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DEPARTMENT OF STATISTICS

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RISK FACTORS ASSOCIATED WITH DIARRHEA AMONG CHILDREN UNDER-FIVE IN MYANMAR

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MAS - 34

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This thesis is submitted to the Board of Examination as partial fulfillment of the requirements for the Degree of Master of Applied Statistics

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ABSTRACT

Diarrhea is the common childhood disease all around the world especially in low and middle income countries. This study aimed to explore the factors associated with the occurrence of diarrhea among under-five children using the Myanmar Demographic and Health Survey (2015-2016) data. Total 4782 children aged under-five were analyzed in this study. The descriptive statistics, Chi-square test and binary logistic regression model were used in the study. It was found that 12% of children had diarrhea but 88% of children had not diarrhea. According to the results of Chi-square test, mother's education and employment status, wealth index, age of child and duration of breastfeeding were significantly associated with the diarrhea occurrence. Regarding the binary logistic regression model, this study identified that children with educated mother, children from middle and rich households, older children, children with complete immunization, children with breastfeeding and nourished children were less likely the diarrhea occurrence in Myanmar. Whereas children with employed mothers were more likely the diarrhea occurrence than unemployed mothers. Government and health planners should conduct diarrhea prevention and control program especially in rural areas of Myanmar to raise the level of mother's education and health awareness and proper nutrition of children.

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LIST OF ABBREVIATIONS

AOR	Adjusted Odds Ratio
CCM	Chronic Care Management
CI	Confidence Interval
df	Degrees of Freedom
DHS	Demographic and Health Survey
DPT	Diphtheria-Pertussis-Tetanus (vaccine)
F-IMNCI	Facility based Integrated Management of Neonatal and Childhood Illness
GAPP	Global Action Plan for Prevention
HIV	Human Immunodeficiency Virus
IMNCI	Integrated Management of Neonatal and Childhood
LMIC	Low and Middle Income Countries
MDHS	Myanmar Demographic and Health Survey
MOHS	Ministry of Health and Sports
NFHS	National Family Health Survey
OBC	Other Backward Classes
OR	Odds Ration
ORS	Oral Rehydration Solution
SC	Scheduled Castes
SDG	Sustainable Development Goal
ST	Scheduled Tribes
U5C	Under-Five Children
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organization

CHAPTER I
INTRODUCTION

Diarrhea is the second leading cause of under-five mortality and globally accounts for 526,000 child deaths every year. Worldwide diarrhea disease is a significant population health hazard. It is a leading cause of mortality and morbidity among under-five children in developing countries. The leading causes of diarrhea deaths are severe dehydration and fluid loss for most people and children. Diarrhea is treated with an ORS, i.e., solution of clean water, sugar and salt. A proportion of 3 out of 1000 children under-five years died due to diarrhea in 2016, accounting for approximately 8 percent of all deaths among children under age five worldwide in 2017. Most deaths from diarrhea develop among children less than two years of age living in South Asia and sub-Saharan Africa.

1.1 Rationale of the Study

Diarrhea is defined as the passage of three or more loose or liquid stools per day by the World Health Organization (WHO, 2022). Diarrhea is caused by bacteria, viruses, or parasites and reveals an intestinal infection. Diarrhea has long been established as a leading cause of morbidity and mortality throughout the world, accounting for 9% of all deaths among children under-five years of age worldwide in 2015 (UNICEF, 2016). This translates into over 1,400 young children dying each day, or about 530,000 children a year, despite the availability of simple and effective treatment. Each year almost 18% of deaths among children under-five in Myanmar are due to diarrhea, although deaths from diarrhea can be prevented (Kamp, 2017).

The diarrheal disease continues to be one of the main problems affecting the infant population in the first years of life, especially in less developed regions. Although diarrhea can influence all age groups, it is a special concern for children under-five in Myanmar. Due to its high morbidity and mortality, it is a priority public health issue.

Diarrhea is a common childhood illness and on causes of under-five mortality, is the fourth-leading cause of death among children under age five in Myanmar (MOHS, 2020). Nationwide implementation of F-IMNCI, IMNCI, and CCM is being carried out to address this major cause of morbidity and mortality in children. National F-IMNCI, IMNCI, and CCM guidelines have been developed by the MOHS and are being used by health care providers across the country. According to 2015-2016 Myanmar Demographic and Health Survey, it is found that 10% of children under age five had diarrhea in the two weeks preceding the survey (MOHS, 2017).

Diarrhoeal disease can also spread from person-to-person, aggravated by poor personal hygiene. Interventions to prevent diarrhoea, including safe drinking-water and use of improved sanitation can reduce disease risk. Diarrhea cases can be prevented through good sanitation techniques such as latrine building, the use of clean water, and exclusive breastfeeding. The efforts to prevent diarrhea include latrine construction, promotion of clean water, latrine use and hygiene.

Diarrhea is the important childhood disease with high mobility and mortality although it is preventable. For effective prevention and control of diarrhea, it is very important to identify the associated factors of diarrhea. Therefore, this study analyzed the risk factors associated with diarrhea among children under 5 years of age in Myanmar.

1.2 Objectives of the Study

The objectives of this study are:

i. To describe the background characteristics of children with occurrence of diarrhea in Myanmar.
ii. To examine the relationship between mother factors, child factors and household factors and occurrence of diarrhea among children under 5 in Myanmar.
iii. To explore the risk factors associated with occurrence of diarrhea among children under 5 years in Myanmar.

1.3 Method of Study

Secondary data from the 2015-2016 Myanmar Demographic and Health Survey (MDHS) were used in data analysis. The 2015-2016 MDHS is the national sample survey that provides the information related to demography and health related indicators. The MDHS collected the data from 12500 households, 12885 women, 4737 men and 4815 children. Among them, the sample of under-five children (n= 4815) were collected for the current analysis. Descriptive statistics was used to describe the mother factors, child factors and household factors. Binary logistic regression analysis was used to explore the risk factors associated with the occurrence of diarrhoea among under-five children.

The dependent variable was the occurrence of diarrhea among under-five children.

The independent variables were mother factors (age of mother, mother's education and mother's employment), child factors (sex of child, age of child, duration of breastfeeding, immunization and nutritional status (weight for age), household factors (place of residence, states and regions, wealth index, source of drinking water, type of toilet facility and sharing toilet).

1.4 Scope and Limitations of the Study

This study was carried out by using secondary data from the 2015-2016 MDHS. This study found out the factors relating to the occurrence of diarrhea among under-five children. This study only focused on 4782 children among total 4815 children because 33 dead children were excluded. The nationwide large dataset is needed for more accurate data analysis.

The secondary data used in this study was collected by cross sectional survey. Therefore, a causal relationship between the dependent and independent variables could not be found out.

1.5 Organization of the Study

This study includes five chapters. Chapter I is the introduction which consists of rationale of the study, objectives of the study, method of study, scope and limitations of the study and organization of the study. Chapter II presents the literature review. Chapter III which describes methodology. Chapter IV deals with the results and findings. Chapter V mentions the conclusion with major findings, discussions and suggestions and further research of this study.

CHAPTER II
LITERATURE REVIEW

This chapter presents the occurrence of diarrhea in children under 5 years of age, etilology and pathogenesis, factors associated with occurrence of diarrhea, review on the related studies and prevention of diarrhea.

2.1 Diarrhea

Diarrhea is defined as the passage of three or more loose or watery stools per day (or more frequent passage than is normal for the individual) as by WHO definition (WHO, 2022). Diarrheal diseases have been a major health problem throughout human history. Prior to the advent of modern medicine, severe diarrhea was often fatal and disease outbreaks spread quickly, affecting large populations. It is the common health problem affecting all ages and all over the world. Although diarrhea can be affected in all ages, it is of high burden in children. It is the second leading cause of death in children under five-year-old according to WHO data. Diarrhea kills around 525,000 under-five children each year. In spite of advance in diagnostic and curative treatment, diarrhea is still an important public health problem especially in low and middle income country including Myanmar.

2.2 Etiology and Pathogenesis

Diarrhea itself is not the disease, but the symptom of gastrointestinal disease or infection. The casual organisms are diverse consisting of virus, bacteria, protozoa and parasites. The infectious agents that cause diarrhea are usually spread by the faecal-oral route, which includes the ingestion of faecally contaminated water or food, person-to-person transmission, and direct contact with infected faeces. Examples of behaviors that help enteric pathogens to spread are: preparing food with hands that have been soiled during defecation and not washed; or allowing an infant to crawl, or a child to play in an area where human or animal faces are present (WHO, 2001).

Microbial agents cause diarrhea by a number of mechanisms, several of which are considered as follow.

Viruses

Viruses, such as rotavirus, replicate within the villous epithelium of the small bowel, causing patchy epithelial cell destruction and villous shortening. The loss of normally absorptive villous cells and their temporary replacement by immature, secretory, crypt-like cells causes the intestine to secrete water and electrolytes. Villous damage may also be associated with the loss of disaccharidase enzymes, leading to reduced absorption of dietary disaccharides, especially lactose. Recovery occurs when the villi regenerate and the villous epithelium matures.

Bacteria

Mucosal adhesion: Bacteria that multiply within the small intestine must first adhere to the mucosa to avoid being swept away. Adhesion is caused by superficial hair-like antigens, termed pili or fimbriae, that bind to receptors on the intestinal surface; this occurs, for example, with enterotoxigenic E. coli and V. cholerae 01. In some instances, mucosal adherence causes changes in the gut epithelium that may reduce its absorptive capacity or cause fluid secretion (such as., in infection with enteropathogenic or enteroadherent E. coli).

Toxins that cause secretion: Enterotoxigenic E. coli, V. cholerae 01 and possibly other bacteria, such as., Salmonella, cause intestinal secretion by producing toxins that alter epithelial cell function; these toxins reduce the absorption of sodium by the villi and may increase the secretion of chloride in the crypts, resulting in net secretion of water and electrolytes (see Unit 2). Recovery occurs when the intoxicated cells are replaced by healthy ones after 2-4 days.

