5. DISCUSSION

Infantile diarrhoea is an important cause of morbidity and mortality in developing countries. Diarrhoea is one of the most common symptoms of illness in pediatric practice. It usually appears in the form of acute diarrhoea, but it may also progress to a chronic state (Branski, 1984).

The nutritive, cognitive and emotional benefits of breast milk and breastfeeding are significant and well documented. Labenthal, (1980) has explained both magnitude and devastation of the effect of diarrhea on infants. The possible etiology of the diarrhoeal episodes and to some extent the severity can be determined by knowing the duration of diarrhea, frequency of bowel movements, stool consistency, presence of visible blood or mucus in stools, fever and other symptoms. Duration of illness allows an arbitrary classification of diarrhea into acute or chronic (longer than 2 weeks). Acute infectious diarrhea is caused when a critical number of micro-organisms or (in a few instances) preformed microbial toxins are ingested, survive passage through normal gastric acidity and reach the intestinal tract(Connor and Barrett, 1967).

Acute diarrhoeal diseases constitute an important cause of morbidity and mortality throughout the world, particularly in infants in developing countries. It has been estimated that some 500 million episodes of diarrhea occur annually among children under five years of age in the developing countries of Asia, Africa and Latin America, causing 5-18 million deaths (Moffet et al., 1968).

Palti et al. (1984) in a prospective study stated that 52% of bottle fed infants suffered from diarrhoea when compared to 15% of those who were breastfed.

Huffman et al. (1990) stated that breastfeeding is important in providing necessary calories and protein during a time when infants often refuse solids.
Breastfeeding plays an important role in reducing the incidence and severity of infantile diarrhoea (Al-Ali F.M. et al., 1997).

Breast milk is the best infant food where water supplies are bad and hygiene is difficult (Portobian, S. et al., 1992).

5.1 IN BREASTFED INFANTS-URBAN AND RURAL AREAS

In this study, 36% of the breastfed infants suffering from diarrhea were from urban and rural areas of which 48.6% was from urban and 51.3% was from rural areas. de Souza et al. (2001) in their study in Ceara signified the fact that determinants of variability in diarrhea was exclusive breastfeeding.

Scott et al. (1986) in their study of exclusively breastfed Nigerian infants stated that 35% of them had diarrhea.

Unni et al. (1988) in their study conducted in urban south Indian families at 6 weeks stated that 2% of the exclusively breastfed infants had diarrhea compared to 24% of partially breastfed infants. At 14 weeks, 0% of the exclusively breastfed infants had diarrhea, compared with 7.5% of partially breastfed infants.

Overall morbidity was uncommon in breastfed infants. The development of significant illness was delayed in infants who were breastfed beyond 6 weeks of age. Feeding patterns of infants in the age range of 0-5 months have a major impact on the incidence of diarrhea in infants (Cunningham, 1977).

Exclusive breastfeeding is an optimal practice, compared to other infant feeding practices (McNeil et al., 2010).
A study by Perera *et al.* (1999) once again proved the extended protective effect of exclusive breastfeeding for a period of over 4 months against respiratory and diarrhoeal diseases.

**5.2 IN BOTTLE FED INFANTS-URBAN AND RURAL AREAS**

In this study 64% of the bottle fed infants suffering from diarrhea were from urban and rural areas of which 64.9% was from urban areas and 35.1% was from rural areas. Diarrhoea was 64% in infants who were bottle fed in a study by Vieira *et al.* (2003) conducted in the city of Fiera de Santana, Brazil.

Bottle fed infants, particularly in an insanitary condition, are at greater risk of infection from utensils and artificial milk (WHO bulletin .1989).

Fergysson *et al.* (1978) studied the GI disturbances in 10 hospitalized infants, 4 were formula fed, 1 was almost exclusively breastfed and 5 were exclusively breastfed (EBF). A significant relationship was found between GI disturbance and diet, with formula fed infants having close to 4 times the risk of medical consultation and 5 times the risk of symptoms of GI disturbance than EBF (Exclusively breast fed) infants. Microbial contamination of produced infant formula is known to cause gastrointestinal infections in infants (Elisabeth *et al.*, 2009)

Risk factors for an infant not being exclusively breastfed were high socio-economic status (Mihrshani *et al.*, 2010).

In a rural study in Peshawar, Pakistan revealed that diarrhoeal episodes were common in 84% formula fed infants as compared to 16% of breast fed infants (Hussain Khan *et al.*, 2003).
56% of artificially fed infants suffered from diarrhoea in a study conducted in Kuwait by Klausreither Ralf et al., (2007).

