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**EFFECTS OF PRE-HOSPITAL MANAGEMENT OF
DIARRHEAL DEHYDRATION BY A FIRST RESPONDER
ON INFANT MORTALITY**

MASTER OF SCIENCE THESIS

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ONAY

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DECLARATION

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material that has been accepted for the award of any other degree except where due acknowledgment has been made in the text.

18th July 2023

Marriam Waseem Malik

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LIST OF SYMBOLS AND ABBREVIATIONS

ORT	Oral Rehydration Therapy
ORS	Oral Rehydration Solution
WHO	World Health Organization
GEMS	Global Enteric Multicenter Study
MSD	Moderate to Severe Diarrhea
LSD	Less severe diarrheal episode
BHU	Basic Health Unit
LHW	Lady Health Workers
RHC	Rural Health Center
SPSS	Statistical Package for the Social Sciences

ABSTRACT (ENGLISH)

Malik, M. (2023). Effects of pre-hospital management of diarrheal dehydration by a first responder on infant mortality. Yeditepe University, Institute of Health Sciences, Department of Public Health, MSc thesis, İstanbul.

Dehydration has been one of the major causes of death in children under the age of five till date. According to the World Health Organization, dehydration takes the lives of approximately 525,000 children each year. Pakistan, a developing country, has the fourth highest child mortality rate worldwide.

This thesis is a case-control study conducted in rural areas of Islamabad. The research population consists of 100 patients who died as a result of dehydration or who were hospitalized in a critical condition, and 100 control groups who also had less episodes of diarrhea. The data of the study were collected between February 2021 and February 2022. To determine the importance of rehydration therapy and its role in infant mortality, a comprehensive questionnaire was prepared and administered to the participants' primary caregivers. In the findings, a significant relationship was found between the administration of oral rehydration at home and the course of the disease, and improvement was observed in 92% of these infants (p value < 0.05). The most severe manifestations of dehydration were seen in the presence of convulsions, sunken fontanel, or a combination of significant symptoms. On the other hand, no relationship was found between demographic characteristics such as age, gender, caregiver's relationship with the baby, the region of residence and family type, and the course of the disease. In conclusion, the findings of this study are important to promote the use of oral rehydration therapy for children under 5 years of age and raise awareness about it.

Keywords: Diarrheal dehydration, Infants, Oral rehydration therapy, caretaker's education, adversity awareness.

ÖZET

Malik, M. (2023). İshalli dehidrasyonun hastane öncesi yönetiminin ilk müdahale eden kişi tarafından bebek ölümleri üzerindeki etkileri. Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü Halk Sağlığı Anabilim Dalı, Yüksek Lisans Tezi, İstanbul.

Günümüze kadar beş yaş altındaki çocuklarda dehidratasyon önemli ölüm nedenlerinden biri olmuştur. Dünya Sağlık Örgütü'ne göre dehidratasyon her yıl yaklaşık 525.000 çocuğun hayatına mal oluyor. Gelişmekte olan bir ülke olan Pakistan, dünya çapında dördüncü en yüksek çocuk ölüm oranına sahip ülkedir.

Bu tez çalışması, İslamabad'ın kırsal bölgelerinde yapılan bir olgu kontrol çalışmasıdır. Araştırma toplumu, dehidrasyon sonucu ölüm ile sonuçlanan ya da uzun süreli hospitalizasyonu yapılan 100 olgu ve yine ishali olan ama hafif geçiren 100 kontrol grubundan oluşmaktadır. Araştırmanın verisi, Şubat 2021 ile Şubat 2022 tarihleri arasında toplanmıştır. Rehidrasyon tedavisinin önemini ve bebek ölümlerindeki rolünü belirlemek için kapsamlı bir anket hazırlanıp, katılımcıların birincil bakıcılarına uygulanmıştır. Bulgularda, evde oral rehidrasyon uygulanması ve hastalığın seyri arasında anlamlı bir ilişki saptanmıştır ve bu bebeklerin %92'sinde iyileşme görülmüştür (p değeri < 0.05). Dehidrasyonun en şiddetli belirtileri, konvülsiyon, çökük fontanel ya da önemli belirtilerin kombinasyonu varlığında görülmüştür. Buna karşılık yaş, cinsiyet, bakıcının bebekle ilişkisi, yaşanılan bölge ve aile tipi gibi demografik özellikler ile hastalığın seyri arasında ilişki bulunamamıştır. Sonuç olarak, bu araştırmanın bulguları, 5 yaş altı çocuklar için oral rehidrasyon tedavisinin kullanımını teşvik etmek ve bununla ilgili farkındalığı artırmak için önem taşımaktadır.

Anahtar Kelimeler: İshalli dehidratasyon, Bebekler, Oral rehidrasyon tedavisi, önlenabilir hastalıklar tezahür, farkındalık.

1. INTRODUCTION AND PURPOSE

1.1. Background of diarrheal diseases

The term "diarrhoea" refers to loose, watery bowel motions that may be more frequent, with or without accompanying symptoms including nausea, cramping in the abdomen, and vomiting. Even though it may seem harmless and transient, there were 1.6 million deaths attributed to diarrheal illnesses in 2017. One of the top causes of death worldwide is diarrheal illness. More than 500,000 of the 5.4 million children who passed away in 2017 were tragically killed by the disease, which was the cause of one in ten child deaths in 2017. (fig 1).

Dehydration, which by definition means the occurrence of losing more fluid than the intake, depriving the body of enough water and other fluids to carry out its normal functions, and affecting the very young (infants and small children) and the very old, especially for children under five, is the most serious complication of diarrhea (11).

While it is crucial to drink or give plenty of fluids with electrolytes when you have diarrhea, in some parts of the world, especially in parts of Southeast Asia and Africa, diarrhea is a condition that poses a life-threatening risk due to dehydration and loss of electrolytes (10). The World Health Organization first adopted and began using ORT (Oral Rehydration Therapy) in 1978, and since then, it has effectively saved many lives while significantly reducing the burden of disease.

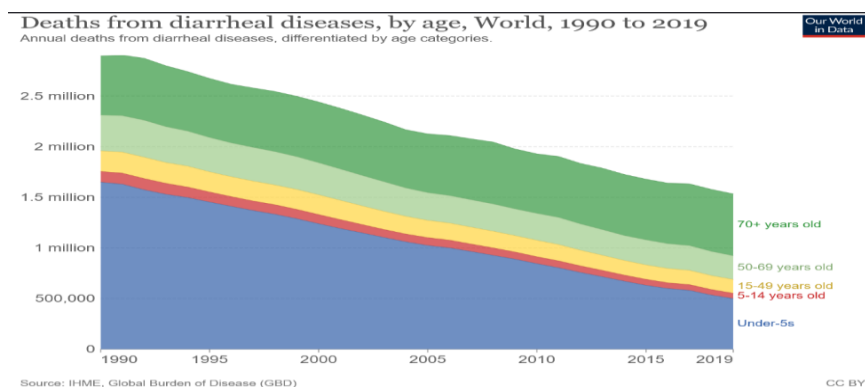


Figure 1. Death by diarrheal diseases from 1990 to 2019

1.1.1. Diarrhea and ORS

1.1.1.1. Diarrhea

According to John Hopkin Medicine, diarrhea is when stools (bowel movements) are loose and watery with frequent episodes of passing stools. If diarrhea lasts more than 2 days, the child may have a more serious problem

a. Types

- **Short-term (acute).** Diarrhea that is resolved in less than 2 days. This may be caused by contaminated food and water (bacterial infection). Or it may happen if your child gets sick from a virus.
- **Long-term (chronic).** Diarrhea that lasts for several weeks. This can be caused by another medical problem, such as irritable bowel syndrome. Intestinal disease can also be the cause. These include ulcerative colitis, Crohn's disease or celiac disease. Giardia can also cause chronic diarrhea; the study aims to focus on short-term or acute diarrhea.

b. Causes

- Infections (bacterial/viral)
- Indigestion (food intolerance)
- Immunity Diarrhea occurs when stools (bowel movements) are loose and watery, with frequent episodes of passing stools, according to John Hopkin Medicine. If the diarrhea lasts more than two days, the youngster may be suffering from a more serious condition.

Types

- **Short-term (acute).** Diarrhea that clears up in less than two days. This could be due to tainted food and water (bacterial infection). It could also happen if your child contracts a virus.
- **Long-term (chronic).** Diarrhea that lasts more than 2 or more weeks. Another medical condition, such as irritable bowel syndrome, can cause this. Intestinal illness is another possibility. Ulcerative colitis, Crohn's disease, and celiac disease are examples of these. Giardia can also cause chronic diarrhea, although this study focuses on acute diarrhea. response to certain foods (food allergy)
- Parasitic infestation
- Reaction to medicines
- Intestinal disease, like inflammatory bowel disease
- Functional bowel disorders (irritable bowel syndrome)
- Surgical
- Traveler's diarrhea

c. Symptoms of diarrhea

Symptoms can occur a bit differently in each child including:

- Cramps
- Abdominal pain
- Bloating
- Nausea
- Frequent nappy changes in case of infants
- Fever
- Blood in stool
- **Loss of body fluid (dehydration)**

The symptoms of diarrhea resemble those of other health issues. Severe diarrhea could indicate a dangerous illness. . But in this study, we focus mainly on signs and symptoms

that are most frequently seen in infants and can account for the severity of disease based on these symptoms from mild to moderate to severe.

d. Red flags for children under 6 months of age

Worrisome signs and symptoms for a child less than 6 months of age:

- Abdominal pain
- Bloody stools
- Frequent vomiting
- refusing to consume liquids
- High fever
- Dry mouth
- Loss of weight
- Urination with less frequently (< 6 diapers per day)
- Excessive episodes of diarrhea
- Extreme thirst
- Tearless cry
- Sunken (fontanelle) on baby's head

1.1.2. Oral Rehydration Therapy Composition

- **Oral rehydration initiation**

A sort of fluid replacement used to treat and prevent dehydration caused by diarrhea.

Originally composed of a reasonable amount of water, sugar, and salt, it was later enhanced with sodium, potassium, and, most recently, zinc. If glucose is unavailable, sucrose can be replaced, and sodium bicarbonate can be used for sodium citrate. Oral rehydration therapy has been shown to reduce the risk of death from diarrhea by up to 93%. ORT was first utilized in the 1940s, but it was not widely used until the 1960s, following a cholera outbreak.

The best treatment for dehydration caused by acute diarrhea, oral rehydration solution (ORS), is the most important medical advance of the twentieth century because it is critical to reducing baby and child morbidity and mortality. Pathogens that cause acute diarrhea include those that create enterotoxin on the surface of the intestinal mucosa, promote secretion, but are not invasive (e.g., *Vibrio cholerae*); those that assault and destroy the mucosal lining (e.g., *Shigella* species); and rotaviruses. The World Health Organization (WHO)/UNICEF ORS is regarded as the universal ORS. Much study has been conducted to determine the optimal ORS composition. The ORS must have enough sodium to replace volume losses, a glucose concentration that matches the sodium concentration to assure transport to the ileum, and enough potassium.

The most common cause of child malnutrition is diarrheal illness. Many cases of acute diarrhoea are caused by toxin-producing bacteria. Dehydration caused by acute episodes of diarrhea is treated with oral rehydration solution (ORS). WHO recommends a single oral rehydration formula containing 3.5 g sodium chloride, 2.5 g sodium bicarbonate or 2.9 g trisodium citrate dihydrate, 1.5 g potassium chloride, and 20 g glucose per litre of water. This ORS solution is suitable for people of all ages and for all types of diarrhea. ORS replenishes and maintains fluid and electrolytes that have been lost. In most industrialized nations, pediatricians do not recognize this ORS formula in cases of rotavirus diarrhea because rotavirus blunts some absorptive villi and lowers activity.