Mucosal invasion: Shigella, C. jejuni and enteroinvasive E. coli cause bloody diarrhea by invading and destroying mucosal epithelial cells. This occurs mostly in the colon and the distal part of the ileum. Invasion is followed by the formation of microabscesses and superficial ulcers, and hence the presence of red and white blood cells, or frank blood, in the stool. Toxins produced by these organisms cause tissue damage and possibly also mucosal secretion of water and electrolytes.

Protozoa

Mucosal adhesion: G. lamblia and Cryptosporidium adhere to the small bowel epithelium and cause shortening of the villi, which may be how they cause diarrhoea. **Ausing microabscesses and ulcers**, in much the same way as Shigella. This only happens, however, when the infecting strain of E. histolytica is virulent. In about 90% of human infections the strains are non-virulent; in such cases there is no mucosal invasion and no symptoms occur, although amoebic cysts are present in the faeces.

The absorption and secretion of water and electrolytes throughout the gastrointestinal tract is a finely balanced, dynamic process and, when there is loss of this balance caused either by decreased absorption or increased secretion, diarrhea results. The main cause of death from acute diarrhea is dehydration, which results from the loss of fluid and electrolytes in diarrheal stools. Other important causes of death are dysentery and undernutrition. Diarrhea is an important cause of undernutrition. This is because patients eat less during diarrhea and their ability to absorb nutrients is reduced; moreover, nutrient requirements are increased as a result of infection. Each episode of diarrhea contributes to undernutrition; when episodes are prolonged, their impact on growth is increased.

2.3 Factors Associated with Occurrence of Diarrhea

Many studies have identified numerous factors associated with increased risk in diarrhea among children under-five. As stated by Ethelberg, the risk factors for childhood diarrhea in industrialized countries were recent foreign travel, contact with symptomatic person or dog, hospitalization, private day care, consumption of formula milk, unemployment and education of parents according to the survey done in Denmark (Ethelberg, 2006). George stated that caregiver lack of awareness of practices related to personal and food hygiene for diarrhea prevention were a significant risk factors for diarrheal disease in this cohort of children < 5 years of age in Cochabamba, Bolivia (George, 2014). As reported by the comparative cross sectional survey in southwest Ethiopia, the variation in occurrence of diarrhea was well explained by maternal education, income, personal hygiene, waste disposal system and the effect of health extension programme (Gebru, 2014).

According to the study done by Gedamu, Children from rural areas, whose mother took 30 and more minutes for getting drinking water, whose age between 6-11, not vaccinated for Rotavirus, from households having latrine facility and whose mothers used only water to wash their hands were more likely to have diarrhea (Gedamu, 2017). The study done by Aziz in 2018 found significant differences in diarrhea prevalence by ethnicity, parents' education and occupation, household income, water supply, sanitation and waste disposal (Aziz, 2018).

Evidence from demographic and health surveys of 34 Sub-Saharan countries described that Maternal age, wealth index, maternal education, maternal occupation, age of child, time of initiation of breast feeding and time to get water source were significantly associated with childhood diarrhea (Desmennu, 2017).The analysis on Kenya's demographic health survey 2014 found that increasing caregiver education, wealthier households and promoting hygienic behaviors in poor households were associated with reduce prevalence of diarrhea (Mulatyaa, 2020). The family health survey in rural India conducted by Saha found that different sociodemographic factors, such as caste, religion, economic condition, and women's education, were significantly associated with diarrheal disease. Household environmental factors, such as sources of drinking water, toilet facilities, child stool disposal, and household roof and floor materials, were also risk factors for diarrhea according to the above mention survey (Saha, 2022).

The systematic review on diarrhea prevention and treatment of childhood diarrhea in Myanmar which was carried by Kamp reported that social determinants of health and cultural factors encourage the spread of diarrhoeal diseases among under-five children. The social determinants include disparities due to geography, education and economic and cultural factors such as strong allegiances to norms viewing latrines (Kamp, 2017).

2.3.1 Mother Factors

Generally, mother is the primary care-taker of children and role of mother in child care is highly accepted. The health knowledge of mother has high influence on the occurrence of infection in children as well as treatment and care of sick children. Mother factors are important determinants of diarrhea occurrence.

Mother's education provides knowledge of hygiene, good feeding and weaning practices, early recognition of symptoms and, thus, timeliness in responding to childhood illnesses. On the other hand, mothers' poor knowledge and attitude about the cause of diarrhea might limit them from taking appropriate timely actions. By education level, Aziz reported that children of parents with lower education levels were more prone to have diarrhea compared to parents with tertiary education levels (Aziz, 2018). The caregivers with lower education were twice as likely to predispose their children to diarrhea according to Kenya DHS survey data. The study conducted by Desmissie revealed that the prevalence of diarrhea was higher among children whose mothers had secondary education and below (Demissie, 2021). Regarding parents' education, diarrhea most commonly occurred among children whose father has no formal /primary level education, 5.0% (95% CI = 3.5–7.0) and, even higher, among those whose mother has no formal education, 7% (95 CI = 4.5–10.9) (Aziz, 2018).

The employment status of mother also has an important role on diarrhea occurrence in children under-five. The demographic and health surveys of 34 sub-Saharan countries reported that the odds of getting diarrhea for the children of working mothers was increased by 12% as compared to those children of non-working mothers (Demissie, 2021). The study done by Ugboko also stated that there is significant association between diarrhea occurrence and mother's employment (OR =2.082, P-value =0.025) (Ugboko, 2021). However, the opposite finding was also reported by other studies. The cross sectional study done in Senegal by Thiam stated that there is association between diarrhea occurrence and unemployment of mother (AOR = 1.62, 95% CI: 1.18-2.23) (Thiam, 2017).

The age of mother has also effect on the childhood diarrhea occurrence. In general, young mother are less experienced in child care predisposing to the occurrence of childhood infection. The finding of demographic and health surveys of 34 sub-Saharan countries stated that the children of mothers aged 15–24 (AOR = 1.26; 95% CI: 1.23-1.30) and 25–34 years (AOR =1.15; 95% CI: 1.12-1.18) had higher odds of having diarrhea (Demissie, 2021).

2.3.2 Child Factors

Several host factors are associated with increased incidence, severity, or duration of diarrhea. They include:

Child's age: Most diarrheal episodes occur during the first two years of life. Incidence is highest in the age group 6-11 months, when weaning often occurs. This pattern reflects the combined effects of declining levels of maternally-acquired antibodies, the lack of active immunity in the infant, the introduction of food that may be contaminated with fecal bacteria, and direct contact with human or animal feces when the infant starts to crawl. Most enteric pathogens stimulate at least partial immunity against repeated infection or illness, which helps to explain the declining incidence of disease in older children and adults.

Mulatya stated that child's age is a significant risk factor for diarrhea with the highest risk group identified as children 6–11 months in Kanya (Mulatya, 2020). Naturally, most children start crawling and teething from six months and this predisposes many infants to frequent infections as they wander into unhygienic environments. The study by Natnael found that factors significantly associated with acute diarrhea were a child's age of 12–23 months (AOR = 4.68, 95% CI: 1.45–1.50) (Natnael, 2021). On the other hand, some studies found that there is no association between diarrhea occurrence and child age. The study in Nigeria described that there is no significant relationship between child's age and diarrhea occurrence (COR =0.359, CI: 0.101 – 1.274, P-value = 0.113) (Ugboko2020). The cross sectional study in Senegal stated that the prevalence of diarrhea was highest in the age group 24–59 months (51.5%) (Thiam, 2017).

Undernutrition: The frequency, severity, duration, and risk of death from diarrhea are increased in undernourished children, especially those with severe under-nutrition. The national family health survey in rural India found that the odds of emergent diarrhea were 1.135 times higher among children with low birth than those with normal birth weight and the odds of developing diarrhea were 1.097 times higher among undernourished children than well-nourished children (Saha, 2022).

The relationship between diarrhea and malnutrition is bidirectional: As reported by Njuguna, malnourished children are highly vulnerable to infectious diseases such as diarrhea (Njuguna, 2011).

Current or recent measles: Diarrhea and dysentery are more frequent or severe in children with measles or who have had measles in the previous four weeks. This presumably results from immunological impairment caused by measles.

Immunodeficiency or immunosuppression: This may be a temporary effect of certain viral infections (e.g., measles), or it may be prolonged, as in persons with the acquired immunodeficiency syndrome (AIDS). When immunosuppression is severe diarrhea can be caused by unusual pathogens and may also be prolonged.

Failing to breastfeed exclusively for the first 4-6 months of life: The risk of developing severe diarrhea is many times greater in non-breastfed infants than in infants who are exclusively breastfed and the risk of death from diarrhea is also substantially greater. Failing to continue breastfeeding until at least one year of age had significant impact on the nutrition and immune status of child. Prolonged breastfeeding reduces the incidence or severity of certain types of diarrheal disease, such as shigellosis and cholera. The case control study in northeast Ethiopia found that no exclusive breast feeding was determinants of acute diarrhea among under-five children (AOR=3.32; 95% CI :1.21-9.14) (Delelegn, 2020).

Using infant feeding bottles: The feeding bottles easily become contaminated with fecal bacteria and are difficult to clean. When milk is added to an unclean bottle it becomes contaminated; if it is not consumed immediately, further bacterial growth occurs.

2.3.3 Household Factors

Diarrhea occurrence was higher in rural setting especially in low and medium income countries which may be due to multifactorial causation such as low socio-economic status, poor sanitation, nutrition and climate change. Similarly Diarrhoea poses serious health problems among under-five children (U5C) in resource poor setting. The study by Gedamu showed that children from rural areas were 2.6 times more likely to have diarrhea compared to their urban counterparts (Gedamu, 2017). The study by Paul stated that children living in rural areas (AOR= 1.05, 95% CI: 1.01, 1.09) significantly associated with higher likelihood of diarrhea (Paul, 2020). The data analysis of 57 LMIC from the most recent Demographic and Health Survey (2010-2018) found statistically significant pro-rural inequalities with higher odds of diarrhoea in rural areas than in nonrural areas and Fagbamigbe stated that overall main contributors to pro-rural inequality were neighbourhood socio-economic status, household wealth status, media access, toilet types, maternal age and education (Fagbamigbe, 2021).

