# Prevalence of Diseases among Waterlogged Farmers in Bangladesh and Their Associated Factors

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*Abstract:* This study aimed to explore the prevalence of diseases among waterlogged farmers and their associated factors. We conducted the study using mixed-methods approaches. We employed simple random sampling for this study. To collect quantitative data from the field, we used an interview schedule. We conducted IDIs, FGDs, and KIIs to gather qualitative data from the participants. We categorized the self-reported diseases of the waterlogged farmers into four areas: waterborne diseases, pain-related diseases, hypertension-induced diseases, and dementia. For descriptive statistics, we used frequency and percentages, and for inferential statistics, we used mean rank and non-parametric tests. Prolonged water immersion led to the onset of various waterborne diseases. Due to their high mental stress, they quickly developed hypertension. The farmers also placed significant importance on pain-related issues. Researchers discovered significant disparities between farmer demographic, economic, and environmental factors and conditions such as asthma, skin diseases, knee pain, dental problems, high blood pressure, and optical difficulties. For all factors combined, we observed a small effect in assessing disease prevalence. We can implement a variety of efforts (GO-NGO) to reduce the incidence of the disease in waterlogged areas. Considerable research volume addresses numerous issues confronting farmers. However, concerns about waterlogging and its impact on farmers' physical health are less focused. This study investigates the prevalence of diseases among farmers and the factors that contribute to them.

*Keywords:* prevalence, waterlogging, disease, disaster, physical health, suffering.

## 1. Introduction

Waterlogging, due to over-siltation in the river, is a very common phenomenon in the southern part of Bangladesh. These hazards create a series of other socio-economic and health problems. The prevalence of diseases among waterlogged farmers is associated

with different factors, i.e., social, economic, and environmental. Several studies are looking into the prevalence of diseases among farmers. However, we tend to focus less on issues concerning farmers affected by flooding. In any disaster, people's vulnerability increases, l*et al*one the poor and less privileged groups in society. In flood-related disasters, asthmatic disease, eye irritation, and skin disease become frequent (Saha *et al.*, 2021). The formation of salt-affected soils adversely affects agricultural production and deteriorates the environment due to increased waterlogging, floods, poor life of buildings and engineering structures, and the spread of diseases like malaria and skin problems. Some of the alkali diseases, such as selenosis, fluorosis, and molybdenous, appear when normal soils turn alkali (Chhabra, 2021). In addition, other ill health cases reported by the farm workers included bilharzia, typhoid, back pains, aching bones, and gastrointestinal ailments during the disaster (Mburu, 2019). The participants also provided accounts of various optical difficulties and respiratory complications due to polluted particles (Apu, 2023; Zhang *et al.*, 2012).

After the Fukushima disaster, hypertension, hyperlipidemia, and diabetes generally increased over 9 years in Fukushima Prefecture (Dong *et al.*, 2014; Murakami and Nomura, 2023). Even the prevalence of all four diseases increased after the COVID-19 outbreak in Japan, impacting the lives of affected people with secondary effects on their physical and psychological health. People who have experienced natural or man-made disasters, such as the Chornobyl nuclear power plant accident in 1986 and Hurricane Katrina in 2005, have reported an increase in major non-communicable diseases (NCDs) like hypertension, hyperlipidemia, diabetes, and mental disorders (Bromet, 2012; Sakai *et al.*, 2017). We have observed incidences of lung illnesses, diarrhoea, and urinary tract infections in China and Iran. We have also connected outbreaks of communicable diseases to overcrowding in makeshift shelters (Cartwright *et al.*, 2017). Within the first six months following the 2015 earthquake, Nepal experienced an 80% increase in water-borne diseases (Uprety *et al.*, 2017). Following the 2005 earthquake in Pakistan, there were more than 400 cases of measles and epidemics of meningitis (Kouadio *et al.*, 2012). Researchers suspected gas gangrene in 2.41% of the fatalities after the 2008 Sichuan earthquake (Chen *et al.*, 2011).