1.2. Reasons of Importance

Dehydration caused by diarrheal disease alone is caused by a loss of body fluids, especially water and salts. Children who have diarrhea can lose large amounts of salt and water from their bodies and can quickly become dehydrated, especially under 5 years of age, with special consideration for infants under 1 year of age. Children can get dehydrated even more quickly if they are vomiting. MSD takes 2,195 children daily, more than AIDS, malaria, and measles combined. In textbooks drinking clean water, proper hygiene practices and scheduled vaccinations can be enough to prevent it, but in reality, some parts of the world like Sub-Saharan Africa and South Asia with countries like Mali, Mozambique, The

Gambia Bangladesh, India, Pakistan, and Kenya even today are struggling with the disease as one of the deadliest mortalities caused in infants because of a lack of hygiene, knowledge, resources, infrastructure, political instabilities, and economic crisis. Identification of signs of dehydration and home-based cure becomes highly important in this situation, not only to minimize the burden on governments and organizations but also on the healthcare system, to identify signs of diarrheal complications and to combat them as soon as possible to prevent devastating results.

1.3. Significance and Aim of This Study

The purpose for this study was to test a hypothesis based on evidence of early identification of dehydration in diarrheal disease by the first responder of an infant was significantly important in reducing the risk of mortality or morbidity in low socio-economic communities. As with 465,000 estimated annual child deaths in 2008, Pakistan has the world's fourth-highest burden of child mortality, contributing 5% or 1 in every 20 child deaths to the global child mortality pie (3), and is one of seven participating countries in the Global Enteric Multicenter Study (GEMS) due to its high burden of child mortality. This is potentiated by illiteracy, lack of health information, and malpractice in society. This particular study aimed to differentiate between the outcomes of dehydrated infants reported to the local healthcare centres, with or without initial rehydration therapy either with WHO guidelines or otherwise general practices of rehydration and observation of knowledge in the general population especially the parents of these infants and if it had affected mortality rate or positive impact on the infants' hospital management. It was of great importance in saving precious lives and decreasing the load on hospitals and healthcare setups and reducing hospital exposure for these families.

1.4. Innovations Aiming

After the desired outcome of this data-based hypothesis has been proven results available that support the evidence that rehydration efforts made for a dehydrated infant before reaching the hospital can avoid mortality/morbidity in infants and to what extent. Based on

these results, the program can further be taken up to help healthcare workers and medical practitioners to pay more attention to counseling caregivers/mothers/first responders to identify complications of diarrhea and simply manage them at home before reaching the hospital for definitive treatment by pediatricians. Also, models can be designed for more effective, easier, and inexpensive ways to raise awareness amongst caregivers regarding the causes, signs, symptoms, and management of MSD. As there are many hurdles in rural areas of developing countries, special attention to Pakistan (my area of focus) where the infrastructure and system of patient transport are not very well established the caregivers are not literate or trained to deal with such situations. This study can pave the way for further improvement in this to avoid future mortality in a curable/preventable disease such as diarrheal dehydration by simple steps. Prospective studies can be done in the future for the effects of co-counseling these cases as well as other manageable childhood diseases, which is one out of all the possibilities that can be achieved by this current study.

Therefore, the aim of this study was to determine:

1. The use of early rehabilitation at home for dehydration caused by diarrheal disease can significantly reduce the risk of mortality or morbidity in low socio-economic communities.
2. Positive results carved a way to decrease the load on hospitals and healthcare setups and reduce hospital exposure for infants by treating them correctly at home
3. To provide an evident correlation between early detection of fatal signs symptoms of dehydration and prompt treatment which will help healthcare workers and medical practitioners to pay more attention to counseling caregivers/mothers/first responders to identify complications of diarrhea
4. Based on a proven hypothesis models that can be designed for more effective, easier, and inexpensive ways to raise awareness amongst caregivers regarding the causes, signs, symptoms, and management of MSD.

2. GENERAL INFORMATION

2.1. Literature Review

Dehydration is caused by acute diarrhea and vomiting in infants worldwide.

Gastroenteritis-associated vomiting also leads to infantile dehydration (1). Due to electrolyte imbalance and dehydration, diarrhea is a significant cause of death in children under five years old. Even if a baby is not consuming breast milk or formula, dehydration may still exist. Infants are particularly vulnerable to the negative effects of dehydration due to increased metabolic rates and higher evaporative losses. Dehydration in infants is characterized by decreased urine production, decreased tears, sunken eyes, dry mouth, depressed anterior fontanelle, and no tears. To maintain a homeostatic fluid environment, infants require greater volumes of water (2).

A review article evaluated children under 5 for the prehospital management of diarrhea-causing dehydration. Caregivers with children were interviewed by questionnaires and it was concluded that dehydration danger signs had no relationship with education and knowledge. Prehospital management can be done by anyone following diarrheal restrictions during episodes and correct use of ORS (3). Probiotics, prebiotics, fibre, and micronutrients along with early nutritional supplementation can be an effective management protocol in infants with dehydration complications (4).

A study conducted in Nigeria in 2017 about prehospital management of dehydrated children stated that oral rehydration therapy can be used as primary management or first-line treatment. The study concluded that despite high maternal awareness and the use of ORT, the impact of the treatment was obscure due to vomiting and feed refusal (5).

Another study conducted in 2001 about infant feeding practices in complex emergencies concluded that infant mortality rates are lower in a population where mothers breastfeed their newborns than in bottle feeding. According to the results of the study, diarrhea is the main cause of infant mortality increasing the chances of dehydration which can be addressed by continuous feeding by mothers (6).

A well-renowned study conducted in 2010 studied the effects of prebiotics and probiotics in children with diarrhea and dehydration. According to the analysis, both probiotics and prebiotics are equally responsible for preventing diarrhea and dehydration in infants (7). Oral rehydration solution is the best recommendation to treat impending dehydration in infants until 6 months in more than 90 per cent of cases. Rehydration in this way can prevent children from being hospitalized, according to a German study conducted in 2009 on acute infectious diarrhea in children (8). Another review article worked on homecare issues in viral gastroenteritis causing vomiting and dehydration. The study recommended that home-based management with hygienic conditions may limit emergency department visits and hospitalizations (9).

In a systematic review, Lamberti and his colleagues included all research that addressed child dehydration in low- and middle-income nations. Estimates of mild, moderate, and severe dehydration indices were produced by the study. Most of the time, severe dehydration in children and newborns was shown to influence infant mortality (10).

According to a study written by an American author and published in a peer-reviewed publication, newborns can avoid dehydration by receiving immediate thermal protection, which lowers the risk of infant death. Other measures that reduce hospital visits include breastfeeding and dressing (11). Infant prehospital treatment is now a common practice among caregivers. There are oral rehydration products in every home. As a result, these solutions significantly reduce infant mortality due to their accessibility (6).

In 2011, a systematic study was undertaken in Africa to examine infant mortality related to pneumonia, diarrhea, and malaria with the introduction of various home treatment alternatives before hospitalization. According to research, community health professionals are crucial in reducing the factors that ultimately lead to newborn dehydration (12). 20ml/kg bolus of normal saline can be given as prehospital management to infants with severe dehydration and dry mouth. It is better to transport infants with severe dehydration to the hospital for IV fluids if caregivers fail to maintain a homeostatic environment and transport the child to the hospital (13).

Research conducted by Munos and his colleagues found that ORS can reduce diarrhea mortality by 93%. ORS is a tried-and-true strategy that may be applied at the community level to reduce diarrheal mortality and treat dehydration. By properly distributing ORS and encouraging its usage at home, ORS coverage should be enhanced to reduce diarrhea mortality (14). Homeless people in America are constantly at risk for health problems. Ailments like diarrhea have a large impact on infants. Dehydration develops into a serious emergency if it is not treated. Identifying diarrhea and dehydration as soon as possible is critical to prevent consequences. So, educating homeless parents is the key to preventing sickness in babies (15).

The essential techniques for treating infantile diarrheal illnesses at home include early care and the detection of warning symptoms. This study attempted to gauge the level of awareness of baby dehydration and diarrhea in Uttar Pradesh, India. According to mothers' understanding, newborns' life-threatening symptoms included frequent vomiting and wet stools. Less than half of the women knew about the use of ORS, and some of them were able to properly make the solution. Half of the moms ceased breastfeeding, while the other half continued it during diarrhea and dehydration. Some of them were aware that a homemade sugar-salt solution might be used to treat diarrhea and dehydration instead of water. According to the study, the mother's attentiveness was insufficient. It was recommended to instruct them (16).

Another study conducted in the United States stated that a combination of glucose-based oral rehydration solution and a rice syrup solid-based ORS can be used as a gold standard for treating severe dehydration due to ailments (17).

Another study conducted in India suggested that after conducting a survey it was concluded that the majority of houses in India have readily available sugar, salt, and water solutions at home for uncomplicated diarrheal dehydration for infants. Such solutions reverse dehydration and in addition to home care, the researchers highly recommended frequent breastfeeding which is proven to act as a miracle in combating diarrhea and maintaining rehydration. In this way, dehydration-related mortality can be markedly reduced (18).

Another author led a study in which fluid and dietary management at home in infantile gastroenteritis is an effective intervention to deal with dehydration. Corrective use of an oral rehydration regime for one or two days along with infants' normal diet is the key factor to overcoming the manifestations of diarrhea, vomiting, and ultimately dehydration (19).

A study demonstrated that the severity of the condition determines the management of dehydration at home for infants less than six months. If the condition is mild, can be treated at home but the severity of the condition demands hospitalization. So, it's way better to initially overcome the condition with home care. This study also encouraged the use of oral rehydration such as Pedialyte, Enfalyte, or a store brand that contains the correct number of electrolytes to fight dehydration. After every few minutes, an infant can be given two teaspoons of oral rehydration solution. If vomiting is not frequent continue formula or breastfeed and medications should not be given unless recommended by a doctor. The study also recommended some tips for infants under 1 year, for instance, infants should be given un-sweetened fluids and slowly the number of oral fluids can be increased (20).

A systematic review closely monitored some African infants and suggested feeding should be paused for an hour if frequent vomiting is present. After such a time limit, a caregiver can resume the replacement of diarrheal fluids. Also, children should not be given a BRAT (Banana, rice, applesauce, toast) diet and continue a regular diet. The study also recommended the use of ORS with ReSoMal which contains higher potassium and lower sodium level than the original oral rehydration solution (21).

Feeding infants are not required extra fluids if they are dehydrated just because they are getting all the essential nutrients from the natural mechanism. So, infants suffering from dehydration should continue feeding. The study also suggested ice lollies if it's hot outside to keep them hydrated if it is a mild level of dehydration. If the level of dehydration is severe, and the baby has all the symptoms like sunken eyes, dry mouth, lack of tears, etc. then an oral rehydration therapy solution could be offered to keep them hydrated and continue to breastfeed or formula. After a large watery stool, 5ml/kg of ORS can be given to avoid the increased risk of dehydration (22).

Another study conducted in Kisumu County, Kenya in 2021 suggested that for diarrheal home management, caretakers looking after infants under five should be assessed. So, a survey of 394 caregivers was performed in the form of questionnaires. It concluded that the majority of the population was well aware of the causes of diarrhea and dehydration, about one-quarter population was aware of home management of the condition, and 20% population knew already about the positive effects of breastfeeding during diarrhea and dehydration. So, the study recommended educating parents about home management of dehydration due to ailments (23).

Children of 4 months should be encouraged towards breastfeeding before ORS. After that with the addition of ORS, breastfeeding should be grouped. Antibiotics, antimotility, and anti-secretory are less effective than the ORS Protocol and it reduces vomiting and diarrhea by 30 percent. The study also discussed that the World health organization also recommends the use of zinc which is lost in diarrhea and it should be given for 12-15 days. And the indication should be 10 milligrams for infants less than 6 months. The study also gave some guidelines to follow. For instance, with each diarrheal episode, a supplemental diet and ORS should be given to infants suffering from diarrhea with no dehydration. Normal diet, ORS, and medical care should be followed for infants with a combo of diarrhea and dehydration (24).

Another study suggested stopping lactose use in infants if diarrhea and dehydration are severe. This study also recommended using home-available fluids such as salt, sugar solution, soups, rice water, coconut water, mineral water, etc. Simple sugar solutions and glucose solutions should not be encouraged (25).