Wealth has a direct implication on access to basic water and sanitation services. Households in poor settings are more likely to use unimproved water and sanitation sources, thus children in these settings are highly susceptible to infections. A study conducted by Masangwi mentioned that the father's job or poor income of a head of the household is a risk factor for diarrhea in children (Masangwi, 2010). As reported by the cross sectional study in Malaysia, the lowest household income group recorded the highest prevalence of childhood diarrhea (5.8%) compared to (3.2%) in the highest income quintile (Aziz, 2018). The study conducted by Ugboko was significant association between family income and diarrhea occurrence (OR = 7.613, P-value= 0.0001) (Ugboko, 2021).

Diarrhea is food borne disease and food and water sanitation plays an important role in diarrhea occurrence and control. A number of specific behaviors help enteric pathogens to spread and thus increase the risk of diarrhea. Storing cooked food at room temperature is one of the associated factors of occurrence of diarrhea. When food is cooked and then saved to be used later, it may easily be contaminated, for example, by contact with contaminated surfaces or containers. If food is kept for several hours at room temperature, bacteria in it can multiply many times.

Drinking water can be contaminated with bacteria by various ways. Water may be contaminated at its source or during storage in the home. Contamination in the home may occur when the storage container is not covered, or when a contaminated hand comes into contact with the water while collecting it from the container. A study done by Thiam described that there is significant association between diarrheal disease and no treatment of stored drinking water (AOR = 1.69, 95% CI: 1.11–2.56) (Thiam, 2017). The cross sectional study by Natnael reported that unimproved water sources (AOR = 2.97, 95% CI: 1.28–6.87) was significantly associated with diarrhea (Natnael, 2021). Obtaining water from a protected water source (AOR = 0.265, 95% CI: 0.108–0.650, P-value = 0.004) was associated with a 73.5% reduction in diarrhea disease when compared with unprotected water as stated by the study done in Uganda (Nantege, 2022).

The presence of latrines increases the chance of safe disposal of feces, reduces the risk of contact between the causative organisms of diarrhea and the host. It is often believed that infant feces are harmless, whereas they may actually contain large numbers of infectious viruses or bacteria; animal feces also can transmit enteric infections to man. A recent study conducted by Romanhwati in Indonesia, discovered that mothers who defecated at latrines have fewer children with diarrhea than mothers who defecated at other places (Romahwati, 2012). The similar finding was showed by George in 2014. This finding was supported by the study done in Senegal which described that there is significant association between diarrhea and use of shared toilets (AOR = 1.69, 95% CI: 1.11–2.56) (Thiam, 2017). According to the study by Nantege, having a vent piped toilet (AOR = 0.503, 95% C.I 0.281–0.900, P-value = 0.021) was protective against diarrhea among children below 5 years (Nantege, 2022). As regard to the Ethiopian demographic and health survey, increasing prevalence of diarrhoea was significantly associated with households who shared toilet facilities with other households (AOR: 1.4, 95% CI: 1.09-1.77) (Ferede, 2020).

2.4 Prevention of Diarrhea

Effective interventions to target previously identified knowledge and behavioral risk factors for diarrheal disease in children include promotion of hand washing with soap, hygiene education, latrine installation at the household and community level, municipal water connection, water kiosk, household-based chlorination, filtration, solar disinfection, and improved water storage. In 2009, WHO, United Nations International Children's Emergency Fund (UNICEF) and partners published two separate strategies for control of pneumonia and diarrhoea: a *Global Action Plan for Prevention and Control of Pneumonia* (GAPP) (WHO/UNICEF, 2013). The GAPP envisions the various interventions for controlling pneumonia and diarrhoea in children less than five years of age as:

- *protecting* children by establishing and promoting good health practices;
- *preventing* children from becoming ill from pneumonia and diarrhoea by ensuring universal coverage of immunization, Human Immunodeficiency Virus (HIV) prevention and healthy environments;
- *treating* children who are ill from pneumonia and diarrhea with appropriate treatment.

However, risk factors for childhood diarrhea vary by population with some factors being more important than others in particular settings. Therefore, it is important to identify the distinct risk factors for diarrhea in a particular target population so disease control programs can be implemented that are tailored to target these risk factors.

2.5 Review on the Related Studies

There are many researchers and health person who have carried out studies related to the occurrence of diarrhea among under-five children. Ugboko (2021) studied the association between the risk factors and diarrhea prevalence among children under-five years in Lagos and Ogun States, Southwest Nigeria. Participants included 280 women aged 15–49 years and children aged 0–59 months. This study used quantitative data, which were assessed by a structured questionnaire. Pearson's Chi Square test and logistic regression analysis were used in the study. One hundred and eighteen (42%) of the children were male, and 162 (58%) were female. The majority of the children belonged to the age group 0–11 months (166). Logistic regression analysis showed that mother's educational status, mother's employment, and family income were the factors significantly associated with diarrhea in Southwest Nigeria. The study recommends that female education should be encouraged by the right government policy to enhance the achievement of the sustainable development goal three (SDG 3) for the possible reduction of neonates and infants' deaths in Nigeria.

Saha (2022) analyzed that the socio-demographic and environmental factors associated with diarrhea among under-five children in rural India. A total of 188,521 living children aged (0–59 months) were studied from the National Family Health Survey-4, 2015–2016. Binary logistic regression models were carried out from the available NFHS-4 data. In rural India, children aged 12–23 months, 24–35 months, 36–47 months, and 48–59 months were significantly improbable to suffer diarrheal disease. Children of the female sex, as well as children of scheduled tribes and other backward classes were less likely to experience diarrhea. The diarrheal disease was more likely to occur among children of scheduled castes; Muslim or other religions; children belonging to central, eastern, and western regions; children with low birth weight; as well as children with improper stool disposal and rudimentary roof materials. In the rural parts of India, socio-demographic and environmental factors were most influential.

Hussein (2017) estimated the risk factors for the occurrence of childhood diarrhea among children aged 0-5 years in northern Nigeria regions. Demographic and Health Survey (DHS) data of Nigeria 2013 were used for this study. Data were analyzed from the three northern Nigeria Regions: Western, Eastern, and Central. The study population was under-five children who were residents in the households during the survey. Bivariate and multivariate logistic regression were computed to assess influencing factors of childhood diarrhea. The prevalence of diarrhea in a two weeks period among under-five children in the northern regions was 12.7 %. The results of this study showed that maternal education, religion, age, working status, unprotected water source, main floor material, DPT3 and polio3 vaccination were found to be positively associated risk factors for childhood diarrhea.

Demissiei (2021) focused the prevalence and associated factors of diarrhea among children under-five years in Sub-Saharan Africa. The most recent demographic and health survey dataset of 34 Sub-Saharan African countries were used to determine the prevalence and associated factors of diarrhea among under-five children in the region. A total weighted sample of 330,866 under-five children were included in the study. Logistic regression analysis were done to determine the associated factors of diarrhea among under-five children in Sub-Saharan Africa. The overall prevalence of diarrhea in this study was 15.3%. Those children of mothers aged 15–24 and 25–34 years, those children of mothers with no education, primary education and secondary education had higher odds of having diarrhea. Those children from poorest, poorer, middle, and richer households had higher chance of having diarrhea compared to their counterparts.

Gebru (2014) studied the risk factors of diarrheal disease in under-five children among health extension model and non-model families. A community based comparative cross-sectional study design was employed in 2012 at Sheko district. Multi-stage sampling technique was employed to select 275 model and 550 non-model households that had at least one under-five children. Data was collected using structured questioner by trained data collectors. Multivariate logistic regression analysis was computed to describe the functional independent predictors of childhood diarrhea. The diarrhea prevalence in under-five children among health extension model and non-model households were 6.4% and 25.5%, respectively. The independent predictors of childhood diarrhea revealed in the study were being mothers can't read and write, monthly family income earns less than 650 Birr, mothers hand washing not practice at critical time, not soap use for hand washing improper refuse disposal and being non-model families for the health extension programme. The level of diarrheal disease variation was well explained by maternal education, income, personal hygiene, waste disposal system and the effect of health extension programme. Thus encouraging families to being model families for the programme and enhancing community based behavioral change communication that emphasize on personal hygiene and sanitation should be strengthening to reduce childhood diarrhea.

George (2014) examined the relationship between childhood diarrhea prevalence and caregiver knowledge of the causes and prevention of diarrhea in a prospective cohort of 952 children under 5 years of age in Cochabamba, Bolivia. It found that more than 80% of caregivers were unaware that hand washing with soap could prevent childhood diarrhea. Furthermore, only 17% of caregivers reported hand washing before cooking and feeding a child. Lack of caregiver awareness of the importance of practices related to hygiene and sanitation for diarrhea prevention were significant risk factors for diarrheal disease in this cohort. The knowledge findings from this study suggest that health promotion in these communities should put further emphasis on increasing knowledge of how water treatment, hand washing with soap, proper disposal of child feces, and food preparation relate to childhood diarrhea prevention.

Thiam (2017) studied the risk factors of diarrheal diseases in children under the age of five in Mbour, Senegal. A cross-sectional survey was conducted in four zones of Mbour to estimate the burden of diarrheal diseases (i.e. diarrhea episodes in the 2 weeks preceding the survey) and associated risk factors. The zones covered urban central, peri-central, north peripheral and south peripheral areas. Overall, 596 households were surveyed by a questionnaire, yielding information on socio-demographic, environmental and hygiene behavioral factors. Binary logistic regression analysis were used to identify risk factors associated with the occurrence of diarrhea. The reported prevalence of diarrhea among children under the age of five during the 2 weeks preceding the survey was 26%. The highest diarrhea prevalence rates were observed in the peri-central (44.8%) and urban central zones (36.3%). Multivariable regression revealed significant associations between diarrheal diseases and unemployment of mothers, use of open bags for storing household waste, evacuation of household waste in public streets, no treatment of stored drinking water and use of shared toilets.