In addition to hypertension and diabetes, more than half of the families in Thailand experienced acute health issues like skin infections and cold symptoms during floods (Srikuta *et al.*, 2015). Snake bites and fires have increased (Chan *et al.*, 2019). Flash floods happen more frequently in Pakistan's steep Himalayan regions, where polio, TB, and malaria are already common (Chan *et al.*, 2019). Acute diarrhoea was the most common incidental episode of infectious disease, and two weeks later, acute respiratory

infections became more common (Shabir, 2013). Since farming is an open-air industry, individuals, especially farmers, would suffer from long-term climate-related ailments such as sunstroke, depression, asthma brought on by pollution, infertility, skin problems, and chronic kidney disease in the event of a severe global warming scenario. Suicides, mental illnesses, and social unrest could result from climate stress if it persists past a certain point (Balasubramanian, 2023). Many evacuees may have been compelled to alter certain facets of their lifestyles, such as food and exercise, as a result of this evacuation, which could potentially increase the occurrence of lifestyle disorders like cardiovascular diseases (CVDs) in the future. Following the accident, there was a rise in the percentage of people who were overweight or obese as well as those who had diabetes, hypertension, dyslipidemia, liver dysfunction, atrial fibrillation, and polycythemia (Ohira *et al.*, 2017).

Risk factors during a disaster include knee joint injury and meniscectomy due to occupational mechanical loading (Palmer a Strong, 2022). In later life, these factors can either cause or exacerbate the disease (McWilliams *et al.*, 2011; Fransen *et al.*, 2011). Osteoarthritis and other forms of arthritis, such as rheumatoid and gout, commonly cause back pain. These conditions often lead to common comorbidity patterns, such as hypertension, diabetes, and obesity (Merkeb Alamneh *et al.*, 2022). The losses and fears of volcanic eruptions challenge people's established sense of place and identity and can lead to feelings of helplessness and depression (Warsini *et al.*, 2014). Dementia is a disease that represents a public health priority. Researchers have made some efforts to uncover dementia risk factors, identifying several lifestyle and disease-related risk factors (Livingston *et al.*, 2017). Recent studies have shown that stress accelerates the features of Alzheimer's disease in animal models (Machado *et al.*, 2014). Researchers have depicted an association between chronic life stress and dementia development, but the evidence for this in humans is fairly limited (Greenberg *et al.*, 2014). Disasters such as earthquakes cause a variety of psychiatric problems, including psychological distress lasting a minimum of several years (Nakamura *et al.*, 2019). Research suggests that disaster victims may be more susceptible to short-term cognitive decline (Cherry *et al.*, 2010; Furukawa *et al.*, 2012). The study aimed to explore the disease prevalence of waterlogged farmers, its associated factors, and recommendations against the problem.

## 2.   Methodology

### 2.1. Research Design and Study Settings

This study employed mixed methods, utilizing both quantitative and qualitative data. The quantitative component used a survey research design. The qualitative portion

included IDIs, FGDs, and KIIs for collecting the narratives of the waterlogged farmers. The Bhabadaha point primarily triggers perennial waterlogging in three upazilas: Abhoyanagr, Manirampur, and Keshabpur. During the heavy pours in the late rainy season, those three Upazilas go underwater (Meherun Nesa, 2018). We purposefully selected the first two Upazilas (marked with a red rectangle) for the study. We then selected 12 villages from 6 unions, primarily located in waterlogged zones, to serve as the study area for this research. Two villages from each union. Table 1 displays the villages.