Sometimes infants undergo hypernatremia dehydration due to lactation failure which is a life-threatening condition and requires medical attention. The condition is mostly caused by inadequate breastfeeding and fluid intake. So, parental knowledge should be increased in countries with limited resources (26).

Another study reported the same protocol for dehydration in infants. It suggested that to overcome dehydration, breastfeed your baby as much as you can or formulae them. Do not

switch instantly from formula milk, sugar drinks, or fruit juices because they can add more complications and symptoms can be worsened. Rather, rice porridge, vegetable soup, and coconut water in combination with ORS are recommended for infants more than 6 months, and for those who are on a solid diet, their diet should be continued to restore nutrients. The study also demonstrated that it is difficult to rule out diarrhea in some infants because of its initial stage. So, the best way to rule it out is to go for signs such as fever, poor eating, and sunken eyes. In formula-fed infants, the stool is yellow in colour and smells bad. So recommended home management is keeping them hydrated by electrolyte balancing drinks and cereals for infants who are given solids (27).

According to another study, the disease resolves itself a few days after home management. But in immunocompromised infants, it can prolong and can lead to hospitalization. So, it is encouraged for caregivers at home to majorly focus on hydration status and maintain electrolyte losses to decrease the mortality rate. Low oxygen saturation (90-92%), moderate-to-severe respiratory distress, dehydration, and the occurrence of apnea are all requirements for hospitalization. Children with established risk factors should undergo a thorough evaluation. Consistent recommendations call for rehydrating children who are dehydrated, replacing continuous fluid losses, continuing breastfeeding while they are being rehydrated, and starting an age-appropriate diet after the first rehydrating (it is not necessary to avoid milk-based products). Severe dehydration, social issues (such as worries about a caregiver's capacity to recognize which symptoms call for a follow-up visit or to follow rehydration therapy instructions), unsuccessful rehydration, or suspected dangerous alternative conditions are also indications for hospital admission (28).

In Indonesia, research on mothers' perceptions of diarrhea-related dehydration and how it affects ORS usage was carried out. A study on 100 moms of young children under the age of five was done in rural Indonesia. In their houses, a structured questionnaire was distributed using an interviewing approach. Only 38% of the moms who participated in the survey could correctly identify two or more dehydration symptoms and the use of ORS as a home remedy. Researchers concluded that additional programmed assessment and intervention research and enhanced health education programs for mothers of young

children were needed. Oral rehydration salts contributed to the well-being of infants which added to the positive effects of fluid therapy (29).

Another study conducted in West Ethiopia for the home-based management of diarrhea in infants less than 5 years of age demonstrated that a solid home-based management technique for diarrhea in young children is used by more than half of the responders. The variables discovered were caregivers' level of education, whether they were the mothers of the kid and monthly income. Therefore, it is crucial to provide caregivers with health education and awareness programs on diarrhea prevention, oral rehydration solution usage, and fluid preparation at home (30).

3. MATERIALS AND METHODS

3.1. Study Design

This study was an observational study that collected data through a survey. A case-control analytical study design was used to determine the correlation between different outcome variables in infants in one time period retrospectively after dividing equal participants as cases and controls based on outcomes of the disease.

3.2. Study Duration

The duration of the study was 6 months during which the data was collected from the participants. The data collection began in October 2022 and was completed in November 2022 in which data for 1 year from 1st February 2021 to February 2022 was collected.

3.3. Study Setting

With the help of Lady Health Workers and the District Health Officer of Islamabad data was collected personally in collaboration with local teams from 4 districts of the rural developmental area of Zone 4 in Islamabad which mainly comprised of large 4 areas: Terlai, Taramri Jhang Sayeedan, and Alipur infants were reported to either the LHWs or were brought to the local basic health units where not only first aid was provided but also was referred to tertiary care units in case of need.

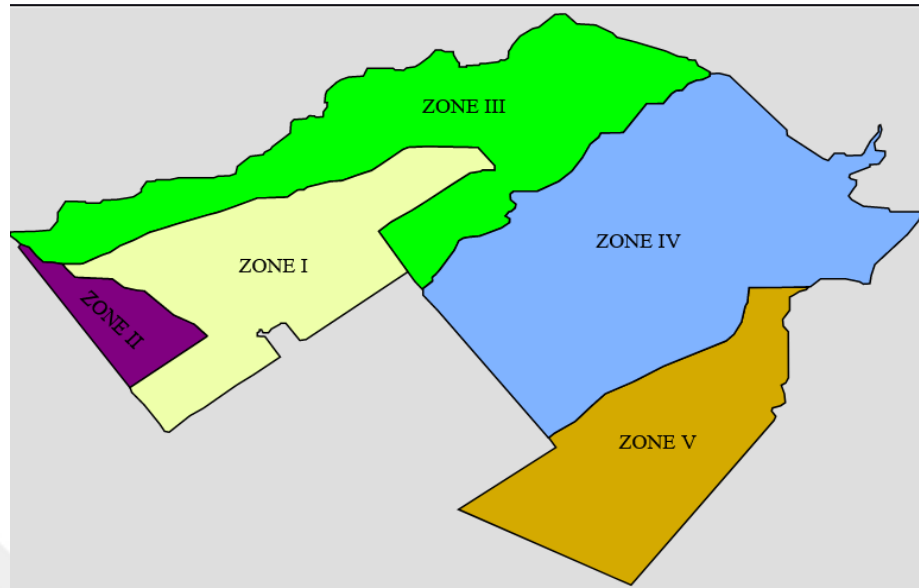


Figure 2. Selected zones of Islamabad

3.4. Study Population and Sample Selection

3.4.1 Sample Size

In total, 250 participants were approached for data collection. Out of 250, responses given by 48 respondents were incomplete and thus excluded from this study. Overall, the response rate was 80 per cent. And 200 participants were selected for the study.

Out of total of 200 infants selected 100 cases and 100 controls with exposed controls at 50% and individual cases at about 71.5 %. Based on infants under age 1 living in rural setups majorly these 4 Union councils in Zone 4 of the federally administrated area of the capital city of Islamabad, Pakistan, between 1st Feb 2021 and Feb 2022. Data was collected after approval from the ethical committee and the District Health Officer at that time who is the administrative authority from the Ministry of Health.

The approximate population of areas from where the data is collected

DISTRICT	POPULATION
JHANG SAYEEEDAN	6,230
ALIPUR	29,936
PIND BEHWAL	9,270
TARLAI KARAN	17,000
TARAMRI	3,265

Approximate population = < 55,000 population with approximately 1300 infants born between Feb 2021-22. Using EpiInfo Statcalc v7 sample size was estimated with power 80% which consisted of equal cases and controls.

Table 11. Area frequency

Area	Frequency	Percent
Alipur	47	23.5
Jhang Sayeedan	32	16.0
Tarlai	81	40.5
Taramri	40	20.0
Total	200	100.0

Confidence Level: 95%

Population Size: 2000 approx. infants (under 1 year of age)

The margin of Error: is 5%

P-Value: 0.05

Sample Size: approximately 250 infants who were reported for isolated diarrheal disease reported in 1-year duration and the outcomes but 200 were selected based on the willingness of parents and inclusivity criteria.

3.4.2 Data Collection Process

The data was collected with the help of Lady Health Workers who are structured in the healthcare system in Pakistan to ensure the provision of primary, preventative, promotive, and curative care services mainly in marginalized remote rural and urban slum communities, with the main objective of providing these services at the community level, particularly for women and children. Through almost 90,000 Lady Health Workers (LHWs). A particular Tehsil (town) has a certain number of LHWs detailed who walk door to door to help people with non-emergency medical conditions and preventive care, reporting the data to their allocated BHUs (Basic Health Units) or RHC (Rural Health Centers). During the data collection of the study approximately 60 LHWs participated in 4 districts was collected who personally attended the infants with diarrhea or were reported to. The pre-approved questionnaires were filled under the supervision of the researcher (first author) after the informed consent was taken from the first respondents of the diseased infants over a period of 1-2 months. the data collected was conditionally collected in 3 forms i.e.; from the first respondents who were notified by the dedicated LHW, by the LHWs personal data about the patients, the electronic data present in the RHCs mostly comprised of infants who were either referred to Tertiary Care hospitals or were admitted for a certain period in case of critical condition.

3.4.3 Sampling Technique

Non-probability consecutive sampling was used to select the participants for this study. The consecutive sample is a non-probability sampling technique in which the participants are chosen by the researcher at her convenience and requirements as per the sample characteristics. In this technique, subjects which are meeting the criteria are selected until

the required sample size is met. Therefore, every infant that was meeting the criteria for this study was selected until the total sample size was not achieved based on the outcome of the discussed disease.

3.4.4 Sample Selection Criteria and Variables

Enrollment of participants in the study was based on the criteria mentioned below:

- Infants between the age of 0-1 year.
- Infants who were brought to the hospital for diarrhea treatment or reported to lady health workers of the area.
- Both boys' and girls' infants were included in this study.

Independent Variables: Age, Gender, Education level of parents, Socio-economic level of the caregiver, Severity of disease, Previous illness in the infant e.g.; Birth defects, Nutritional deficiencies, Physical and mental constraints time duration of data recorded

Dependent Variables: infants with diarrheal dehydration (isolated diarrheal diseases)

Inclusion: infants (under age 1) otherwise healthy with isolated diarrheal disease born during Feb/march 2021-2022, present in the focal area designated for research

Exclusion: The data collected has the following characteristic

1. Age: children above the age of 1 year are not included in the study
2. Previous illness e.g.: birth defects, nutritional deficiencies, physical and mental constraints, or additional diseases that may lead to dehydration or a similar situation
 - Patients with diarrhea due to cholera
 - Systemic illness (e.g., pneumonia, tuberculosis, enteric fever, and meningitis)
 - Bloody diarrhea
 - Any congenital anomaly or disorder (e.g., a diagnosed inborn error of metabolism, congenital cardiac disease, seizure disorders, hypothyroidism, and Down's syndrome)

3. Time: the data taken before and after Feb 2021-2022 is excluded.

Strengths and Limitations

Strengths: negligible bias in provided data which is consistent and reliable by efficient international authorities, controlled duration of study and distribution of data, easy to analyze, cost-effective, multiple uses of provided data

Limitations: limited data, less diversity, no related secondary data. Findings may not be generalized to all populations of the target region of study

Data taken from a radius outside of the allocated territory is excluded from the study. The focus is on rural areas to establish a relationship between the education of the first respondents regarding dehydration (acknowledgement and management)

3.5. Data Analysis

This study used the Pearson Correlation method for the analysis of data collected through the survey. Pearson's Correlation is one of the most distinctive statistical apparatuses used to determine the strength of the relationship between the two specific variables that are being used. It is labelled by "r" and its value ranges from -1 to +1. When the value of "r" for the two variables lies between 0 and +1, it is said to have a positive relationship. On the other hand, if the value of "r" falls between -1 and 0, there is said to be a negative correlation between the two variables. The higher the value of "r" the stronger the positive correlation there is between the two variables, this correlation is found to have a standardized slope.

The significance of each variable is derived through a T-test or Pearson correlation. To equate the null hypothesis with the sample, mean, the T-test is being used which merges the entire sample into a single value. When the t-value is zero, this relates that the findings from the sample population are almost parallel to the null hypothesis. The value of the t-test

increases as the difference between the sample data and the null hypothesis increases. This test is very crucial in measuring whether the null hypothesis will be rejected or accepted. Rejection of the T-test implies that the variable is significant in determining the relation between two variables. Mainly the variables to be tested for association against the outcome were:

- Education of first responders
- Knowledge of signs and symptoms of dehydration
- Application and knowledge of ORT
- Type of ORT given
- Severity of diarrheal episodes

3.5.1 Questionnaire Setting

A precise close-ended questionnaire also translated into the local dialect in case of need was designed by the first author after modifying it based on the literature review. A copy is attached below. Questions were set after the department and principal investigator's approval. Data was collected with the help of allocated lady health workers (LHWs) of the area, the Hospital/Basic Health Units, and the infant's family individually in case of insufficient data, the questions are divided as followed:

1. Demography
2. Duration and Severity of illness
3. Signs of dehydration
4. Hospital management
5. Outcome

3.5.1.1 The Questionnaire and Variables

- **Demography**

The initiation of the questions was by the demographical area division and basic family introduction question. The most sort after questions to be asked here was the age of the infant in months which was then divided into subcategories for data allocation as well as the level of education of the first responder and the person who was majorly the first responder of the infant. The purpose to inquire about the 1st responder's educational background is to then develop an association with the outcome of the diseased infant if the association is positive it can give us a basis to educate the caretakers of the infants/children to avoid morbidities and mortalities related to early age child care.