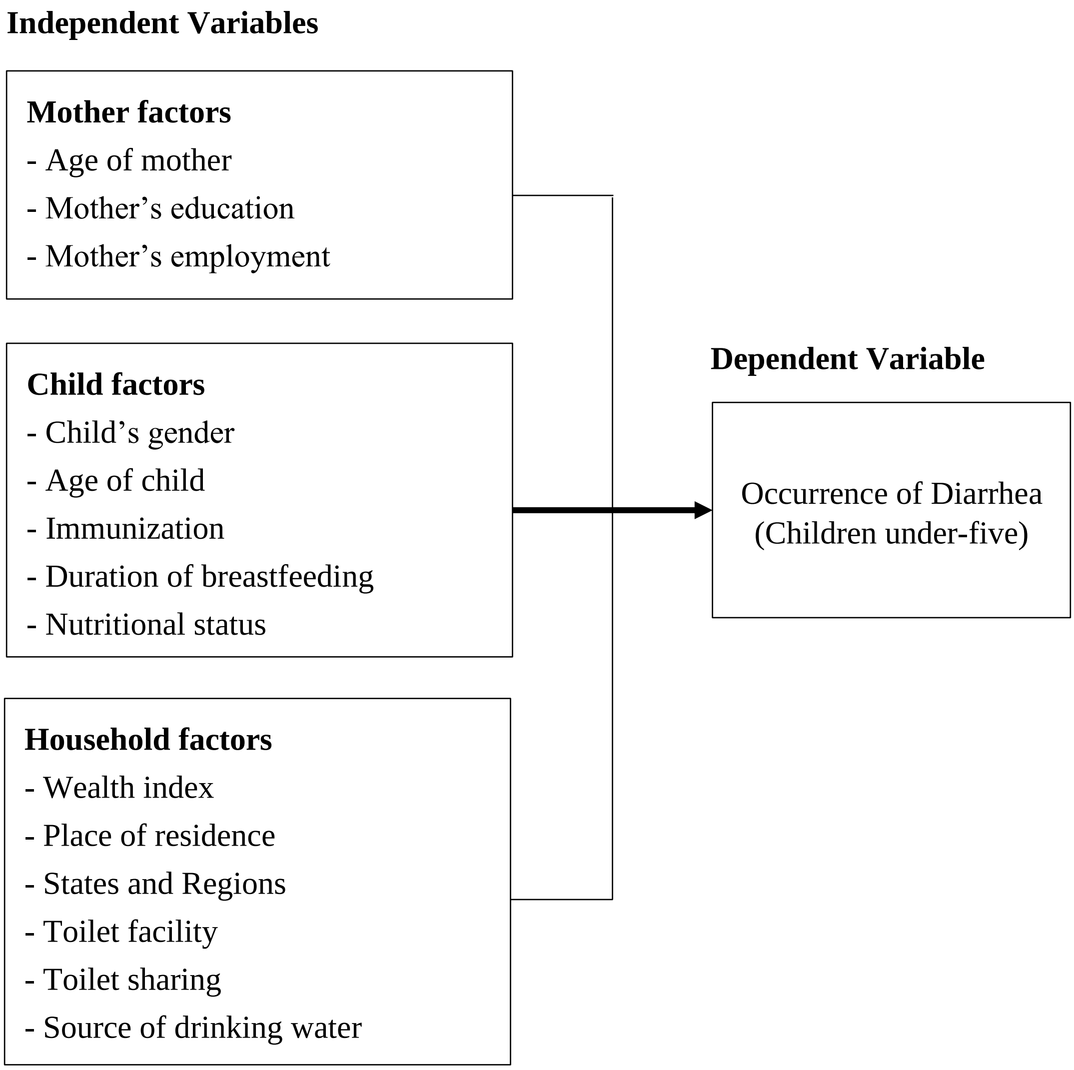
Kamp (2017) performed a systematic review of diarrhea prevention and treatment efforts among children under-five in Myanmar. Eighteen percent of deaths among children under-five in Myanmar are due to diarrheal diseases even though diarrheal diseases can be prevented. Results of the study indicated that although individuals in Myanmar have high levels of knowledge regarding prevention of diarrheal diseases, social determinants of health and cultural factors encourage the spread of diarrheal diseases. Social determinants of health include disparities due to geography, education, and economics. Cultural factors such as strong allegiances to norms viewing latrines as uncustomary can promote diarrheal diseases. There is a need for interventions designed to address social determinants of health in order to enhance diarrhea prevention and treatment efforts and reduce the under-five mortality in Myanmar.

Delelegn (2020) studied that Diarrheal disease is the second leading causes of death among under-five children. Most of the death due to diarrhea is reporting in developing countries. This study aimed to identify the determinants of acute diarrhea among under-five children in the Northeast part of Ethiopia. An institution-based unmatched case–control study was conducted among 306 under-five children from March to April 2019. A systematic random sampling technique was employed to select study participants. Data were collected by face to face interviews using a pretested structured questionnaire. Logistic regression analysis was applied. The improper child’s stool disposal, absence of home-based water treatment, did not wash hand at critical times, did not practice exclusive breastfeed, unable to get counseling from health professionals, provide left over food to the child and maternal diarrhea were determinants of acute diarrhea among under-five children.

2.6 Conceptual Framework of the Study

The conceptual framework of the study explains the relationship between diarrhea among children under-five years and mother factors, child factors and household factors. The conceptual framework of this study was developed based on the previous studies related to the occurrence of diarrhea among under-five years children and presented in Figure (2.1).

Figure (2.1) Conceptual Framework for the Analysis of Diarrhea among Children Under-Five Years in Myanmar



Source: Own Compilation

CHAPTER III
METHODOLOGY

In this section, chi-square test, logistic regression model, assumptions of logistic regression model, binary logistic regression model, parameter estimating in the logistic regression model and goodness of fit test and selecting predictor variables for logistic regression model are presented.

3.1 Chi-square Test

Pearson's Chi-squared test (χ^2) is a statistical test applied to test a null hypothesis stating that the frequency distribution of certain events observed in a sample is consistent with a particular theoretical distribution (Moore et al., 2011). The events considered must be mutually exclusive and have total probability 1.

The Chi-square test use to determine whether the association between two qualitative variables is statistically significant. The chi-square test is the most common reported nonparametric statistics and is used when the two variables are independent of one another. It compares the actual number (or frequency) in each group with the expected number if the two variables were completely independent of one another. The expected number in each group is computed from the data.

The chi-square statistic is computed with the following formula:

$$\chi^2 = \sum_{i=1}^{n} \frac{(f_0 - f_e)^2}{f_e} \qquad (3.1)$$

Where, f_0 is the observed frequency in the cell

f_e is the expected frequency in each cell

The chi-square statistic is computed by adding together the results of these computations for each cell. A Chi-square Test can be used when the following assumptions are met:

Assumption 1: Both variables are categorical.

It is assumed that both variables are categorical. That is, both variables take on values that are names or labels.

Assumption 2: All observations are independent.

It is assumed that every observation in the dataset is independent. That is, the value of one observation in the dataset does not affect the value of any other observation.

Assumption 3: Cells in the contingency table are mutually exclusive.

It is assumed that individuals can only belong to one cell in the contingency table. That is, cells in the table are mutually exclusive an individual cannot belong to more than one cell.

Assumption 4: Expected value of cells should be 5 or greater in at least 80% of cells.

It is assumed that the expected value of cells in the contingency table should be 5 or greater in at least 80% of cells and that no cell should have an expected value less than 1.

3.2 Logistic Regression Model

This section presents some types of logistic regression and goodness of fit test statistics and test statistics which are used to assess the significance of the individual coefficient (Hosmer and Lemeshow, 2000).

Multivariate analysis commonly appears in general health science literature. Multivariate analysis refers to simultaneously predict multiple outcomes and uses multiple variables to predict a single outcome. It serves two purposes: (1) it can predict the value of dependent variable for new values of the independent variables, and (2) it can help describe the relative contribution of each independent variable to the dependent variable, controlling for the influences of the other independent variables.

In logistic regression, the outcome variable is usually categorized. In discriminant analysis, the outcome variable is a category or group to which a subject belongs. For only two categories, discriminant analysis produces results similar to binary logistic regression. In proportional hazards regression, the outcome variable is the duration of time to the occurrence of a binary "failure" event during a follow-up period of observation. The logistic regression is the most popular multivariable method used in health science.

Binary logistic regression is typically used when the dependent variable is dichotomous and the independent variables are either continuous or categorical. When the dependent variable is not dichotomous and is comprised of more than two categories, a multinomial logistic regression can be employed.

3.3 Assumptions of Logistic Regression Model

The assumptions of logistic regression model are:

1. Logistic regression requires sufficiently large sample size.
2. Logistic regression requires each observation to be independent.
3. Logistic regression requires there to be little or no multicolinearity among the independent variables.
4. The error terms (the residuals) do not need to be normally distributed in logistic regression analysis.
5. Logistic regression dose not require a linear relationship between the dependent and independent variables.

3.4 Binary Logistic Regression Model

Binary logistic regression is a prognostic model that is fitted where there is a dichotomous/binary dependent variable. Since logistic regression calculates the probability of an event occurring over the probability of an event not occurring, the impact of independent variables is usually explained in terms of odds (Hosmer and Lemeshow, 2000). With logistic regression the mean of the response variable Y in terms of an explanatory variable X is modeled relating Y and X through the equation

$Y = E(Y \mid X) + \varepsilon_i$

$$Log(Y) = ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 X_i \qquad (3.2)$$

Where, p_i is the probability of the outcome of interest

$p_i = 1$, if the event will occur.

$p_i = 0$, if the event does not occur.