When compared with exclusively breastfed infants, infants who were exclusively formula fed had an 80% increase in their risk of developing diarrhoea. The risk of developing diarrhoea increases as the amount of breast milk received decreases (Dewey et al., 1995).

5.3 ISOLATION OF BACTERIAL DIARRHOEAL PATHOGENS

*E. coli* was isolated from 72.9% of breastfed infants from rural areas in our study. A study by Samuel S et al. (1997) has shown that 85% of diarrhoeal cases (0-2 year age) were due to Enterotoxigenic *Escherichia coli*.

The study results of 70.3% isolation of *E. coli* in bottlefed infants correlated with a cohort study in Durango, Mexico by Macias Carrillo et al. (2005).

Enteropathogenic *E. coli* (EPEC) has been implicated as a cause of diarrhoea and gastroenteritis in children (Tewari et al., 1979).

WHO International Escherichia Centre listed 150 serogroups of *E. coli* as enteropathogenic to man (Thoren, 1983), Sakazaki and 10 workers (1967 and 1974) identified 34 OH groups of *E. coli* as possible enteropathogens, Experiments with animal models and human subjects have shown that EPEC can cause intestinal secretion and diarrhoea (Thoren, 1983).

The mechanism of production of diarrhoea by EPEC may be the production of an enterotoxin which is different from those produced by enterotoxigenic *E. coli* (Konowalchuk, 1977 and Klipstein, 1978) or a mechanism related to adhesion and colonization of the small intestine (Williams et al., 1978; Craviota et al., 1979 and Darfeuille, et al., 1983).
In this study the isolation rate of *E.coli* from rural infants suffering from was 72.9% which contradicted the rural based US study of 244 infants by Paine *et al.* (1982).

Dallal *et al.* (2006) isolated 3.4% of *Shigella* species in children under 5 years of age. In this study 9.7% of *Shigella flexneri* was isolated from breastfed infants. 4.6% of *V. cholerae* species was isolated from bottle fed infants when compared to no *V. cholerae* from this study.

Enteropathogenic *E.coli* (EPEC) has been implicated as a cause of diarrhoea and gastroenteritis in infants (Tewari *et al.*,1979).

EPEC is one of the most important aetiologic agents of infantile diarrhoea in developing countries (Kandakai *et al.*,2008).

EPEC is an important cause of epidemic diarrhoea (Bray and Neter 1959). Hugh *et al.* (1968) isolated EPEC in 7% to 30% diarrhoeal cases. Studies in India detected EPEC in 8% to 24% of cases of diarrhoea in children (Sen *et al*.1983). In this study the isolation rate of EPEC was 5.6%.

7 EPEC isolates of the 125 *E.coli* isolates were reported in our study while Lee-Jene teng *et al* detected 6 EPEC isolates from 150 *E.coli* isolates from children under 5 years of age.

Gison *et al.*(1984) in their study emphasise that PCR primers have been successfully developed for all categories of diarrhoegenic *E.coli*. PCR can be used for both diagnosing and typing *E.coli* strains. It is commonly used for detecting different virulence associated genes. In this study PCR was used to confirm the EPEC strains of *E.coli*. PCR is considered the most reliable technique to characterize diarrhoegenic *E.coli* strains (Nataro and Kapper, 1998).
Pathogenic bacteria account for about 30% of diarrhoea in infants (Ramblett and Siewess 1965, Conner and Baeret 1967 and Moffet et al., 1968). The most important are enteropathogenic *E.coli*, *Sh. dysentriae* and *S. typhi*.

There are four major categories of diarrhoeagenic *E.coli*: enterotoxigenic (a major cause of traveller's diarrhoea and infant diarrhoea in less developed countries) enteroinvasive (a cause of dysentry), enteropathogenic (an important cause of infant diarrhoea) and enterohaemorrhagic (a cause of haemorrhagic colitis and hemolytic uraemic syndrome). These categories differ in their pathogenesis, clinical features, epidemiology and O.H. serotypes (Levine, 1987) and can be identified by using specific DNA probes (Nataro et al., 1985 and Smith et al., 1987).

EPEC is an important cause of infantile epidemic diarrhoea and is a likely cause of enteric diarrhoea (Bray, 1945 and Neter, 1959).