- **The severity of the disease and identification**

The questions in this group were to identify diarrhea and the severity of the disease. Diarrhea and vomiting both in excess are major sources of dehydration, especially in the chosen age group of the childhood period. Another question was set up if the responders could identify the severity of dehydration based on the signs and symptoms, some of the S/S were particularly pointing towards life-threatening conditions like fits and depressed fontanelle.

- **Response and knowledge**

The focal point of the study is inquired by these questions where it is established if the first responders have any knowledge about the rehydration therapy or not and if they have the information was it implied or not to treat the dehydration signs and symptoms identified before. As well as to reensure that the concept of ORT is as per the protocols in the practice as it is defined by the health care providers. The type of rehydration therapy given to the infant is asked which can be either of the mentioned above ones or a combination of any two, after the results this can also be established that in the case of mild vs severe disease which combination was popularly used and the effects they had on the outcome.

- **Outcome and feedback**

The last part concentrates on the management of the dehydrated infant in the hospital facility as well as if any additional treatment had to be given other than the rehydration therapy with fluids. The answers given might help to take another step forward in the research to help create a preventive regime that can be taught to the first responders to save precious lives preemptively. Lastly, it was important to take feedback from the healthcare staff if they think that all the precious lives that couldn't be saved or the severity of disease could have been controlled by prehospital home-based remedy the response can be helpful in future studies and management of diarrheal dehydration

The questionnaire doesn't include any pre-constructed scale but rather has questions to measure the variables. Questions are based on definitively related concepts and tailored to fit the focus of the study.

3.6. Ethical Consideration

- The study was designed keeping in view the ethical considerations as stated by “The Declaration of Helsinki”.
- Patient consent was taken before starting the data collection procedure.
- Patient confidentiality was strictly maintained according to the “lock and key” model.
- Participants were informed about the study's general outcome and results.

The method for data sample collection is done by Epi info stat calc. v7

3.6.1 Ethical Board and Permissions:

Ethical approval has been granted by the Non-Interventional Clinical Research Ethical Board Decision in a meeting held on the 14th of September 2022 where adequate documents were provided to the board. The researcher presented a uniquely prepared informed consent form at the meeting and approved it. The process of data collection and

analysis was initiated after the approval. The form of ethical approval has been attached in the appendix

Methodology Summary

This will be a Case-Control Study done in a target hospital setting to acquire data regarding the admission of dehydrated infants (under the age of <1), whether they received any rehydration therapy before they were brought to the hospital, and what effects it had on the outcome of such cases. Method of sample collection is done using EpiInfo Statcalc v7

Case-Control Study for significant odds ratio to determine the relationship between dehydration due to diarrhea and its outcome. Associated with its effects by external intervention and knowledge of treatment which is multifactorial A questionnaire developed by the first author and principal investigator was filled by either the local healthcare workers who were the first responders or the caretakers of infants. After data collection, this data was analyzed by descriptive statistics such as frequency, percentage, and mean $\pm$ standard deviation. To compare the groups (see below the dependent and independent variables) logistic regression analysis using SPSS for the significance of the outcome with the hypothesis was used.

4. RESULTS:

Results obtained in this study are taken by statistical analysis through IBM SPSS version 22. The methods used to draw results, were

- i. Pearson chi-squares. (frequency data charts)
- ii. Independent T Test
- iii. Pearson correlation (for significance and strength of association)
- iv. Simple frequency, mean, median, and standard deviation.
- v. Regression analysis

The method for data sample collection is done by Epi info stat calc. v7

4.1 Demographics:

The study was conducted during the last 3 months of 2022. Data were collected from respondents whose infants were born between 2021 and Feb 2022.

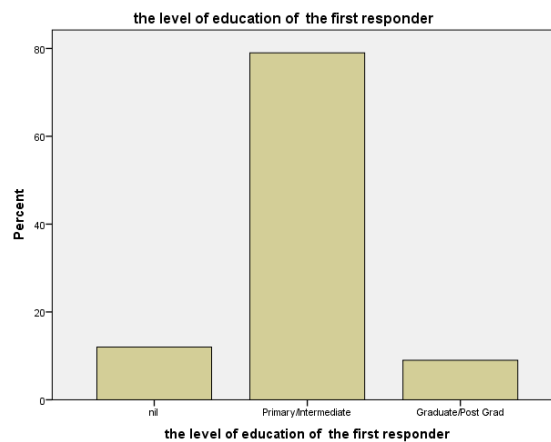
Amongst infants, 1-12 months of age mean age found was 7 months $\pm$ 3, the majority were male 54.5 % whereas female participants 45.5% of all the 200 infants under study (table 2)

Table 12. Gender of Infants

Age (Mean $\pm$ SD) (months)	7.24 $\pm$ 3.23
	n (%)
Male	109 (54.5)
Female	91 (45.5)
Total	200 (100.0)

4.2 Education and ORT:

A total of 32.33% of the population of Pakistan is considered educated with mostly educated to primary level i.e. 67.6% and nearly 16% having a postgraduate degree. Similar results reflect in the study out of 200 participants where 176 (88%) were educated and 24 (12%) were found to be illiterate. Among the educated group, most of the respondents were given formal school education to a primary level:158 (79%). Only 18 participants received education to a graduate or postgraduate level. (table 3)



Graph 1 Level of education of the first respondent

The results shown were promising as amongst the participants of the primary level group 91 out of 158 (57.6%) had information regarding the rehydration therapy for diarrheal dehydration. remaining 67 (42%) were unaware. it was observed that more people were aware of ORT with increasing education levels. According to the data,83% of graduates or post-grads were aware of the remedy for diarrheal dehydration

Table 13. Demographic Characteristics of ORT information with a level of education of the first respondent to the dehydrated infant

	ORT Information		
	Yes n (%)	No n (%)	P-Value
EDUCATION			0.80
NIL	13 (54.2%)	11 (45.8%)	
PRIMARY/SEC.	91 (57.6%)	67 (42.4%)	
GRAD ≤	15 (83.3%)	3 (16.7%)	
TOTAL	119 (59.5%)	81 (40.5%)	

**Pearson Chi-Square*

4.3 Knowledge of first respondents regarding ORT

This question in the study was included to see all the first respondents who had the maximum knowledge regarding ORT. According to the data, mothers were the first respondents the maximum number of times but also had the most knowledge regarding ORT with n= 98 (59 .4%) and the other 67 (40.6%) didn't know. after this, the fathers and other respondents had almost similar results. But these results when run in the analysis didn't show any significance, there is no association between the relation of the first respondent and the knowledge about ORT. But it shows statistically that mothers were more aware of the treatment therapy and are the group that can be taken into consideration for awareness campaigns and preparedness while taking care of infants. (table 4)

Table 14. Knowledge of first respondents regarding ORT

	Knowledge of ORT			
	Yes	No	Total	P Value
	n (%)	n (%)		0.70
Relation				
Mother	98 (82.4%)	67 (82.7%)	165 (82.5%)	
Father	15 (12.6%)	09 (11.1%)	24 (12.0%)	
Others	06 (5.0%)	05 (6.2%)	11 (5.5%)	
Total	119 (100.0%)	81 (100.0%)	200 (100.0%)	

4.4 Multiple demographics about the outcome (table 5)

4.4.1 Gender

As per the results, the outcome based on gender is not significant and has a very negligible association, results of recovery in males were 56 (28%) vs in females 44 (22%). Whereas severely ill or infants were 53 (26.5%) males whereas 47 (23.5%) were females. The

noteworthy difference between the genders was that there was a slightly higher percentage of morbidity/mortality seen in females while in males a positive recovery pattern was seen as prevalent.

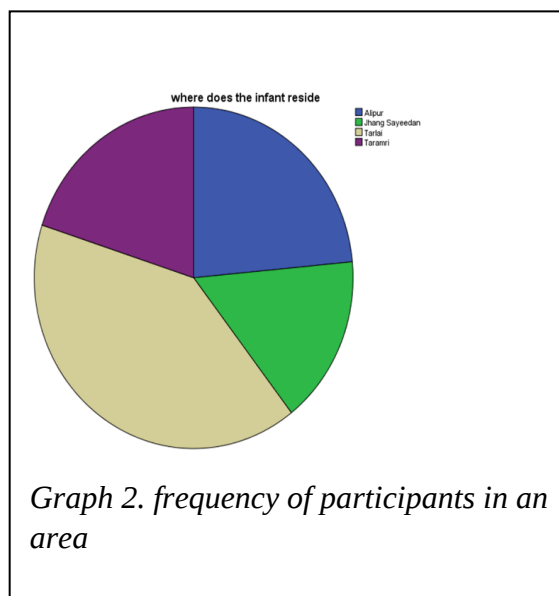
4.4.2 Education

Generally, upon glancing at the results of the association between the level of education of the first respondent and the outcome, you see that the strongest association is weak. Only the group with an education level of graduation and more had more infants who recovered completely (72%) other two groups had more infants who either passed away or became severely ill with a combined rate of 47.5 % (95 out of 200) and individually 13 (54.2%) and 82 (51.9%) respectively. This can broadly be interpreted as a limitation of the data set or may be assumed that education in general cannot specify knowledge about ORT.

4.4.3 Area

Data collected from all four districts showed more or less the same results. Maximum data was taken from Tarlai 81 (40.5%) where there was no significant difference between recovery and death. similar results have been seen throughout the data. With only Jhang Sayeedan becomes the only region with the worst outcome reported with 59% negative results. This pattern seen in the frequency of data was also supported by the statistical analysis where the P value is not significant (0.631)

There has been no association seen between the area and the outcome of the infants.



4.4.4 Age of the infant

The age group kept under consideration globally is under 5 years of age as the developing years are the most vulnerable. a subset of this age chosen for further concentration is an age under 1 year. Further, this was narrowed down to three groups to highlight the most crucial developmental time and effects of diarrheal disease. It was seen during data analysis that infants 1-4 months of age reported a 69.4% mortality/morbidity rate and only 30% recovery. However, in terms of numbers the cases maximum reported were from slightly older age groups i.e. 78 from the 9 -12 months old infant's data and the minimum from the youngest group with 49 infants.

The best recovery rate was seen amongst 9 – 12 months old with a 59% recovery. The trend of recovery was seen in an ascending order which was statistically backed up also by a significant P-value (0.006) which means that there is a positive association strongly present between the age of the infant and the outcome of the diarrheal disease. The factors in support through literature will be further described in the discussion.

4.4.5 Family unit

Pakistan has a prevalent fashion of living to live in a joint family system, especially in the rural setup which can also be seen in the data of this study. Although statistically speaking it is not associated (0.47) but data shows that infants living in a joint family system show a better recovery rate (53%) than the ones living in a nuclear family (46.8%).

4.4.6 Father's education

The education pattern for the first respondent and the father of the infant showed the same pattern of results. Statistically, it is insignificant which shows there is no association between the education of the father and the outcome of the infant disease pattern.