Unfortunately, the extreme values of X will give values of $\hat{\beta}_0 + \hat{\beta}_1 X_i$ that does not fall between 0 and 1. The logistic regression solution to this problem is to transform the odds using the natural logarithm. The estimated logit model is

$$\hat{L} = ln\left(\frac{\hat{P}_i}{1-\hat{P}_i}\right) = \hat{\beta}_0 + \hat{\beta}_1 X_i \qquad (3.3)$$

Where, P is the probability of the interested outcome and X is the explanatory variable. The parameters of the logistic regression are β_i. This is the simple logistic model. Taking the antilog of the Equation (3.2) on both sides, one can derive an equation for the prediction of the probability of the occurrence of the interested outcome as

P = P (Y = interested outcome | X= x, a specific value)

$$P = \frac{e^{(\beta_0+\beta_1 X_i)}}{1+e^{(\beta_0+\beta_1 X_i)}} \quad (3.4)$$

Extending the logic of the simple logistic regression to multiple predictors, one may construct a complex logistic regression as

$$ln\left[\frac{P(X_1 \ldots X_k)}{1-P(X_1 \ldots X_k)}\right] = Log(Y) = Ln(odds)$$

$$= ln\left(\frac{P}{1-P}\right)$$

$$= \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k$$

$$= \beta_0 + \sum_{j=1}^{k} \beta_j X_j$$

Where, p = P $(Y = 1|X_1 = x_1, \ldots X_{k=}x_k)$

$$P = \frac{e^{\beta_0+\sum_{j-1}^{k}\beta_j X_j}}{1+e^{\beta_0+\sum_{j-1}^{k}\beta_j X_j}} \quad (3.5)$$

$$= \frac{1}{1+e^{-(\beta_0+\sum_{j-1}^{k}\beta_j X_j)}}$$

1-p = P $(Y = 0|X_1 = x_1, \ldots X_{k=}x_k)$

$$1\text{-p} = \frac{1}{1+e^{(\beta_0+\sum_{j-1}^{k}\beta_j X_j)}}$$

In this study, binary logistic regression model has been used to find the variables that influenced on occurrence of diarrhea among children under five years in Myanmar.

3.5 Parameter Estimating in the Logistic Regression Model

In logistic regression analysis, the parameters are usually estimated by using the method of maximum likelihood. Maximum likelihood will provide values of β_0 and β_i which maximize the probability of obtaining the data set. The likelihood function is used to estimate the probability of observing the data, given the unknown parameters (β_0 and β_i). A "likelihood" is a probability that the observed values of the dependent variable may be predicted from the observed values of the independent variables. The likelihood varies from 0 to 1 like any other probabilities. Suppose each individual sample of size 'n' selected from a population has the same probability p, an event occurs, $Y_i = 1$ indicates that an event occours for the i^{th} subject, otherwise, $Y_i = 0$. The observed data are $Y_1, \ldots, Y_n$ and $X_1, \ldots, X_n$. The joint probability of the data (the likelihood) is given by

$$L = \prod_{i=1}^{n} p^{y_i}(1-p)^{1-y_i}$$

$$= (p)^{\sum_{i=1}^{n} y_i}(1-p)n - \sum_{i=1}^{n} y_i$$

Natural logarithm of the likelihood is

$$\text{L = Log(L)} = \sum_{i=1}^{n} y_i \, logp + (n - \sum_{i=1}^{n} y_i) log\,(1-p) \qquad (3.6)$$

Estimating the parameters β_0 and β_i is done by using the first derivatives of log-likelihood, and solving them for β_0 and β_i. The iterative computing is used in this case. An arbitrary value for the coefficients (usually 0) is chosen first. Then log- likelihood is computed and variation of coefficient values is observed. Reiteration is performed until maximization of l (equivalent to maximizing L) and the results become the maximum likelihood estimates of β_0 and β_i.

3.6 Goodness of Fit Test and Selecting Predictor Variables for Logistic Regression Model

After estimating the Logistic regression model parameters using the maximum likelihood estimator, there is a need to assess the significance of the variables with regards to predicting the response variable. There are a number of statistical methods that can be used to carry out the assessment which include Deviance, likelihood ratio test, Hosmer-Lemeshow goodness of fit test, Omnibus test, Wald test. These test statistics are distributed as chi-square with degrees of freedom equal to the number of predictors.

Deviance

According to Hosmer & Lemeshow (2000), the statistic D, is called the deviance, and it plays an essential role in the assessment of goodness of fit of the model. Deviance (D) follows a Chi-square distribution with q- degrees of freedom, where q is the number of covariates in the equation.

$$D = -2\sum_{i=1}^{n}\left[y_i ln\left(\frac{p_i}{y_i}\right) + (1-y_i)\ ln\ ln\left(\frac{1-p_i}{1-y_i}\right)\right] \qquad (3.7)$$

Likelihood Ratio Test

The likelihood ratio test is a test based on the difference in deviancies: the deviance without any predictor in the model (or the intercept only model) minus the deviance with all predictors in the model. The Likelihood ratio test, tests the significance of all the variables included in logistic regression model. The likelihood-ratio test is Chi-square distributed and if the test is significant then the dropped variable will be a significant predictor in the equation whilst on the other hand, if the test is not significant then the variable is considered to be unimportant and thus will be excluded from the model. The Log-likelihood ratio is the difference between the deviance of the null model (model with just the constant) and a model after adding independent variables.

The statistic is given by:

$$-2log\left(\frac{l_0}{l_1}\right) = -2[log\ log(l_o) - log\ log(l_1)] = -2(l_0 - l_1) \quad (3.8)$$

where, l_0 is the maximum value for the likelihood function of a simple model and l_1 is the maximum value for the likelihood function of a full model. The full model has all the parameters of interest and the simple model has one variable dropped (Hosmer and Lemeshow, 2000).

Hosmer – Lemeshow Goodness of Fit Test

The test compares the predicted values against the actual values of the dependent variable. The method is similar to the Chi-square goodness of fit. The Hosmer–Lemeshow test is to examine whether the observed proportions of events are similar to the predicted probabilities of occurrence in subgroups of the model population. The Hosmer-Lemeshow test is performed by dividing the predicted probabilities into deciles (10 groups based on percentile ranks) and then computing a Pearson Chi-square that compares the predicted to the observed frequencies in a 2-by-10 table. The value of the test statistics is

$$\chi 2 = \sum_{i=1}^{10} \frac{(O_i - E_i)^2}{E_i} \quad (3.9)$$

Where, O_i and E_i denote the observed events, and expected events for the i^{th} risk decile group.

Omnibus Test

The omnibus test statistic is a measure of the overall model fit. The test is implemented on an overall hypothesis that the null hypothesis; all the coefficients of independent variables are equal to zero against at least one coefficient of an independent variable that is not equal to zero. The null hypothesis is rejected when the p-value is less than significance level. It implies that the logistic regression can be used to model the data.

Wald Test

The Wald statistic can be used to assess the contribution of individual predictors or the significance of the individual coefficients in a given model. The Wald test is obtained from a vector-matrix calculation that involves the parameter vector, its transpose and the inverse of its variance matrix (Hosmer and Lemeshow, 2000). The formula for computing the Wald statistic is;

$$W = \frac{\hat{\beta}_i}{SE\ (\hat{\beta}_i)} \tag{3.10}$$

Where, $\hat{\beta}_i$ is the estimate of the coefficient of the independent variable x_i and SE ($\hat{\beta}_i$) is the standard error of $\hat{\beta}_i$. The squared value of the Wald statistics as indicated below is chi-square distributed with one degree of freedom.

$$W^2 = \left(\frac{\hat{\beta}_i}{SE\ (\hat{\beta}_i)}\right)^2$$

The Wald statistic follows a chi-square distribution with 1 degree of freedom. The null hypothesis is rejected if the p-value of the test is less than α (significance level). A coefficient with a p-value of the Wald statistic less than α (significance level) implies that the variable is important in the model.

Pseudo R-Square

In ordinary least square (OLS) regression, the R^2 statistics measures the amount of variance explained by the regression model. The value of R^2 ranges in [0,1], with a larger value indicating more variance is explained by the model (higher value is better). The pseudo-R^2 measures for evaluating "goodness of fit" in regression models with categorical dependent variables. Unlike ordinary least square-R^2, log-likelihood-based pseudo-R^2s do not represent the proportion of explained variance but rather the improvement in model likelihood over a null model. The multitude of available pseudo-

R^2 measures and the absence of benchmarks often lead to confusing interpretations and unclear reporting. The almost all pseudo-R^2s are influenced to some extent by sample size, number of predictor variables, and number of categories of the dependent variable and its distribution asymmetry. Hence, an interpretation by goodness-of-fit benchmark values must explicitly consider these characteristics. The pseudo-R^2s is as follow:

$$R^2 = 1 - [\ln LL(\hat{M}_{Full})]/[\ln LL(\hat{M}_{Intercept})] \qquad (3.11)$$

This approach is one minus the ratio of two log likelihoods. The numerator is the log likelihood of the logit model selected and the denominator is the log likelihood if the model just had an intercept.

3.7 Definition of Selected Variables

The dependent variable of this study is occurrence of diarrhea (children under-five). It have been defined as diarrhea occurred of children among the age of five years. In this analysis, the selected some variables that include decision on age of mother, mother's education, mother's employment, child's gender, age of child, immunization, duration of breastfeeding, nutritional status (weight for age), wealth index, place of residence, states and regions, toilet facility, toilet sharing and source of drinking water.

