substances by routine Benedict's test. This may be attributed to the response of breast feeds and also due to rotavirus infection. But modified rubner's test\textsuperscript{165} showed positivity in only 19 (8.02%) cases.

32.6% of cases had faecal leucocytes more than 5 per power field and compared to other studies which show 6.2%.

\textit{E. coli} was isolated as a single isolate in 37.7% cases in stool culture studies by us. In studies by others,\textsuperscript{127,211,254,272,273,274} \textit{E. coli} has been isolated in 28-54% of the cases. \textit{Klebsiella} was isolated in 29.2% of cases in our study and noted by others in 6.2% of cases was more frequently isolated in breast babies. This is in conformity with other workers.\textsuperscript{254} \textit{Salmonella} was isolated in 2.5% cases in our study whereas Victor et al.,\textsuperscript{100} noticed in an epidemic infection with salmonella species. No bacterial isolates seen in 2.5% of cases in our study but it was observed in 44.6% of cases by others.\textsuperscript{254}
Klebsiella and E.Coli as mixed isolates in stool culture in 11% of cases, whereas others' incidence is 1.5%. ETEC is dominant E.coli groups seen in our study (75%) and coincides with studies at Galicia,\textsuperscript{83} north western Spain.

Diarrhoea has non specific symptom of infection (parenteral diarrhoea) and the incidence of associated septicemia was 55 (23.3%) in our study as compared to 6-9% by others. Klebsiella forms 11.9%, pseudomonas 4.7%, staph aureus 4.2%, E.coli 4.87% in our study.

Rotavirus was isolated in 36.3% in our study. The incidence of rotavirus diarrhoea is highly variable in India being 22% in Vellore,\textsuperscript{274} 33.3% in Delhi,\textsuperscript{276} and 66% in Calicut.\textsuperscript{152} There is no seasonal variation seen for rotavirus in our study in accordance with other studies.\textsuperscript{127} Rotavirus were not found at all during the summer months in Washington, DC\textsuperscript{154} but they were detected in about 20% of the patients with diarrhea in London\textsuperscript{157} and Melbourne\textsuperscript{276} in topical areas such as Venezuela\textsuperscript{277} and Ecuador\textsuperscript{278} no seasonal variation occurs, whereas human rotavirus infection has been reported in the dry seasons in Costa Rica\textsuperscript{279} India,\textsuperscript{152} and Bangladesh\textsuperscript{280}

Asymptomatic rotavirus infection and disease observed from the neonatal period onwards. Asymptomatic infections without diarrhoea was noted in 12.1% in our study but studies by others 27%.\textsuperscript{281}

Neonatal rotavirus infection confers protection against clinically severe disease during reinfection.\textsuperscript{140} Conversely Riepenhoff Talty et al.,\textsuperscript{282} noticed that children with low levels of antibody response had a higher risk of severe symptomatic infection. We have not done rotaviral antibody titre but
repetition of stool samples after 2 weeks of discharge showed negative for rotavirus by RNA PAGE method.

The incidence of hyponatremia was seen in 11.9% of cases whereas in others it was observed in 12.3% others. Hypernatremia was seen in 4.6% of cases in our study but it was noticed in 8.6% by other studies. Slightly lower incidence has been reported in older infants from other tropical countries including India. This is in sharp contrast to the higher incidence of this problem reported in Western countries. Hypernatremia has been reported with the use of standard ORS containing 90mmol/l sodium as used in our study.

Hypokalemia was seen in 25.4% cases in our study it was noticed in 9.9% in other studies. This may well be due to lower stool electrolyte loss in early infancy.

Metabolic acidosis was seen in 47.9% of cases in our study whereas others showed 80%. It appears that in older infants from tropical countries the incidence was 60.5% by other studies. This high incidence of acidosis in neonates is well encountered and would be likely to decrease by the liberal use of ORS therapy.

Serum triglycerides and serum cholesterol were high in 95.8% and 95.5% of our cases respectively. On repetition of the samples after two weeks during follow up showed increase triglycerides and also cholesterol level in our study but other studies showed high triglycerides level after ten days and decrease level of serum cholesterol and only normal after feeding. This is in accordance with the study where even on repetition of follow up studies tend
to be high indicating that the lipid metabolism is in play. Serum cholesterol level was high in 95.3% of cases in our study but the same in previous study tends to decrease during the follow up samples of serum and tends to become normal after feeding the baby. The explanation may be that those infants might have had familial hypercholesterolemia. This aspect was not looked at in our study. Serum phospholipids was low in 95.3% of cases.