Table 15. Demographics concerning the outcome of the disease

	OUTCOME		
	Recovery	Hospitalization / Death	P-value *
	n (%)	n (%)	0.67
GENDER			
Male	56 (28%)	53 (26.5%)	
Female	44 (22%)	47 (23.5%)	
EDUCATION (First Respondent)			0.737
Nil	11 (45.8%)	13 (54.2%)	
Primary /sec.	76 (48.1%)	82 (51.9%)	
Grad ≤	13 (72.2%)	05 (27.8%)	
AREA			0.631
Alipur	25 (53.2%)	22 (46.8%)	
Jhang Sayeedan	13 (40.6%)	19 (59.4%)	
Tarlai	40 (49.4%)	41 (50.6%)	
Taramri	22 (55.0%)	18 (45.0%)	
AGE OF INFANT (months)			0.006
1-4	15 (30.6%)	34 (69.4%)	
5-8	39 (53.4%)	34 (46.6%)	

9-12	46 (59.0%)	32 (41.0%)	
FAMILY UNIT			0.47
Joint	56 (52.8%)	50 (47.2%)	
Nuclear	44 (46.8%)	50 (53.2%)	
FATHERS EDUCATION			0.79
Nil	6 (46.2%)	7 (53.8%)	
Primary /sec.	80 (49.4%)	82 (50.6%)	
Grad ≤	14 (56%)	11 (44%)	

*Pearson Chi-Square

4.5 Multiple variable associations with Outcome

4.5.1 Relation with the Infant

In the study major two responders found were the parents, with mothers 165 and fathers 24 in number whereas other respondents were grouped while collecting the data it was observed that mostly it was one of the grandparents of the infants, but they were very few in number (11) and mostly this group showed negative results with 63% fatality rate and 36% recovery. Fathers on a similar pattern have a recovery rate of 41.7% and a fatality of 58%. On the other hand, mothers are the most frequent first respondent 82.5 % of the time. Although the statistical test shows no such association between the relation of the respondent and the outcome. But by this, we know that the first respondent is mostly the

mother and more focus can be drawn to teaching mothers about rescue rehydration therapy and child care with regards to their wellbeing.

4.5.2 Age of The First Respondent

The first respondents were divided into 3 major groups, 18 - 25 with n=59, 26 – 35 with n = 117, third group >35 with n=24. The level of education may not be significant statistically but the age of the 1st respondent is significant through the Pearson Chi-square calculation (**0.039**) which is less than the determined P value (0.05). In these groups, the maximum number of respondents reside in the second group with 117 respondents, with a younger population between 26 to 35 years of age. The outcome also revealed that the same group showed the best recovery rate at 56.4%. The distinctive finding was in the group with individuals whose age was more than 35 years + where the adverse outcome was more prevalent with a 70.8% death/morbidity rate.

4.5.3 Episodes of Vomiting

While the study has more focus on diarrhea and the dehydration caused by it. But another factor is vomiting, which plays a vital role in worsening the situation. The groups were divided for analysis into 2 groups. Less than 4 episodes of vomiting were shown by 104 participants with a better recovery rate of 86 (85.4%) and mortality/morbidity of 18 (17.3%). Whereas in the group where there were more than 4 episodes of vomiting, it was analyzed that 86 out of 96 infants either were severely ill or died and only 14 (14.6%) recovered.

The correlation testing also calculated a strong positive association between the outcome and episodes of vomiting with a significance value of **<0.001** meaning that with an increased number of vomiting the outcome was worse.

4.5.4 Oral rehydration

The point of the study was to focus on the role of ORT and the outcome determined by it. After data analysis, it was seen that there is a positive significant association between the administration of ORT and the outcome of these infants (**0.006**) against the ones who didn't receive it. If we open the data sets and observe we can see that 93 infants received the therapy and 107 did not. In the given 93 (91.4%) recovered whereas only 8 infants were not recovered completely. In the other group, the infants who didn't receive the therapy $n = 92$ (86%) had an adverse outcome, in this group only 15 (14%) infants recovered.

4.5.5 Maternal Gravidity

As maternal health is a raving issue in Pakistan even today maternal mortality and family planning require special attention. During the study, the factor was taken under consideration to see the impact of maternal gravidity on infant care during illness. The aim was to establish an association between increased gravidity and adverse outcome of infant diarrheal dehydration. The results of the data responded to the hypothesis as a positive association between the two variables ($P = 0.05 > 0.045$).

As well as the data numerically also responded by the P value, approximately 83% of the 200 mothers who conceived regardless of the outcome less than 4 times had infants who recovered completely as an outcome, 53% of the times where 47% unfortunately, had results otherwise. in the other group where the mothers conceived more than 4 times were 27% in number. The results of those infants were the opposite in terms of recovery with a 35.3% recovery rate and 64.7% infants with death or severe illness as a result (table 6)

Table 16. Multiple variables with relation to the outcome of infants

	OUTCOME			
	Recovery	Hospitalization / Death	Total	p-value *
	n (%)	n (%)		
Relation with infants				0.86
Father	10 (41.7%)	14 (58.3%)	24 (100.0%)	
Mother	86 (52.1%)	79 (47.9%)	165 (100.0%)	
Others	04 (36.4%)	07 (63.6%)	11 (100.0%)	
Age of 1 st respondent				0.039
18 -25	27 (45.8%)	32 (54.2%)	59 (100.0%)	
26 – 35	66 (56.4%)	51 (43.6%)	117 (100.0%)	
35<	07 (29.2%)	17 (70.8%)	24 (100.0%)	
Episodes of vomiting				<0.001
Less than 4	86 (82.7%)	18 (17.3%)	104 (100.0%)	
More than 4	14 (14.6%)	82 (85.4%)	96 (100.0%)	

Oral rehydration				0.006
Yes	85 (91.4%)	08 (8.6%)	93 (100.0%)	
No	15 (14.0%)	92 (86.0%)	107 (100.0%)	
Maternal Gravidity				0.045
Less than 4	88 (53.0%)	78 (47.0%)	166 (100.0%)	
More than 4	12 (35.3%)	22 (64.7%)	34 (100.0%)	

*Pearson chi-square

*Pearson correlation

4.6. Knowledge and Implementation of Rehydration Therapy

The most sort after results during the study was about the implementation and knowledge of ORT. Data reflects the following results for all 200 participants

- The respondents who had knowledge about the ORT and also administered it to the infants = 87
- The respondents who had knowledge about it but did not administer it due to miscellaneous reasons = 32
- The respondents neither knew the ORT nor gave it to infants = 74
- The respondents despite no knowledge of ORT, adequately rehydrated the infants = 07

In total

- The respondents who had information regarding ORT = 119
- The respondents with no information about ORT = 81

- The respondents who rehydrated infants adequately = 94
- The respondents who did not rehydrate the infants = 106

However, as it has been established earlier that the level of education of the participants is not related to the information they have regarding the OR. But having proper information and then applying it to the dehydrated infant has been proven statistically significant and also has a strong association between the two variables (<0.001) meaning that all the first respondents who had information regarding ORT most of them had applied it to the dehydrated infant as a response before reporting the diseased infant to the healthcare facility. Also, as per *Table 4. (4.4.4)*, The association between the positive recovery outcome of the infant with the prehospital rehydration therapy is significant. (table 7)

Table 17. Relationship between knowledge and implementation of rehydration therapy

	Information of ORT			
	Yes n (%)	No n (%)	Total	P value
Oral Rehydration				<0.001
Yes	87 (92.6%)	07 (7.4%)	94	
No	32 (30.2%)	74 (69.8%)	106	
Total	119 (59.5%)	81 (40.5%)	200	

**Pearson correlation*

4.7. Diarrheal Episodes and the Outcome

The severity of the disease is usually a factor that affects the outcome similarly, in the study data a positive association (P-value = **<0.001**) is observed between the independent and dependent variables. And the relation is found to be statistically significant.

According to the data, all the infants with diarrheal episodes less than 5 times a day showed 98% recovery i.e. 71 infants completely recovered, and only 1 infant was reported dead. Meanwhile, all the infants who had diarrheal episodes more than 5 in a day showed more adverse results, 99 (77.3%) infants either passed away or became severely ill with a long hospital stay. Also, 29 (22.7%) recovered completely which may be the result of rehydration therapy. (table 8)

Table 18. The outcome of infants based on the frequency of diarrheal episodes

	OUTCOME			
	Recovery	Hospitalization/ Death	Total	P-Value
	n (%)	n (%)		< 0.001
Diarrheal episodes				
Less than 5	71 (98.6%)	1 (1.4%)	72	
More than 5	29 (22.7%)	99 (77.3%)	128	
Total	100	100	200	

4.8 Outcome of Multiple Signs/Symptoms of Dehydration

There are multiple signs and symptoms of dehydration that are seen daily by doctors, the majority of them were listed in the questionnaire to inquire from the first respondents, based on which the outcomes were co-related. Results were as per expectations. majority of the infants 84 out of the 200 that survived their caretakers observed very pertinent behavior changes i.e. lethargy or crankiness which was succeeded by dry mouth (curling of tongue, drying of the tongue) and dry eyes or also known as tearless cry, which was seen in 40 infants, out of which only 9 infants with this symptom became severely ill. As far as the infant group where either death or morbidity was seen the most prevalent sign/symptom was fits/convulsions with 37 infants who had adverse outcomes and only 3 recovered. One more interesting finding was that no one with depressed fontanelle recovered completely which is one of the most serious signs of dehydration in infants which cannot be observed in any other age group. All the infants with multiple symptoms together mostly fit/convulsions and dryness of mouth /eyes couldn't recover completely with a 0% recovery rate. (table9)

Furthermore, this was supported by the statistical analysis where the significance level of this association was found positive (< 0.001) by Pearson's correlation. this means that the outcome of the infant is dependent on the severity of the physical presence of the infant

Table 19. Comparing the severity of signs/symptoms of dehydration in infants witnessed by the 1st respondents and the outcome

	OUTCOME		
	Recovery	Hospitalization/Death	Total
	n (%)	n (%)	<0.001
S/S of Dehydration			
Dry mouth and eyes	31 (77.5%)	9 (22.5%)	40
Behavioural changes (lethargy and crankiness)	66 (78.6%)	18 (21.4%)	84
Fits / Convulsion	3 (7.5%)	37 (92.5%)	40
Depressed fontanelle of skull	0 (0.0%)	12 (100%)	12
All of the above	0 (0.0%)	24 (100%)	24
Total	100 (50.0%)	100 (50%)	200

4.9 Type of Fluid Given as ORT

4.9.1 Types of Fluids

After an inquiry from the first respondent about the administration of ORT, the most relevant association is of the type of rehydration therapy that was given to the infant. In the study, it was seen that between the people who did and didn't give rehydration therapy breast milk was mostly given in more abundance by the mothers who didn't agree to give ORT. So, by practice and by community learning breast milk was thought to be the most used rehydration monotherapy for dehydration in respondents with no information of ORT. whereas water was the most frequently given liquid rehydration in both the groups with 43/127. 53% of the people who said yes to ORT gave water as a remedy as well as the people who said no 46.6% also used water as the number one provided monotherapy. The group that gave ORT properly and did a combination of ORT with any other remedy were interestingly the only participants who knew about the diarrheal rehydration therapy and agreed to have given it 30 (100%) of the participants in this group used the medically approved ORT and 32 (100%) used combination therapy. Upon inquiry, this combination was all these times with the ORS and any other fluid most frequently being breast milk and sometimes water. It is also noticeable that the total number of participants is 127 out of the 200 yet not all 127 agreed on giving ORT. The explanation to this possible query is that these 127 in one form or another administered the infants with any oral therapy which was more in diarrhea than the usual amount of feed or fluid they give in daily life but significant attention was paid to the 94 participants who efficiently knew about the ORT standardized by healthcare facilities.

After collection and frequency readings this data was analyzed in SPSS through different correlations for significance. And was found to have significance (<0.001) and also a positive association between knowledge and use of ORT and the right type of ORT. (table 10)

Table 20. Information of ORT and Type of fluid given in that case

		ORT done		Total	P value
		Yes n (%)	No n (%)		
Type of fluid	Breast milk	9 40.9%	13 59.1%	22	< 0.001
	Water	23 53.4%	20 46.6%	43	
	ORS only	30 100.0%	0 0.0%	30	
	combination regime (of any 2 or more)	32 100.0%	0 0.0%	32	
Total		94 74.0%	33 26.0%	127	

***Pearson's Correlation**

4.9.2 Type of Fluid Used and Its Effect on The Outcome

After analyzing the association between knowledge of ORT and the type of fluid given, the next step is to know the efficacy of that given fluid on the outcome of the infant. A descriptive cross-tabulation was run to know the dependence of the dependent variable on the independent variable. All types of fluids were analyzed for the outcome. As per the data, the most given therapy was the combination regime with 32 out of 127 infants recovering completely without any adverse outcome. Similar results were seen with ORS monotherapy with 30 infants with complete recovery. water and breast milk showed somewhat the same results which resulted in majority recovery but showed long hospital stay or death in 47.6% of the infants who were given only breast milk and 38.6% similar results in infants who were given water. The infants who completely recovered constituted

a total of exactly 100 infants from the control group whereas 7 of the 100 cases included here by which we can deduce that 73 infants who were not provided with any of the fluid therapy, unfortunately, showed a negative outcome.