Table (3.1) Variables Description

Dependent Variable	Definition	Variable Code
The occurrence of diarrhea	The occurrence of diarrhea in under-five children in the 2 weeks before the survey.	0 = No diarrhea 1 = Diarrhea within 2 weeks before the survey
Independent Variables	**Definition**	**Variables Code**
Age of mother	Current age in completed years	1 = 15-24 2 = 25-34 3 = 35 and above
Mother's education	Highest education level attended by mother	1 = No education 2 = Primary 3 = Secondary 4 = Higher
Mother's employment	Whether mother is currently working or not	1 = No (Unemployed) 2 = Yes (Employed)
Child's gender	Sex of under-five child	1 = Male 2 = Female
Age of child	Age of under-five child (in months)	1 = 0-11 months 2 = 12-23 months 3 = 24-35 months 4 = 36-47 months 5 = 48-59 months
Immunization	Number of entries in the health history.	1 = 1 time 2 = 2 times 3 = 3 times and above
Duration of breastfeeding	Whether the under-five child is currently breastfeeding or not	1 = Never breastfed 2 = Not currently breastfed 3 = Still breastfed
Nutritional status (weight for age)	The nutritional status of under-five children was assessed by weight for age. (weight for age <-2 SD of WHO level is considered as undernourished) (weight for age ≥ -2 SD of WHO level is considered as nourished)	1 = Undernourished 2 = Nourished

Independent Variable	Definition	Variables Code
Wealth index	The wealth index is a composite measure of a household's cumulative living standard. The wealth index is calculated using a household's ownership of selected assets, such as televisions and bicycles; materials used for housing construction; and types of water access and sanitation facilities.	1 = Poor 2 = Middle 3 = Rich
Place of residence	Type of place of residence	1 = Urban 2 = Rural
States and Regions	State and region that respondent currently living.	1 = Chin 2 = Kachin 3 = Kayah 4 = Kayin 5 = Sagaing 6 = Tanintharyi 7 = Bago 8 = Magway 9 = Mandalay 10 = Mon 11 = Rakhine 12 = Yangon 13 = Shan 14 = Ayeyarwaddy 15 = Naypyitaw
Toilet facility	Type of toilet facility that the family members use	1 = Improved (flush to septic tank, flush to pit latrine, pit latrine with slab, ventilated improved pit latrine) 2 = Unimproved (flush to piped sewer system, flush to somewhere else, flush don’t know where, pit latrine without slab/open pit)

Independent Variable	Definition	Variables Code
Toilet sharing	Toilet facilities shared with other households.	1 = No 2 = Yes
Source of drinking water	Major source of drinking water for household members	1 = Improved (contain piped into dwelling, public tap, tubewell/ borehold, protected dug well and sprin, rain water, bottle water) 2 = Non-improved (contain unprotected dwell and spring, tanker truck/cart with drum, surface water, others)

CHAPTER IV
RESULTS AND FINDINGS

This chapter describes the results and findings concerning with the factors relating to the occurrence of diarrhea among under-five children. The first part of this chapter is the descriptive analysis of mother factors, child factors and household factors. The second part of this chapter is the relationship between mother factors, child factors and household factors and the occurrence of diarrhea among under-five children in Myanmar using Chi-square test. Finally, this chapter presents the associated factors of the occurrence of childhood diarrhea using the binary logistic regression model.

4.1 Descriptive Statistics

Descriptive statistics is carried out to describe the occurrence of diarrhea among under-five children and mother factors, child factors and household factors. According to MDHS 2015-2016 data, the frequency and percent distribution of occurrence of diarrhea are presented in Table (4.1).

Table (4.1) Frequency and Percent Distribution of Occurrence of Diarrhea among Children

Occurrence of Diarrhea	No. of Children	Percent
No	4,046	88
Yes	550	12
Total	4,596	100

Note: Missing data on occurrence of diarrhea among children for 186 cases.

Data Source: MDHS (2015-16)

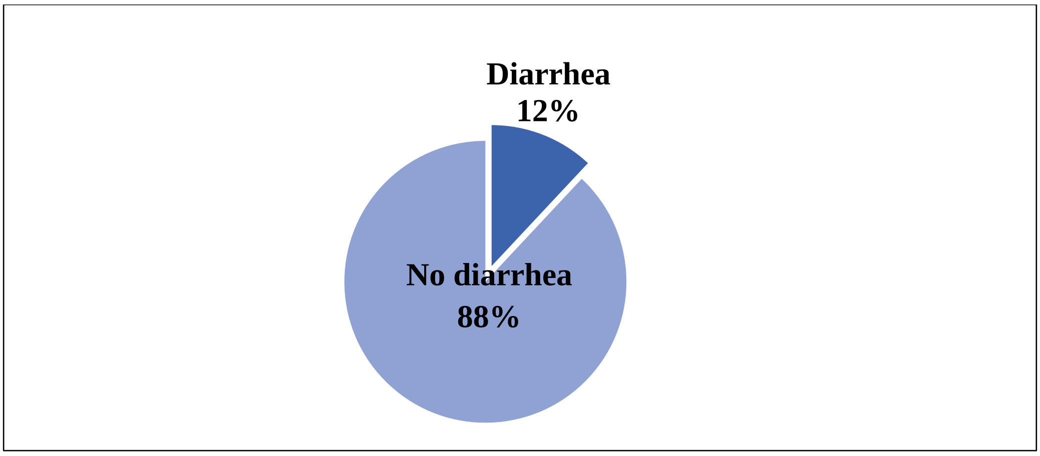


Figure (4.1) Occurrence of Diarrhea among Under-five Children

Data Source: Table (4.1)

According to the result of the study, 12% of children had diarrhea but 88% of children had not diarrhea.

The frequency and percent distribution of mother factors are presented in Table (4.2).

Table (4.2) Frequency and Percent Distribution of Mother Factors

Mother Factors	No. of Respondents	Percentage (%)
Age of mother (Years)		
15-24	886	18.53
25-34	2451	51.25
35 and above	1445	30.22
Mother's education		
No education	855	17.88
Primary	2119	44.31
Secondary	1481	30.97
Higher	327	6.84
Mother's employment status		
Unemployed	2240	46.84
Employed	2539	53.09
Total	4782	100

Note: Missing data on mother's employment status for 3 cases.

Data Source: MDHS (2015-16)

According to Table (4.2), about half of mother were 25-30 years age group (51%) followed by 35 years and above age group which compromised 30%. The lowest percentage (18%) of mother were 15-24 years age group. Regarding the mother's education, the highest percentage of mother (about 45%) achieved primary level of education. Only about 7% of mothers achieved higher level of education. About 20% of mothers were not education at all. Concerning the employment status of mothers, more than 50% of mothers were employed.

The frequency and percent distribution of child factors are presented in Table (4.3).

Table (4.3) Frequency and Percent Distribution of Child Factors

Child Factors	No. of Children	Percentage (%)
Child's gender		
Male	2506	52.40
Female	2276	47.60
Age of child (Months)		
0-11	1571	32.85
12-23	278	5.81
24-35	892	18.65
36-47	953	19.93
48-59	856	17.9
Immunization		
One	3006	62.86
Two	1446	30.24
Three and above	330	6.9
Duration of breastfeeding		
Never breastfed	117	2.45
Not currently breastfed	2623	54.85
Still breastfed	2042	42.70
Nutritional status		
Undernourished	1164	24.34
Nourished	3618	75.66
Total	4782	100

Note: Missing data on age of child for 232 cases.

Data Source: MDHS (2015-16)

In this study, 52.4% of children were males but 47.6% of children were females. Most of children were age group 0-11 months and followed by age group 36-47 months (19.93%), age group 24-35 months (18.65%), 48-59 months (17.9%) and 12-23 months (5.81%). Regarding the immunization status, about 60% of children stated one time entry in health card whereas 30% showed two times entry. Only about 7% of children had three times and above entry in health card. Among the 4782 under-five children about 2% had no history of breastfeeding at all, of the rest of the children about 42% of the children will still breastfed. Nearly one fourth of children were found to be undernourished.

The frequency and percent distribution of household factors are presented in Table (4.4).

Table (4.4) Frequency and Percent Distribution of Household Factors

Household Factors	No. of Respondents	Percentage (%)
Wealth index		
Poor	2543	53.18
Middle	865	18.09
Rich	1374	28.73
Place of residence		
Urban	1007	21.06
Rural	3775	78.94
States and Regions		
Chin	472	9.87
Kachin	352	7.36
Kayah	377	7.88
Kayin	346	7.24
Sagaing	346	7.24
Tanintharyi	328	6.86
Bago	280	5.86
Magway	267	5.58
Mandalay	262	5.48
Mon	247	5.17
Rakhine	357	7.47
Yangon	247	5.17
Shan	349	7.30
Ayeyarwaddy	313	6.55
Naypyitaw	239	5.00

Table (4.4) Frequency and Percent Distribution of Household Factors

(Continued)

Household Factors	No. of Respondents	Percentage (%)
Toilet facility		
Improved toilet	2502	52.32
Unimproved toilet	1430	29.90
Toilet sharing		
No	3230	67.54
Yes	702	14.68
Source of drinking water		
Improved water	3731	78.02
Unimproved water	920	19.24
Total	4782	100

Note: Missing data on toilet facility for 850 cases, toilet sharing for 850 cases and source of drinking water for 131 cases.

Data Source: MDHS (2015-16)

According to Table (4.4), the most children's families (53.18%) had poor wealth conditions followed by rich wealth conditions (29%) and middle wealth conditions (18%). More than three fourth of the children lived in rural areas. About half of the children had improved toilet facility. Only about 15% of the children had toilet facilities shared with other households. More than three fourth of the children used drinking water from improved sources. The children were fairly distributed from all states and regions of Myanmar where highest percentage of children (about 10%) lived in from Chin State and lowest percentage of children (about 5%) from Naypyitaw Region.

4.2 Association Between Occurrence of Diarrhea and Mother Factors, Child Factors and Household Factors

To find the association between each mother factors, child factors and household factors and occurrence of diarrhea, bivariate analysis was used. On the basis of Pearson's Chi-squared statistics, it can be determined whether mother factors, child factors and household factors are related to occurrence of diarrhea occurrence. The Pearson's Chi-squared results of the association between mother factors and the occurrence of diarrhea are described in Table (4.5).