In a study by Kain KC et al., 1991, in Beijing, China, 221 children were examined for enteropathogens. Pathogens (*Escherichia coli*, EIEC, EHEC and EPEC) were identified in 56.5% of children. *E.coli* was detected in 20% cases followed by *Shigella* species 17% and of *Salmonela* species 12%.

In this study 58.3% and 70.3% of *Escherichia coli* were isolated from breastfed and bottle fed infants respectively. *Salmonella typhi* isolated from breastfed was 4.1% and from bottle fed infants was 2.3% included in this study. *Shigella flexneri* isolated from breastfed and bottle fed infants were 9.7% & 2.3% respectively.

Dallal et al. (2006) isolated 6.8% of Enteropathogenic *E.coli*, 3.4% *Shigella* species, 2.95 *Salmonella* species from breastfed and bottle fed infants.
Clemens et al. (1997) compared other feeding modes with exclusive breastfeeding and concluded that breastfeeding of infants was associated with significant protection against severe ETEC diarrhoea.

In Southern India, Maiya et al. (1991) examined 50 infants with acute gastroenteritis. The aetiology revealed EPEC (enteropathogenic E.coli), Salmonella and Shigella as common isolates.

A microbiological investigation of Black South African infants suffering from acute gastroenteritis revealed 81% of enteropathogenic agents. 41% was enterotoxigenic bacteria. (Barry et al., 1977).

Under poorest sanitation conditions, breast feeding provides greater protection (Ahiade Ke et al., 2002).

This study revealed that diarrhoea is more frequent in bottle fed infants (64%) than in breastfed (36%)

Infant formula is basically designed to be medical nutritional tool to feed children of such mothers who are unable to breast feed. Formula feeds do not fully meet the nutritional and immunity needs of infants.

Literacy level is very low in rural area. The diarrhoeal cases in breast fed infants in urban area (48.6%) is less than in rural areas (51.3%) in this study. The diarrhoeal cases in bottle fed infants in urban areas is more (64.8%) than in rural areas (35.1%). Low socio economic status of parents corresponded with greater vulnerability of their infants, irrespective of the mode of feeding.
5.4  ANTIBIOTIC SENSITIVITY TESTING

Antibiotic sensitivity testing is very important for treatment. Treatment begins even before the laboratory results are given. But sometimes antibiotic sensitivity testing enables the clinician to change from a very active antimicrobial agent (which might be toxic at that concentration) to a less active agent or from an expensive to a cheaper antimicrobial agent. Antibiotic sensitivity test plays an important role when patient is not responding to the treatment. Moreover sensitivity testing is used to establish the degree and spectrum of in vitro activity of new antibacterial agents.

Of the 200 isolates Ciprofloxacin was the most effective for *E.coli* (95.4%) in our study. Recent studies by Willie et al.(2011) showed that the drug of choice is Ciprofloxacin to which *E.coli* showed low levels of resistance.

In a study ETEC 9.1%, EPEC 6.8% and EAEC 12.3% , *Salmonella paratyphi* 10.4%, *Shigella flexneri* 1.9% were isolated from 308 children .95% of the isolates were resistant to Amoxicillin and Co-trimoxazole (Shirley et al., 1995).

Cefuroxime is a semisynthetic parenteral cephalosporin with a broad antibacterial spectrum. In a study reported by Eykyn *et al.* (1976) the antibacterial activity of the parenteral cephalosporin and cefuroxime, were compared with that of Cephaloridine and Cephalothin, which have been commercially available and widely used for over 10 years and with that of Cefamandole, an analogue considerably more active against Gram negative bacilli than Cephaloridine and Cephalothin.
The activity in vitro and the properties in vivo of Cefuroxime, the new Cephalosporin for injection, have been described by Collaghan et al., (1976) and Ryan et al. (1976) as having favourable pharmacokinetic properties. It appears to be of very low toxicity in laboratory animals. It seems to have no toxic action on the kidney in contrast to some other Cephalosporins which, at high doses, do have this effect (Foord, 1976).

Bradbher, (1982) recommended that seriously ill patients were found to respond favorably to Ceftriaxone. Ceftriaxone appears to be a safe and effective antibiotic for serious infection in a twice daily regimen.

The impact of oral rehydration therapy (ORT) on the recent decline in diarrhoea mortality in the northeast of Brazil was studied (Victoria et al., 1996). Proportionate infant mortality fell from 32% in 1980 to 17% in 1989 and infant deaths attributed to diarrhoea dropped from 25% to 4%. 