These results were also backed by the statistical correlation tests and the association was found to be strongly positive. (table 11)

Table 21. Type of rehydration fluid given to infants and the outcome

	OUTCOME			
	Full Recovery	Hospitalization/Death		
	n (%)	n (%)	Total	P.Value
Breast milk	11 (52.4%)	10 (47.6%)	21	< 0.001
Water	27 (61.4%)	17 (38.6%)	44	
ORS only	30 (100.0%)	0 (0.0%)	30	
Combined regime	32 (100.0%)	0 (0.0%)	32	
Total	100 (78.7%)	27 (21.3%)	127	

NOTE: Out of 200 infants 127 (63.5%) were given ORT or any fluid resuscitation

*Pearson Chi-Square and correlation

4.10 Correlation Between Therapy Given and The Role It Plays in The Early Rehabilitation of The Infant

After establishing a significant relationship between ORT and outcome. During the survey, another question was asked only from the healthcare workers and hospital staff for all the 99 infants who were admitted to the hospital after their condition became either critical or

they passed away in the hospital during the treatment. If their life could have been saved if they were brought in earlier or if they were brought in with some pre-hospital management. And they responded 95 out of 99 times with a yes. The data also illustrated that in 8 of these children who came with early ORT, their rehabilitation was much easier than the 87 who had no pre-hospital management. Only 4 infants who were brought couldn't be rehabilitated at any cost. The point worth emphasizing here is that 91 of these infants had no ORT given to them before reaching the hospital. These numbers respond well to establishing an association between these two variables

However, there couldn't be an establishment of a significance between the two and the association was also weak by Pearson's correlation (**0.61**) against the two-tail sig. (**0.56 > 0.05 =p value**). This can be explained by two things

- Sample size (n) is very small for analytical analysis
- Early rehabilitation is multifactorial. It not only depends on ORT but also the correct ORT as well as the age, as well as time duration from when the first respondent had identified the signs of dehydration to the time the infant was brought to the hospital, plus the diarrheal episodes in combination with vomiting also depend on the infrastructure of the area they reside in.

This is further concluded in the discussion part of the study (table12)

Table 22. Correlation of information regarding rehydration and the role it plays in the early rehabilitation of the infant

	Early rehabilitation			
	Yes	No	Total	p value
ORT done	n (%)	n (%)		0.56
Yes	8 (100%)	0 (0.0%)	8	
No	87 (95.6%)	4 (4.4%)	91	
Total	95 (96.0%)	4 (4.4%)	99	

NOTE: The results are taken from N = 99 i.e. the infants either were severely ill or died. Healthy infants with full recovery were excluded

4.11 Individual Cases Studies with Unusual Findings

Some of the cases may be masked in the vast data because of the large number, but they are interesting to study as individual cases because they don't resonate with the more popular results. Such cases are worth mentioning in the results for their unique features.

- Case 14: A 7-month-old infant whose mother didn't have knowledge about ORT and didn't provide any therapy, even when the diarrheal episodes and vomiting episodes were in less than 4 in number the infant was admitted to the hospital in critical care and remained there for over a period of 2 weeks because the duration of illness had prolonged and no rehydration therapy was given.

- Case 39: In the controls was one case of a 1-month-old infant who has highly frequent diarrhea as well as vomiting. But because of timely intervention and ORT administration in combination with milk and water, the infant recovered completely without any complication.
- Case 85: This particular infant was administered with the textbook protocol of rehydration yet had complications that led to infant demise. This case led us to find multiple additional reasons that can cause negative results despite the effort. such reasons are discussed in the next chapter.
- Case 104: An infant with 2-3 episodes of diarrhea per day and more than 5 episodes of vomiting with no rehydration therapy led to adverse recovery and the infant had to be kept admitted to the hospital for several days till recovery.

5. DISCUSSION

In Pakistan, 32% of the population is educated most of this public is found in urban areas, since the selected population is on the outskirts of the capital, 88% of the caregiver are educated with 79% only having education till Primary level and according to the data people with at least graduate /post-graduate level had knowledge about the rehydration therapy (83%). Significant positive associations were found between episodes of vomiting and the outcome ($P = < 0.001$), maternal gravidity and information regarding ORT. 92% of the infants recovered when the parents had information about the correct administration of ORT and they adequately performed it. An inverse relation was seen between the signs and symptoms of dehydration and the recovery rate. severe signs like fits and convulsions, depressed fontanelle and a combination of these showed the worst outcome with mostly 90-100% adversity or even mortality. The focus on using ORT was also proved in the results where when other fluids were used as a rehydration therapy like breast milk and water they worked ineffectively. ORT solutions with any other fluid or even alone proved to be the best method as a remedy for dehydration ($P = < 0.001$). However, it couldn't be established how early in the disease the methods of ORT could prevent the advancement of ailment which is usually a multifactorial phenomenon.

In the discussion, some of the major factors deduced in the parts of the result are talked through for elaboration with relevant literature.

5.1. Oral Rehydration Therapy

5.1.1. ORT Knowledge Vs Practicing It Correctly

The most anticipated results during the study were about the implementation and knowledge of ORT as the study aims to determine the role played by quick and correct rehabilitation therapy to save the infant's life (4.6).

As per the statistical analysis of this study, the total number of respondents who had information regarding ORT (n=119) and respondents who had knowledge about the ORT and also administered it to the infants (n= 87) out of all these infants (n=94) were adequately rehydrated. and other results significantly confirmed that the effective method of rehydration also saved the infant's life.

However, as it has been established earlier, the participant's level of education is not related to the information they have regarding the ORT. But having proper information and then applying it to the dehydrated infant has been proven statistically significant and also has a strong association between the two variables (<0.001) meaning that all the first respondents who had information regarding ORT a major fraction of respondents had applied it to the dehydrated infant as a response before reporting the diseased infant to the healthcare facility. Also, as per *Table 4. (4.4.4)*, The association between the positive recovery outcome of the infant with the prehospital rehydration therapy is significant.

A similar study was conducted at Bula-Bulin Comprehensive Healthcare Centre in Nguru, Nigeria (19). Results were conducted amongst 200 participants where only 31(15.5%) people knew the correct composition of ORS/SSS whereas 169 (84.5%) lack knowledge of the correct composition and signs of dehydration. It was deduced that knowledge of diarrhea and ORS has a significant influence on ORS utilization among parents, particularly nursing mothers (P 0.05). As a result, mothers must be educated about the benefits of utilizing ORS to treat diarrhea in children, particularly those under the age of five.

Because most caregivers have good knowledge of the causes of diarrhea but poor knowledge of the signs of dehydration, they generally do not practice diarrheal management at home as advised by WHO. Additionally, caregivers who are knowledgeable about the causes of diarrhea are more inclined to provide water and keep feeding during diarrhea but not ORS. Only 16.2% of caregivers in the study were able to put effective diarrheal management practices into practice at home, according to the study's findings. The ability of caregivers to effectively treat diarrhea at home has previously been linked to their awareness of the causes of diarrhea and the warning symptoms of dehydration

(Mengiste et al., 2013). Additionally, a realistic assessment of the severity of the diarrhea may encourage caregivers to provide better care

5.1.2 Types of Fluid Used as ORT and Local Practices In Diarrhea

As it was established that the use of ORT is significantly important to rehydrate infants next step was to find out the right type of solution used and the most commonly used rehydration therapy used by the parents for the purpose. A descriptive cross-tabulation was run to determine the dependent variables with the independent variable. All given types of fluids were analyzed for the outcome. As per the results, the most given therapy was the combination regime of ORS with water/breast milk, 32 out of 127 infants recovered completely without any adverse outcome despite vigorous diarrheal episodes. Almost identical results were seen with ORS monotherapy with 30 infants completely recovered. In a study, it was observed that not only underhydration can cause adverse effects but overhydration with ORT/ORS can also cause adversities and poor recovery (22). water and breast milk in monotherapy resulted in long hospital stay in 47.6% of the infants who were given only breast milk and 38.6% similar results in infants who were given water alone. The infants who completely recovered constituted a total of exactly 100 infants from the control group whereas 7 of the 100 cases included here by which we can deduce that 73 infants who were not provided with any of the fluid therapy, unfortunately, showed a negative outcome.

These results were also backed by the statistical correlation tests and the association was found to be strongly positive. (table 11)

To determine the kind of ORT applied for baby rehydration, further research was examined. According to a Nigerian research (19). In a survey of 200 caregivers, 40 (20.0 percent) said that the optimal ORS/SSS comprised of salt and water, whereas 31 (15.5 percent) said that salt, sugar, and water were the best options. Similarly, 27 (13.5%)

members of ORS believed it to be coconut water, 18 (9.0%) water plus sugar, and 8 (4.0%) sugar plus salt. Due to the cost of ORS (52) among nursing mothers, about 76 (38.0 percent) of mothers did not know its composition, and this is consistent with a study done in West Java, Indonesia, where mothers' ignorance of the connection between diarrhea and SSS corroborates their use of traditional medicine and other methods.

5.2. Gender Parity Amongst Urban Vs Rural Population

According to the 2021 Global Gender Gap Report, Pakistan is ranked fourth worst in the world for gender parity. Furthermore, only 46.5% of women are literate, 61.6 % completed high school, 34.2 % completed primary school, and 8.3 % completed tertiary education. Children don't have access to enough government schools, or the ones that are there are out of reach for them.

In Pakistan's rural areas, the situation is far worse as schools there lack basic resources like power and water, among other things. Over 60% of the 22.8 million children aged 5 to 16 who are not enrolled in school are girls, according to UNICEF.

This gender parity was also reflected in the undergoing study where males were not only educated more than females (table 5) but also were more in number to receive a higher level of education with 187 fathers with formal education and 13 with no education at all, whereas out of 165 mothers, 20 had no education, 145 with mostly being educated till primary level. These statistics reflected data which was collected from an area which is the capital city of Pakistan where the literacy rate is 82%. These numbers become even more discouraging.

5.2.1 Education of Mother With Regards To Childcare

According to the results from the given study, no association was found between the mother's formal education status and the outcome of diarrheal disease in the infants. As per the results, it was seen only the group with an education level of graduation and more had more infants recovered completely (72%) other two groups had more infants who either passed away or became severely ill with a combined rate of 47.5 % (95 out of 200) and

individually 13 (54.2%) and 82 (51.9%) respectively. This can broadly be interpreted as a limitation of the data set or may be assumed that education in general cannot specify knowledge about ORT. As an observation, while data collection it was seen that the education of the first respondent was a factor for the overall well-being of infants and under 5 children but was not associated with a specification to diarrheal diseases as both are irrelevant. The only way it seemed to be relevant was if mothers had information regarding the signs and symptoms of a dehydrated infant and information regarding ORT which is assumed to be easier to learn if you have education and knowledge about basic healthcare.

Another research conducted in March 2011 by Makerere Medical School in Uganda provided evidence in favour of this hypothesis. In this study (3), despite the people's understanding and acceptance of ORT being adequate, the actual practice was not. Confusion can be shown in the different ways in which caregivers perform the many stages of evolution in the recommended fluid types for oral rehydration. Oral rehydration treatment (ORT) knowledge and abilities must be regularly promoted, and health professionals must make sure that caregivers are instructed in and follow the proper oral rehydration therapy guidelines. , although 73 % of children in the experiment received ORT of dehydration secondary to diarrheal disease at home the results were unsatisfactory as the practice of preparation of the therapy was inconsistent with the standard given by healthcare professionals. Previously another conducted experience with ORT fluids, higher educational or socioeconomic status did not correlate significantly with better performance. Which is very similar to what results deduced in the current study under establishment.