Table (4.5) The Results of Association between Mother Factors and Diarrhea Occurrence

Mother factors	Occurrence of Diarrhea Recently		Chi-square	P-value
	No (%)	Yes (%)		
Age of mother (Years)				
15-24	86.4	13.6		
25-34	87.9	12.1		
35 and above	89.3	10.7	4.4	0.111
Mother's education				
No education	87.4	12.6		
Primary	88.0	12.0		
Secondary	87.1	12.9		
Higher	94.4	5.6	13.88***	0.003
Mother's employment				
Unemployed	89.1	10.9		
Employed	87.1	12.9	4.65**	0.031

Note: ***, **, * represent 1%, 5% and 10% level of significance, respectively.

Data Source: MDHS (2015-16)

Table (4.5) showed that mother education status related to the occurrence of diarrhea among under-five children at 1% significant level. It is found that children of well-educated mothers have lower rates of diarrheal disease than children of low-educated mothers. The mother’s employment status related to the occurrence of diarrhea at 5% significant level. It can be seen that children of unemployed mothers have lower rates of diarrheal disease than children of employed mothers. Because unemployed mothers can take care of children more than employed mothers. There is no significant relationship between mother age and the occurrence of diarrhea in under-five children.

The results from Pearson’s Chi-squared test of the association between child factors and the occurrence of diarrhea are described in Table (4.6).

Table (4.6) The Results of Association between Child Factors and Diarrhea Occurrence

Child Factors	Occurrence of Diarrhea Recently		Chi-square	P-value
	No (%)	Yes (%)		
Child's gender				
Male	87.7	12.3		
Female	88.4	11.6	0.61	0.436
Age of child (Months)				
0-11	84.9	15.1		
12-23	82.7	17.3		
24-35	87.2	12.8		
36-47	90.1	9.9		
48-59	93.7	6.3	52.17***	0.000
Immunization				
One	87.6	12.4		
Two	89.1	10.9		
Three and above	87.8	12.2	2	0.368
Duration of breastfeeding				
Never breastfed	84.1	15.9		
Not currently breastfed	90.4	9.6		
Still breastfed	85.3	14.7	29.41***	0.000
Nutritional status				
Undernourished	88.5	11.5		
Nourished	87.9	12.1	0.31	0.576

Note: ***, **, * represent 1%, 5% and 10% level of significance, respectively.

Data Source: MDHS (2015-16)

Table (4.6) showed that child's age associated with the diarrhea occurrence at 1% significant level and duration of breastfeeding status associated with diarrhea occurrence at 1% significant level. It is found that children's age group (48-59) months have lower rates of diarrheal disease than children's age groups (0-11) months, (12-23) months, (24-35) months and (36-47) months. It has been found that as children get older, the incidence of diarrhea is reduced due to the improvement of their immured system. Duration of breastfeeding related to the diarrhea occurrence at 1% level. It is found that children who drink breastfeed have lower rates of diarrheal disease than children who did not drink breastfeed.

On the other hand, there is no statistically significant association between other child factors such as child's gender, immunization status and nutritional status (underweight) and diarrhea occurrence.

The Pearson's Chi-squared results of the association between household factors and the occurrence of diarrhea are described in Table (4.7).

Table (4.7) Association between Household Factors and Diarrhea Occurrence

Household factors	Occurrence of Diarrhea Recently		Chi-square	P-value
	No (%)	Yes (%)		
Wealth index				
Poor	86.1	13.9		
Middle	87.9	12.1		
Rich	91.6	8.4	24.82***	0.000
Place of residence				
Urban	90.7	9.3		
Rural	87.3	12.7	8.5***	0.004
States and Regions				
Chin	75.9	24.1		
Kachin	83.5	16.5		
Kayah	89.4	10.6		
Kayin	83.9	16.1		
Sagaing	94.0	6.0		
Tanintharyi	92.3	7.7		
Bago	93.0	7.0		
Magway	91.6	8.4		
Mandalay	90.6	9.4		
Mon	92.5	7.5		
Rakhine	85.5	14.5		
Yangon	95.0	5.0		
Shan	89.6	10.4		
Ayeyarwaddy	82.7	17.3		
Naypyitaw	91.4	8.6	130.92***	0.000

Table (4.7) Association between Household Factors and Diarrhea Occurrence

(Continued)

Household factors	Occurrence of Diarrhea Recently		Chi-square	P-value
	No (%)	Yes (%)		
Toilet facility				
Improved toilet	88.2	11.8		
Unimproved toilet	88.5	11.5	0.07	0.785
Toilet sharing				
No	87.9	12.1		
Yes	90.0	10.0	2.31	0.129
Source of drinking water				
Improved water	88.6	11.4		
Unimproved water	86.3	13.7	3.60*	0.058

Note: ***, **, * represent 1%, 5% and 10% level of significance, respectively.

Data Source: MDHS (2015-16)

According to the results of Table (4.7), it is found that children from rich households have lower rates of diarrheal disease that children from poor households. There is a significant association between wealth index and occurrence of diarrhea at 1% level. Moreover, the diarrhea occurrence of children is higher in rural areas compared to urban areas and the association between occurrence of diarrhea and place of residence is statistically significant at 1% level. The diarrhea occurrence was highest in Chin State and association between states and regions of residence and diarrhea occurrence is statistically significant at 1% level. The sources of drinking water related to the occurrence of diarrhea at 10% significant level. It is found that children who drink unimproved water have higher rates of diarrheal disease than children who drink improved water. Contrastingly, other household factors such as toilet facility, and toilet sharing had not associated with the occurrence of diarrhea.

4.3 Binary Logistic Regression Model for Diarrhea Occurrence

In this study, binary logistic regression model has been used to find the variables that influenced on occurrence of diarrhea among children under-five years in Myanmar. The diarrhea occurrence of under-five children has been taken as dependent variable whereas mother’s age, education, employment status, age and gender of child, immunization status, duration of breastfeeding, nutritional status of child (weight for age), wealth index, place of residence, states and regions of residence, toilet facility, toilet sharing and source of drinking water are considered as independent variables. The findings are shown in Table (4.8).

Table (4.8) Model Fitting Information for Occurrence of Diarrhea

Model fitting criteria	χ^2 value	df	P-value
LR Chi-square	208.89	36	0.000***
Hosmer and Lemeshow (H-L) Test	6.99	8	0.538
Log Likelihood	-1258.02		
Pseudo R Square	0.0767		

Note: *** represent 1% level of significance.

Source: MDHS (2015-2016)

Binary logistic regression model was used to investigate the relationship between the occurrence of diarrhea and mother factors, child factors and household factors. The overall model evaluation criteria of binary logistic regression model are presented in Table 4.8. According to the model evaluation criteria (Pseudo R^2=0.0767), 7.67% of the variation in occurrence of diarrhea can be explained by the mother factors, child factors and household factors. LR Chi-square test of model coefficients shows that the addition of the independent variables improved the predictive power of the model. Regarding the LR Chi-square test of model coefficients, it has been found that the model is significant (Chi-square=208.89, df=36, P-value=0.000 < 0.01). The results of Hosmer and Lemeshow statistic (Chi-square=6.99, df = 8, P-value = 0.538>0.01) show that there is no evidence of lack of fit of the model.

Table (4.9) The Results of Binary Logistic Regression Model of Diarrhea Occurrence

Independent variables	Coef.	Odds Ratio	Std. Err.	z	P-value	95% C.I Lower	Upper
Constant	-0.01	0.99	0.49	-0.02	0.98	0.37	2.63
Mother Factors							
Age of mother (Years)							
15-24							
25-34	-0.01	0.99	0.14	-0.11	0.915	0.75	1.29
35 and above	-0.19	0.83	0.13	-1.15	0.251	0.61	1.14
Mother's education							
No education							
Primary	0.12	1.13	0.19	0.74	0.458	0.82	1.57
Secondary	0.09	1.09	0.20	0.49	0.625	0.76	1.57
Higher	-0.53*	0.59	0.19	-1.66	0.098	0.32	1.10
Mother's employment status							
Unemployed							
Employed	0.31***	1.36	0.15	2.73	0.006	1.09	1.70
Child Factors							
Child's gender							
Male							
Female	-0.12	0.89	0.09	-1.11	0.265	0.72	1.09
Age of child (months)							
0-11							
12-23	0.15	1.16	0.24	0.71	0.475	0.77	1.74
24-35	-0.30*	0.74	0.13	-1.72	0.086	0.53	1.04
36-47	-0.55***	0.58	0.11	-2.78	0.005	0.39	0.85
48-59	-0.96***	0.38	0.09	-4.27	0.000	0.24	0.59
Immunization							
One							
Two	-0.31**	0.73	0.09	-2.48	0.013	0.57	0.94
Three and above	-0.40*	0.67	0.16	-1.71	0.086	0.43	1.06
Duration of breastfeeding							
Never breastfed							
Not currently breastfed	-0.50	0.61	0.24	-1.27	0.206	0.28	1.32
Still breasted	-0.63*	0.54	0.21	-1.60	0.100	0.25	1.15
Nutritional status							
Undernourished							
Nourished	-0.37***	0.69	0.10	-2.68	0.007	0.53	0.91

Table (4.9) The Results of Binary Logistic Regression Model of Diarrhea Occurrence (Continued)

Independent variables	Coef.	Odds Ratio	Std. Err.	z	P-value	95% C.I Lower	Upper
Household factors							
Wealth Index							
Poor							
Middle	-0.29**	0.75	0.11	-2.03	0.042	0.57	0.99
Rich	-0.46***	0.63	0.10	-2.82	0.005	0.46	0.87
Place of residence							
Urban							
Rural	0.06	1.06	0.16	0.36	0.717	0.78	1.43
States and Regions							
Chin							
Kachin	-0.48**	0.62	0.13	-2.37	0.018	0.41	0.92
Kayah	-0.97***	0.38	0.09	-4.30	0.000	0.24	0.59
Kayin	-0.51**	0.60	0.14	-2.22	0.027	0.38	0.94
Sagaing	-1.59***	0.20	0.06	-5.67	0.000	0.12	0.35
Taninthayi	-1.50***	0.22	0.06	-5.33	0.000	0.13	0.39
Bago	-1.60***	0.20	0.06	-5.28	0.000	0.11	0.36
Magway	-1.45***	0.23	0.07	-4.92	0.000	0.13	0.42
Madalay	-1.24***	0.29	0.08	-4.32	0.000	0.17	0.51
Mon	-1.34***	0.26	0.08	-4.33	0.000	0.14	0.48
Rakhine	-1.14***	0.32	0.10	-3.59	0.000	0.17	0.60
Yangon	-1.80***	0.16	0.06	-5.16	0.000	0.08	0.33
Shan	-1.12***	0.33	0.08	-4.50	0.000	0.20	0.53
Ayeyarwaddy	-0.66***	0.52	0.12	-2.95	0.003	0.33	0.80
Nay Pyi Taw	-1.44***	0.24	0.07	-4.70	0.000	0.13	0.43
Toilet facilities							
Improved toilet	0.05	1.05	0.13	0.41	0.683	0.82	1.35
Unimproved toilet							
Toilet sharing							
No							
Yes	-0.11	0.90	0.13	-0.71	0.477	0.67	1.21
Sources of drinking water							
Improved water							
Unimproved water	0.06	1.07	0.15	0.46	0.648	0.81	1.40

Note: ***, **, * represent 1%, 5% and 10% level of significance, respectively.
Data Source: MDHS (2015-2016)

Binary logistic regression model is performed on occurrence of diarrhea among children in Myanmar. The results are shown in Table (4.9).