Blood urea and serum creatinine was increased in 16.5% and 17% of cases respectively, whereas in others serum urea was increased in 37.1%. This is due to the inefficient handling of urea by the immature kidneys in neonates particularly during diarrhoea. Serum creatine levels are high at birth (reflects the maternal serum creatinine and decreases to less than 0.5mg/dl in a term infant by 5-7 days of age but may not reach this level in a preterm infants even upto 10 days. Failure to achieve a fall in the levels of serum creatinine or an actual rise indicates impaired renal function.

Hypoglycemia was seen in 25.4% of cases in our study whereas in others it was showed in 13.6% cases. In an acute diarrheal child with continuous nutritional support, hypoglycemia is a rarity (<5%). In an malnourished infant and young infants (upto 15%) as noted by others. But it was noted to rise in malnourished and young infants (upto 15%) according to studies by others. This high percentage of neonates probably due to the fact that carbohydrate is used up, to the fullest extent leading to hypoglycemia. Hypoglycemia was said to be the commonest cause of death in diarrhoea. Hyperglycemia was noted in 11.5% of our cases, whereas in others noted in 2.5%. This could have been due to the blood samples that were collected after
starting of intravenous fluids in severely dehydrated neonates in emergency situation.

It is well known that infants born at term have normal adult level of IgG as a result of active transport of maternal IgG across the placenta. Since IgM and IgA are impermeable their levels are very low as compared to adult levels. Young et al., found that since the fetus is not normally subjected to antigenic stimulus, it produces very little immunoglobulins but as maternal IgG is transferred to the fetus in the last few months of pregnancy, so serum levels are lower in babies born prematurely.

Serum IgA level was low in 52.5% of cases in our study and this is due to the mucosal injury of the neonatal gut in diarrhoea and this neonates also fed with colostrum feeds.

Serum IgG level was high in 87.5% of cases in our study. It is due to the infection which would have been transferred from the mother as evidenced by maternal sepsis.

Serum IgM level was low in 25% of cases in our study and this low level of IgM was not to be explained at the present movement.

Serum complements C₃ levels was low in 65% of cases in our study and this indicate C₃ components have been utilized in emergency situations - neonatal diarrhoea.

Serum C₄ level was high in 10% of cases in our study and this is explained by activation of alternate path way of compliment system. At term
compliment components $C_3$ and $C_4$ are 50% to 65% of the corresponding levels in normal adults serum or paired maternal serum.\textsuperscript{287}

LBW infants have much lower levels $C_3$ and $C_4$, and these are reduced in proportion to the degree of prematurity.\textsuperscript{287-289} Compliments $C_4$ and $C_3$ present in human milk but their concentrations are low as compared to those in human serum.\textsuperscript{290}

In a study by Ashok Kumar et al $C_3$ levels were influenced by gestational age, while $C_4$ level remained unaffected. Reduced compliment activity in neonates may contribute to opsonic defects and predispose to infection.\textsuperscript{190}

Presence of sclerema is significant risk factor for death.

Presence of fever in case is significant High risk factors for death in cases. This significance indicates possibility of infection with neonate most probably gram positive infection in cases compared to controls.

Bottle feeding and no breast feeding were significant risk factors for death. This may be due to improper sterilisation of the bottle, may be due to type of bottle used for the feeding and boiling the bottle for less than 20 mts.\textsuperscript{220}

Anuria even after 12 hours of admission is a significant risk ($p<.01$) in neonatal diarrhoea for death.

Positive blood culture significant is a risk factor for death when compared with controls.
High blood urea is significant risk for death. This high uremia is the result of dehydration as a part of diarrhoea in neonates.

Lack of breast feeding is significant risk factor for death though breast feeding is not giving complete protection against diarrhoea but breast feeding as a definite role in avoiding death due to diarrhoea. Hence breast feeding has to be continued in every neonate with diarrhoea.

Severe degree of dehydration is significant risk factor for death. Hence all cases of diarrhoea in neonates should be prevented from going in for dehydration and appropriately managed in time. Prevention of dehydration must be the major aim of therapy.

Abdominal distention though statistically not significant risk encountered in our study but biologically it is a significant risk factor in diarrhoeal cases for death.

Harfouche found that diarrhoea rates are 10 or more times higher in babies when they are fed by nonhuman milk and mortality rate is 5-10 times greater than amongst breast fed babies.\(^{260}\)

Mortality in neonatal diarrhoea in our study was 11.44% studies by others\(^{261}\) showed the mortality in neonatal was 27.11%.