Contrary, to this study a meta-analysis has been conducted under the name “The effect of maternal education on infant mortality in Ethiopia” during 2017- 2019 (50). Multiple research papers were included in the study, the results were surprisingly in favour of an association between maternal education and childcare. According to an estimate, there was a 28 percent reduction in the risk of infant death among moms with only an elementary education compared to illiterate mothers. In contrast to infants born to mothers who are illiterate, another estimate showed that having completed secondary education or above was related with a 45 percent lower risk of infant death. However, alternative analysis utilized

in the five studies considered for this review found no such correlation. Following the discussion of the odds ratio results, some arguments were made that may be relevant for early-age childcare, such as the notion that education improves a mother's knowledge of healthcare practices related to the use of contraceptives, nutrition, hygiene, and disease prevention.

5.3 Vulnerability Due to Age Group

The age group kept under consideration globally is under 5 years of age as the developing years are the most vulnerable infants to volume depletion than older children because of their higher baseline fluid needs (caused by higher metabolic rates), higher evaporative losses (caused by a higher surface area to volume ratio), lower fluid reserves, and inability to express their thirst or seek water, infants are especially vulnerable to the negative effects of dehydration. In this study, this was further narrowed down to three groups to highlight the most crucial developmental time and effects of diarrheal disease in this concentrated period of 1 year of age where it is most necessary to take care of the diseased infant as we have already learnt that taking extra care and the amount of seriousness shown by the caregiver can help save the infants life and avoid adversities to a great extent. However, if they receive the right care, pediatric patients with volume depletion typically have a very good prognosis.

During the study, data analysis has shown that infants 1-4 months of age reported a 69.4% mortality/morbidity rate and only 30% recovery. However, in terms of numbers the cases maximum reported were from slightly older age groups i.e. 78 from the 9 -12 months old infant's data and the minimum from the youngest group with 49 infants.

The best recovery rate was seen amongst 9 – 12 months old with a 59% recovery. The trend of recovery was seen in an ascending order which was statistically backed up also by a significant P-value (0.006) which means that there is a positive association strongly present between the age of the infant and the outcome of the diarrheal disease. It was observed that diarrhea with hypernatremia is more profound in bottle-fed children in comparison to

breastfed children which can be another cause of more seriousness in the illness amongst the older infants who are weaned off from exclusive breastfeeding by that time of age (51).

Another study found that children aged 6 to 11 months had the highest rate of diarrhea, with a median of 4.8 episodes per kid per year. For 4-year-olds, the incidence gradually decreased to 1.4 incidents per child per year. The median incidence was 3.2 episodes per child-year for all children under the age of five (32).

On a global scale, it was estimated that from less than 15% in 1984 to almost 40% in 1993, oral rehydration therapy was used to treat diarrheal episodes. Children under the age of one have had a faster decline in diarrheal mortality than children between the ages of one and four. This is in line with the finding that newborns are more likely to die from severe dehydration diarrhea. Diarrheal dehydration in infants should be avoided as early as possible because it has been shown to be not only fatal but also morbid, as children with both syndromes showed linear growth faltering in comparison to their matched healthy controls during the two to three months following their illness. These results highlight the significance of preventing both LSD and MSD in order to reduce the negative nutritional effects of young child diarrheal illness (35).

5.4 Signs and Symptoms of Dehydration and Degrees of Seriousness of The Disease and Their Outcomes.

There are multiple signs and symptoms of dehydration that are seen daily by doctors, but the first signs that can be seen in the dehydrated infant are dry skin, tongue and lips, rapid breathing, fewer wet diapers and tearless crying. A spectrum of all observed signs and symptoms from mild to severe and combination were listed in the questionnaire to inquire from the first respondents, based on which the outcomes were co-related.

5.4.1 Study Observations and Relevant Results

Results deduced in the study were as per expectations, 84 out of the 200 that survived, their caretakers observed very pertinent behavior changes i.e. lethargy or crankiness which was succeeded by dry mouth (curling of tongue, drying of the tongue) and dry eyes or also known as tearless cry, which was seen in 40 infants, out of which only 9 infants with this symptom became severely ill. As far as the infant group where either death or morbidity was seen the most prevalent sign/symptom was fits/convulsions with 37 infants who had adverse outcomes and only 3 recovered. One more interesting finding was that no one with depressed fontanelle recovered completely which is one of the most serious signs of dehydration in infants and cannot be observed in any other age group. All the infants with multiple symptoms, mostly fit/convulsions and dry mouth /eyes, couldn't recover completely with a 0% recovery rate. (table 9)

In 2013, the WHO strongly advised that a newborn should be referred for additional evaluation if any of the warning signals were detected. The signs should be checked during each postnatal care visit. The warning signs are as follows: 1-stopped eating well, 2-history of convulsions, 3-fast breathing (breathing rate $>60/\text{min}$), 4-severe chest in-drawing, 5-no spontaneous movement, 6-fever (temperature $>37.5^{\circ}\text{C}$), low body temperature 35.5°C , and 7-jaundice in the first 24 hours of life or yellow palms and soles at any age. Since mothers and caregivers would benefit most from being able to distinguish between episodes that need care at a health facility and those that can be successfully treated, appropriate care seeking is especially important in areas with limited access to health services.

5.4.2 Dangerous Signs of Dehydration and Their Effect On Mortality

The signs and symptoms of dehydration in diarrheal disease were defined by WHO and short-listed after the data collection from caregivers of diseased infants, results were compiled after listing the s/s. According to the study the most fatal signs were convulsion, depressed fontanelle and a combination or presence of all these symptoms in an infant

Convulsions or fits are considered to be a red flag sign in any child under 5 but most alarming in children under 1 year of age especially secondary to dehydration which is most evidently seen in the study where only 3 out of 40 infants recovered after developing

convulsions with a roaring 92% fatality rate. (Table 9). ORS provides the required balance of electrolytes such as sodium and potassium as well as rehydration of the fluid deficit.

A noticeably sunken fontanelle is a sign that the infant does not have enough fluid in its body especially in ages between 7-19 months usually, so it is a good severity indicator of infant dehydration. As per the study, 12 infants exhibited this sign and the recovery rate was 0% i.e. all infants with depressed fontanelle resulted in either death or a long recovery time.

Encouragement of this instruction should put a special emphasis on how to spot danger indications and the best course of action to take, especially in rural areas where expert medical care might not be readily available. (55)

5.5 Use of Zinc In Rehydration Therapy

A crucial new element to the treatment plan for pediatric diarrhea is a zinc supplement. New low-osmolarity oral rehydration solutions/salts (ORS) may help to reduce the length and severity of diarrheal episodes for a longer period of time, according to recent studies. To lessen the severity of the episode and prevent subsequent occurrences in the ensuing two to three months, the World Health Organization (WHO) and UNICEF recommend daily doses of 20 mg of zinc supplements for 10 to 14 days for children with acute diarrhoea and 10 mg per day for infants under six months old. This significantly reduces morbidity. Additionally, it was discovered that ORS was less cost-effective than believed. While using zinc as a complementary therapy

Interestingly during the study, it was seen that all the infants managed at the healthcare facility were largely given zinc either as an adjunct to aggressive rehydration therapy or as a combination therapy with antibiotics. As per the results, it is seen that 47.5% of all infants treated at the facility were given a combination therapy of zinc and antibiotics. Similarly, 13% were given zinc alone with ORS and only 37% were treated with only antibiotics. concluding that 63% of all the diseased infants were given zinc on the way or at the facility

The only setback observed during the study was that the childcare program in Pakistan has only enabled healthcare facilities and hospitals to use zinc in severe cases of dehydrated infants. However, there is still a lack of awareness regarding the benefits Zinc can provide in rehydration therapy which is not only a plus but also cost-effective in the regime. An acidified low-lactose infant formula enhanced with precooked rice and added active components, probiotic bacteria, was administered to one group in a recent case-control study.

prebiotic (inulin) and dietary fibre (soya polysaccharides) as well as micronutrients like Zinc and Iron. very encouraging results were deduced that the children in this group not only showed early recovery from diarrhea with lesser stools but also weight gain in a period of 2-3 weeks post-disease. So, it was inferred from the study that adding zinc fibre and probiotics to the diet of both healthy and diseased infants can improve their health and prevent diarrheal disease (4,5).

6. CONCLUSION AND SUGGESTIONS

It was observed through the results and even during data collection that either there was altogether lack of knowledge about the ORT, even if sufficient knowledge was present the timing to use it was not accurate, especially regarding the signs and symptoms of dehydration, red flags in diarrheal diseases and when to label it as an emergency. Data was collected from an area which is the capital city of Pakistan where the literacy rate is 82%, in-depth this data mostly reflected that the majority of the population is educated to a primary level only and that also with a major gender disparity, these numbers become even more discouraging when we move south of the country into other provinces. Statistically the level of education doesn't affect the results of our study but it is generally observed that the higher education level attained by the mothers the better management regarding use of ORT was seen. So it is suggested that more focus is paid to education in developing/underdeveloped countries where communicable diseases are prevalent so that these diseases can be eradicated especially by educating the mothers. It is also because the mothers are taught a lot of local practices mostly adopted by older family members which are most of the times without any medical backing and ineffective.

Education regarding the disease and the complication may also play a vital role in the recognition of disease severity s parents who have a better understanding of danger signs related to the disease considerably increase the likelihood of the mother/caregiver in healthcare facilities as well as take prompt actions at home to prevent further deterioration of the baby. Encouragement of this instruction should put a special emphasis on how to spot danger indications and the best course of action to take, especially in rural areas where expert medical care might not be immediately available (55). Signs of special consideration as per medical knowledge and experience are convulsions, depressed fontanelle and excessive lethargy.

This study will help all researchers, medical professionals, and healthcare workers to promote the need for public awareness regarding communicable diseases, especially with

preventable complications. for example, the correct use of ORT in the age group most susceptible to adverse outcomes can save lives. There was an emphasis on pre-hospital management because a lot of underdeveloped countries face issues like lack of infrastructure, resources and funds, overpopulation, and hesitation to go to healthcare facilities due to financial constraints and various other reasons. So efficient and easy methods of teaching, mass media campaigns and awareness spread in these localities by their healthcare workers or other sources like peers and local political bodies would prove to be a relief for not only the general population but will also ease the burden on healthcare facilities which are already facing numerous challenges like lack of funds, over crowdedness, shortage of staff and a general uncooperative environment.

This particular study can be taken up for follow-up studies to help relevant people design different models and strategies to cater to and eradicate the matter on hand. The same pattern of study can be implemented for other communicable diseases where disease awareness and prompt intervention can save precious lives

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8. APPENDICES

8.1. Ethical Approval



T.C.
YEDİTEPE ÜNİVERSİTESİ REKTÖRLÜĞÜ
Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu

Sayı : E.83321821-805.02.03-70
Konu : Non Interventional Clinical Research
Ethics Board Decision

Sayın Dr. Öğr. Üyesi Hale Arık Taşyikan

Yeditepe University Non-Interventional Clinical Research Ethics Board has reviewed the research proposal placed upon ethical approval for the project as the research title, the researchers, the application number, the ethics board meeting details, and the provided documents have been outlined below. This research proposal has been evaluated by the members of the ethics board and full ethical **APPROVAL** has been granted.

Research Title:	Effects of pre-hospital management of diarrheal dehydration by first responder on infant mortality
Researchers:	Marriam Waseem Malik, Asst. Prof.Dr. Hale Arık Taşyikan
Application Number:	202208Y0273

ETHICS BOARD MEETING DETAILS			
Meeting Date:	14 September 2022	Meeting Place:	Online (Google Meet)

PROVIDED DOCUMENTS	
Wet signed application file, file uploaded to a CD or USB media, and electronic submission	
Title of research and the names of the researchers	
Letter of application	
Application Form	
Nature of the Research;	
• Type	
• Significance and distinctive value	
• Aims and objectives	
• Method	
• Management of the research	
• Widespread impact	
• Pertinence of the budget and reason (if applicable)	
• Timeframe and convenience	
• References	
Informed consent form (uniquely prepared for the research)	
Letter of Undertaking-1	
A commitment to undertake the responsibility of obtaining institutions permission from where the data collection will be made	

Bu belge, güvenli elektronik imza ile imzalanmıştır.