Concerning the mother factors, the coefficient of mother's education is statistically significant at 10% level. The children with mothers got higher level of education are about 0.41 times less likely to be diarrhea occurrence as compared to children with uneducated mothers. The coefficient of mother's employment status is statistically significant at 1% level. The children with employed mothers are about 1.36 times more likely to be diarrhea occurrence as compared to children with unemployed mothers.

Regarding the child factor, the coefficients of children age are statistically significant at 1% and 10% levels. The children's age group 24-35 months, 36-47 months and 48-59 months are about 0.32, 0.48 and 0.66 times less likely to be diarrhea occurrence as compared to children's age group 0-11 months. The children who have age group 24-35 months are about 0.26 time less likely to be diarrhea occurrence as compared to their age group 0-11 months. The children who have age group 36-47 months are about 0.42 time less likely to be diarrhea occurrence as compared to their age group 0-11 months. The children who have age group 48-59 months are about 0.62 times less likely to be diarrhea occurrence as compared to their age group 0-11 months. In addition, the coefficients of immunization status are statistically significant at 5% and 10% levels. The children who received two times immunization are about 0.27 times less likely to be diarrhea occurrence as compared to the children who received first time immunization. The children who received three times and above immunization are about 0.33 times less likely to be diarrhea occurrence as compared to the children who received first time immunization. The coefficient of duration of breast feeding of children is statistically significant at 10% level. The children who have still breasted are about 0.46 times less likely to be diarrhea occurrence as compared to the children who have not breasted. The coefficient of nutritional status of children is statistically significant at 1% level. The nourished children are about 0.31 times less likely to be diarrhea occurrence as compared to undernourished children.

As regards the household factors, the coefficients of wealth index are statistically significant at 1% and 5% levels. The children from middle households are about 0.25 times less likely to be diarrhea occurrence as compared to children from poor households. The children from rich households are about 0.37 times less likely to be diarrhea occurrence as compared to children from poor households. The coefficients of states and regions are statistically significant at 1% and 5% levels. The children from Kachin, Kayah, Kayin, Mon, Rakhine and Shan States are about 0.38, 0.62, 0.4, 0.74, 0.68 and 0.67 times less likely to be diarrhea occurrence as compared to children from Chin State. The children from Sagaing, Tanintharyi, Bago, Magway, Mandalay, Yangon, Ayeyarwaddy Regions and Naypyitaw are about 0.8, 0.78, 0.8, 0.77, 0.71, 0.84, 0.48 and 0.76 times less likely to be diarrhea occurrence as compared to children from Chin State.

CHAPTER V
CONCLUSTION

This chapter describes the major findings of the study, discussions, suggestions and further research.

5.1 Findings

Diarrhea is the common childhood disease globally and locally. It is the second leading cause of death in children under-five years old although it is preventable and treatable. This study found out the factors influencing the occurrence of diarrhea among under-five children. This is the secondary data analysis of the data from 2015-2016 Myanmar Demographic and Health Survey (MDHS).

According to the descriptive statistics of mother factors, occurrence of diarrhea was highest mother age group 25-34 year, mother with primary education level and employed mother. On the aspect of child factors, factors associated with the high occurrence of diarrhea were found to be male, under one year age, incomplete immunization and malnourished children. With regard to the household factors, diarrhea occurrence was increased in poor households, rural areas, Chin state and unimproved water.

Regarding the chi-square results, mother's education, mother's employment, children's age, duration of breastfeeding, wealth index, type of place of residence, states and regions and source of drinking water related to the occurrence of diarrhea.

The results from binary logistic regression model stated that mother's education plays an important role in occurrence of diarrhea according to this study. Mother's employment status also has significant effects on the diarrhea occurrence. Children of employed mothers are more likely to cause childhood diarrhea. This may be due to the fact that employed mother had limited time for child care and nutritional support.

In respect of child factors, the age of child is an important influencing factor of diarrhea occurrence. The younger age (<12 months) are more likely to be occurrence of diarrhea and special attention should be provided in child care of younger children.

Immunization is the protective factor of diarrhea as stated by this study. The complete immunization status can prevent and reduce the occurrence of diarrhea and complete childhood immunization should be encouraged. Duration of breastfeeding has significant effect diarrhea occurrence. Children drink currently breastfeeding are likely to be occurrence of diarrhea. Child nutrition is an important factor in diarrhea occurrence in accordance with this study. Undernourished children are more likely to be occurrence of diarrhea compared to well-nourished or normal weight children. Proper nutrition should be provided for all children under-five years old.

The wealth index has significant effect on the diarrhea occurrence. The children from poor households are more likely to be occurrence of diarrhea which may be the results of poor nutrition, poor sanitation and hygiene. Similarly, children from rural area suffer diarrhea more than those from urban setting.

Regarding the household factors, improved toilet and improved drinking water have protective effects on the occurrence of childhood diarrhea. Water sanitation and proper excreta disposal should be encouraged to reduce the prevalence of childhood diarrhea.

In this study, place of residence was found to be associated with diarrhea occurrence where the highest number of diarrhea was found at Chin State. Chin State is the poorest state in Myanmar with low socio economic and education status. This may be the contribution factors for the high occurrence of diarrhea in Chin State. Then, the wealth index was significantly associated with the diarrhea occurrence. The children from middle and high income families were less likely to occur diarrhea compared to poor income families. The high socio-economic status contribute to good sanitation, proper nutrition and child care and thus diarrhea occurrence can be reduced.

5.2 Discussions

This study explored the factors associated with the occurrence of diarrhea among under-five children in Myanmar. According to this study, mother's education, mother's employment status, age of child, immunization status, duration of breastfeeding, nutritional status, wealth index and states and regions were found to be significantly associated with the diarrhea occurrence in under-five children.

Regarding mother's education, children of educated mothers are lower risk of diarrhea compared to children of uneducated mothers. This finding was consistent with the study done by Aziz (2018) which stated that children of parents with lower education levels were more prone to have diarrhea compared to parents with tertiary education levels. This finding also support the results of the study conducted by Desmennu (2017) which stated that diarrhea prevalence was higher (15.5%) among children of women who have no formal education. This may be due to the fact that the educated mother could support proper child care and nutrition due to the good health education knowledge.

The diarrhea occurrence is 1.36 times higher among children of employed mother as stated by this study. This finding was similar to the results from a study by Ugboko, where children with employed mother were 2 times more likely to occur diarrhea compared to those with unemployed mother (Ugboko, 2020). Conversely, the study done in Senegal by Thiam found that housewife was associated with higher diarrhea risk compared to those working in the private or public sector (Thiam, 2017). Generally, employed mother had limited time for proper child care predisposing to high risk of malnutrition and infection.

This study observed that the occurrence of diarrhea in children's age groups with 24-35 months, 36-47 months and 48-59 months is 0.32, 0.48 and 0.66 times respectively lower as compared to 0-11 months age group of children. This finding was consistent with the study of Shati (Shati, 2020) reported that the age-specific prevalence of diarrhea was the highest, at 40% among children aged 7–12 months in Saudi Arabia. However, the prevalence of diarrhea among children under the age of five was highest in the age group 24-59 months as stated by Thiam (Thiam, 2020). Generally, under one year children had low immunity compared to older children as well as they are more prone to get diarrhea due to weaning. The different findings may be the results of different sample size and distribution.

This study revealed that children who received 3 or more immunization were less likely to suffer from diarrhea. There were limited data describing the association between childhood immunization and diarrhea occurrence. Childhood immunization was supposed to be protective factors of diarrhea in under-five children because of its immunity to certain infection.

In the present study, the nutrition status was significantly associated with the occurrence of diarrhea. The association between nutrition status of children and diarrhea occurrence is bidirectional. This suggestion was supported by the finding of the study done by Njuguna which showed that diarrhea morbidity and being at risk for malnutrition were closely correlated (Njuguna, 2011). The under-nourished children had reduce immunity and more prone to get infection as well as the children can be malnourished if he/she suffered diarrhea frequently.

5.3 Suggestions and Further Research

This study based on the secondary data from MDHS 2015-2016 survey. Some factors associated with the occurrence of diarrhea such as hand washing practice, personal hygiene, feeding habit, contact with disease person are not included in the original data set and cannot be analyzed in this study. Further study should be conducted for the additional factors (hand washing practice, personal hygiene, feeding habit, contact with disease person) to find out the risk factors of childhood diarrhea occurrence. Therefore, government and health person should conduct the protective and preventive methods to reduce the diarrhea occurrence and to reduce the morbidity and mortality of diarrhea in under-five children in Myanmar.

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