Belge Doğrulama Adresi : <http://belgedogrulama.yeditepe.edu.tr/bg.aspx?id=1CABD20C-59E1-44B9-A1A7-108CE33919BE>

Yeditepe Üniversitesi 26 Ağustos Yerleşimi, İnönü Mahallesi Kayışdağı

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İnternet Adresi www.yeditepe.edu.tr

Kep Adresi : yeditepeuniversitesi@hs03.kep.tr

Bilgi İçin: Didem ÖZDEMİR ÖZENEN

Unvan: Başkan

Telefon No:



Letter of Undertaking-2 A commitment to read the latest version of the World Medical Association Declaration of Helsinki and all relevant guidelines of the Ministry of Health
Letter of Undertaking-3 A commitment on whether there are previous ethical board applications
Letter of Undertaking-4 A commitment that no action will be taken during the research that is not included in the research budget and that will bring additional burden to the volunteer or the Social Security Institution
Letter of Undertaking-5 A commitment to reading the circular on treatment approaches and scientific research in COVID-19 patients
Letter of Undertaking-6 A commitment to reading the document of Research Application Permissions that is published by Ministry of Education
'Resume Forms' filled separately by all the researchers and signed
Additional documents (Scale permissions used, if any, etc.)

Prof. Dr. Didem ÖZDEMİR
ÖZENEN
Chair

Assoc. Prof. Dr. Gökhan ERTAŞ
Deputy Chair

Assoc. Prof. Dr. Elif SUNGURTEKİN
EKÇİ
Reporter

Prof. Dr. Feryal SUBAŞI
Member

Assoc. Prof. Dr. Binnur OKAN
BAKIR
Member

Assist. Prof. Dr. Elif Çiğdem KELEŞ
Member

Assist. Prof. Dr. Emine Nur
ÖZDAMAR
Member

Assist. Prof. Dr. Sevim ŞEN
Member

Bu belge, güvenli elektronik imza ile imzalanmıştır.

Belge Doğrulama Adresi : <http://belgedogrulama.yeditepe.edu.tr/bg.aspx?id=1CABD20C-59E1-44B9-A1A7-108CE33919BE>

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Bilgi İçin: Didem ÖZDEMİR ÖZENEN

Unvan: Başkan

Telefon No:



8.2. Questionnaire Consent Form

16/08/2022

QUESTIONNAIRE CONSENT FORM

You are invited to participate as parents/legal representatives of the featured pediatric volunteers in a questionnaire-based study titled “Effects of Pre-hospital management of dehydration by first responders on infant mortality”. This is a research-based **retrospective case-control study**. The purpose of the study is to understand the effect of early resuscitation of a dehydrated infant in order to save his/her life and severe consequences and the role that the first responder or caregiver of such an infant can perform to help. The study is being conducted by Marriam Waseem Malik (researcher) of the Health and Sciences department, Yeditepe University, Istanbul Turkey, as academic research for her thesis in the Ms. Public Health program under the supervision of Assistant Prof. Dr. Hale Arik Tasyikan (principal investigator). You will participate as a parent/ legal representative/ first responder of an infant with acute presentation of diarrheal dehydration, all participants have to fill out a 10 questions-based survey which will take 5-10 minutes to complete and is the sole participation step required by the volunteers, then these answers are analyzed, analytical tests are performed to deduce results based on the answers provided. As volunteers, you will be expected to answer all the questions with all honesty and correct recall, and false statements or dishonesty may cause termination from the study. The questionnaire has questions based on demography, duration and severity of illness, signs of dehydration, hospital management, and the outcome and similar information. An estimated total of 200 people will participate in the survey. You may refuse to participate in the research or withdraw from the research without any penalty or sanction and without losing any rights; records to reveal the identity of the volunteer will be kept confidential amongst researchers, ethical committees, and relevant institutions and never be made public, even if the results of the research are published, the identity of the volunteer, as well as the information collected from the healthcare setup, will remain confidential. The volunteer or the legal representative will be informed in a timely manner when new information about the research subject is needed, volunteer's willingness to continue in the research will be obtained beforehand. Moreover, there are no risks involved in the research other than the risks experienced in daily life.

Participation in this study may not benefit you directly, but the results accomplished in the study are expected to benefit the community at large. Based on these results, the program can further be taken up to help health care workers pay more attention to counseling of caregivers/mothers / first responders to identify complications of diarrhea and simply manage them at home before reaching the hospital for definitive treatment by pediatricians. Your information will assign a unique code throughout the process and only be presented in a summary form and your name will remain confidential to the fullest extent of the law. No financial burden will be put upon volunteers and no payments will be made. All expenses will be borne by the researcher in case of transport or food, during the process. Taking part in the study is optional but your participation will be highly appreciated In case you have questions or ambiguity regarding the study, financial assistance relevant to the study researcher can be contacted at all times on information given here:

Marriam Waseem Malik (marriamwaseem.malik@std.yeditepe.edu.tr), +92310 3388332, +90 552 607 84 74, +968 7811 9460

|

16/08/2022

"By signing the informed consent form I agree that I have read all the explanations detailed in the consent form in both written and verbal in the local language for my understanding regarding the above-mentioned research given to me by the researcher named below and also in the presence of a witness mentioned below. I also acknowledge that I can quit the research at any point without any implications legal or otherwise. Also, I am participating on behalf of my infant (under 1 year of age) as the legal guardian voluntarily without any pressure or coercion. I agree not to restrict the use of results of this study and use them in reports, publications, and similar scientific experiments when needed. Necessary assurance is provided in case of any difficulty which may arise directly or indirectly from the practice during the process "

Parent/Legal Representative:	Witness
Name: _____	Name: _____
Surname: _____	Surname: _____
Address: _____	Address: _____
Phone number: _____	Phone number: _____
Signature: _____	Signature: _____
Date: _____	Date: _____

Researcher (informer for consent)	
Name: _____	Date: _____
Surname: _____	Phone number: _____
Address: _____	Signature: _____

Initials of legal representative: _____

8.3. Questionnaire

Questions that will primarily be either deduced from the given data of the facility or to be asked from the caregivers/ first responders or the hospital staff to get accurate answers :

DEMOGRAPHY:

- a) Name
- b) Age & date of birth : _____
- c) Sex
 - i. Male
 - ii. Female
- d) No. Of siblings : _____
- e) Gravity no. Of the mother : _____
- f) Area of residence : _____
- g) Caretakers(first responder) name : _____
- 1) Relation : _____
- 2) Age : _____
- 3) Level of education
 - a) Nil
 - b) Primary
 - c) Intermediate
 - d) Graduation
 - e) Post graduation or more
- h) Fathers name : _____
- 1. Age : _____
- 2. Level of education
 - a) Nil
 - b) Primary
 - c) Intermediate
 - d) Graduation

e) Post graduation or more

i) Family unit :

- i. Joint
- ii. Nuclear

1. Established diagnosis is dehydration secondary to isolated acute gastroenteritis :

- a) Yes
- b) No

2. DURATION AND SEVERITY OF ILLNESS :

- Number of diarrhea episodes per day :

- i) 1-2
- ii) 3-5
- iii) 6-8

iv) 9-10

v) More than 10

- Accompanied episodes of vomiting :

- i) 0-2
- ii) 3-4
- iii) 4-5

iv) More than 5

3. IDENTIFICATION

- Signs of dehydration seen by the first respondent for which the infant was brought to the emergency dept accompanied with diarrhea :

iii. Dry mouth and eyes

iv. Behaviour change (crankiness or lethargy)

- v. Fits / convulsions
- vi. Depressed fontenelle of skull
- vii. All of the above

4. Does the mother / care giver had information regarding rehydration therapy :
(a) Yes
(b) no

5. Oral rehydration done either via breast feeding or other fluids adequately
a) Yes
b) No

6. In case of a given therapy what was the type of fluid given (skip incase the answer for question 4 is "No")
I. Breast milk only
II. Water only
III. Ors only
IV. Combination regimen

7. TREATMENT GIVEN DURING HOSPITAL STAY

- Treatment given immediately after the admission i.e: aggressive rehydration therapy given ?
a) Yes
b) No

8. incase of any addition therapy given , state the treatement?

9. OUTCOME OF HOSPITAL ADMISSION

- What was the outcome of the infants stay at the hospital or facility ?
a) Full recovery
b) Prolonged hospital stay including intensive care or high dependency treatment
c) Death

10. FROM THE STAFF

- Had the infants life be able to be saved if a pre hospital managemnet was given earlier or the child was brought in early in time (to be answered by the hospital staff)?

(1) Yes

(2) No

(3) Maybe

8.4. Data Collection Permission Letter Pakistan



YEDİTEPE UNIVERSITY
INSTITUTE OF HEALTH SCIENCES

Date:15/01/2022

Dr Zaeem Zia
District Health Officer
Islamabad

Subject: REQUEST FOR PERMISSION TO USE YOUR DATA TO CONDUCT ACADEMIC RESEARCH

Dear Dr. Zia

My name is Dr.Marriam Waseem Malik , and I am a Public Health student at Yeditepe University, Istanbul Turkey . The research I wish to conduct for my Master's dissertation involves Effects of pre-hospital management of dehydration by first responders on infant mortality. This project will be conducted under the supervision of Assistant professor Dr. Hale Arik Tasyikan, Dept. of Health Sciences Yeditepe University, Turkey

I am hereby seeking consent for using your data collected over the past period of 1 year in the rural outskirts of capital district of Islamabad for children under 1 year of age for patients with dehydration secondary to diarrheal disease

I have provided you with an attachment of my thesis proposal as well as copies of the consent and assent forms to be used in the research process, signed by my supervisor. I also assure the authorities that the data is strictly used for academic purposes and no risk is involved other than the risks expected in daily life. With this I shall also maintain anonymity of my responders as well as the provided data regarding the infants from the data record of the local health facility. A copy of consent form for written informed consent is also attached to the application assuring that incase of contact with the parents/caretakers for further details, complete research has been explained to them in their local language for better understanding before signing the translated consent.

If you require any further information, please do not hesitate to contact r

Email :(marriamwaseem.malik@std.yeditepe.edu.tr)

Contact numbers: +92310 3388332 , +90 552 607 8474

Thank you for your time and consideration in this matter.

Yours sincerely,

Dr.Marriam Waseem Malik

Yeditepe University ,Istanbul Turkey

Kayışdağı, İnönü Mahallesi, Kayışdağı Cd., 34755 Ataşehir/Istanbul, Turkey
Yeditepe Üniversitesi

E-mail : info@yeditepe.edu.tr · Phone : 0216 578 00 00 · Fax : 0216 578 02 99.

9. Curriculum Vitae

Personal Informations

Name	Marriam Waseem	Surname	Malik
------	----------------	---------	-------

Education

Degree	Department	The name of the Institution Graduated From	Graduation year
Doctorate			
Master	Public Health	Yeditepe University	2023
University	MBBS	Yusra Medical & Dental College	2018
High school	Pre-medical	Army Public School & College	2011

Languages	Grades ([#])
English	IELTS Band 7.5

[#] All the grades must be listed if there is more than one (KPDS, ÜDS, TOEFL; EELTS vs),

Work Experience (Sort from present to past)

Position	Institute	Duration (Year - Year)
Medical House Officer	Pakistan Institute of Medical Sciences	2018-2019
		-

Computer Skills

Program	Level
Microsoft Office	Excellent

*Excellent , good, average or basic

Scientific works

The articles published in the journals indexed by SCI, SSCI, AHCI

Articles published in other journals.

Proceedings presented in international scientific meetings and published in proceedings book.

Journals in the proceedings book of the refereed conference / symposium

Others (Projects / Certificates / Rewards)