## 2.2. Study Participants

The unit of analysis. We selected farmers based on the criteria: (i) they possessed at least 20 decimals of arable land, (ii) cultivable land undergoing water, and (iii) cropping was the sole source of income, even without any service members in the family. We conducted a household survey from December 15 to 28, 2022, to accurately determine the population size in the study area. To conduct this survey, the researcher and a research assistant went door-to-door to identify the population based on the previously mentioned attributes. The Union Parishad (UP) and Agriculture Extension Office (AEO) did not maintain any lists of waterlogged farmers, so there were no alternative methods to determine the unit of analysis for this study. In certain cases, the researcher received assistance from elderly farmers and local leaders in the relevant areas. The study employed a simple random sampling method. We selected 480 farmers as the sample after conducting the household survey and taking into account their attributes. We conducted 12 IDIs, 5 FGDs with eight farmers, and 21 KIIs to collect qualitative data on the prevalence of farmers' diseases during waterlogging. Before heading out to the field, the researcher prepared various checklists. Five research assistants helped the researcher conduct the study.

**Table 1 Study area by Union and village**

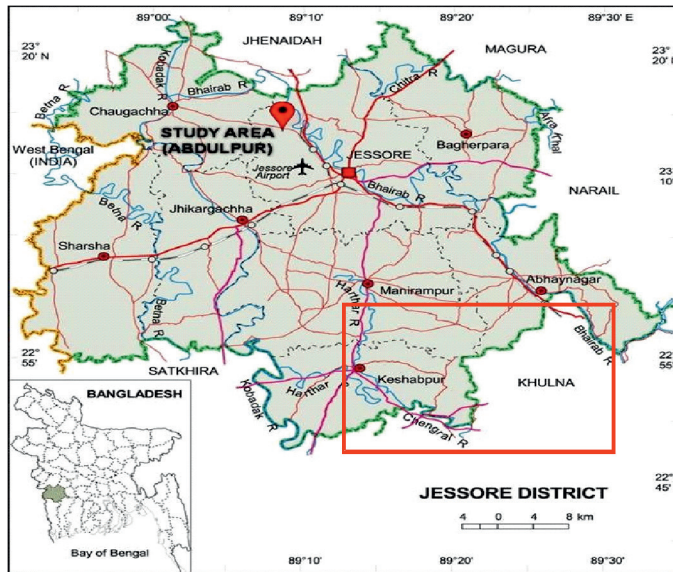| Upazila | Union | Villages | Total |
|---------|-------|----------|-------|
| Manirampur | Durbadanga | Kaminidanga, Kushorikona | |
| | Kultia | Hatgacha, Sujatpur | |
| | Haridashkati | Nebugati,  Kuchlia | 12 |
| Abhoyanagr | Pairahat | Paira,  Barandi | |
| | Chalisia | Andha, Bolarabad | |
| | Sundali | Dharmashiahati,  Fulergati | |

**Figure 1: Study areas by Upazila**

## 2.3. Data Collection

We prepared an interview schedule based on the study's objectives. The schedule contains their disease prevalence. We asked them whether they suffered from any diseases during the waterlogging period. The entire sample reported experiencing asthma, diabetes, skin diseases, heart diseases, knee pain, waist pain, high blood pressure, optical difficulties, denture problems, and dementia. During a face-to-face interview, they reported these self-reported (not clinically tested) diseases. However, these diseases were well connected to farmers' agricultural activities. The researcher, along with five experienced data collectors, gathered quantitative data from March to May 2023. During the qualitative data collection process, we used a checklist for each qualitative tool. Following the checklist, we conducted 12 IDIs in 12 villages under 6 unions, which took approximately 45 minutes to complete. We conducted six FGDs across six unions. A facilitator and some assistants helped conduct the sessions following the checklist. However, 21 key informant interviewers enriched the study by delivering specific information regarding their disease conditions, causes, and consequences.

## 2.4. Statistical Analysis

We applied thematic and narrative analysis for the qualitative part to present the results. We processed the collected data for the quantitative part and then used descriptive

and inferential statistics to analyze and interpret the results. SPSS 25.0 (IBM Corp.) analyzed the data. We used a mean rank to describe the various aspects of disease prevalence among waterlogged farmers. We used a non-parametric test (the Mann-Whitney U test for two groups) and the Kruskal-Wallis H test to find significant differences between the disease rates of farmers and their economic, demographic, and environmental factors. This was because the data in this study was not normally distributed (p = 0.000). All relevant statistical tests were done at both significant levels *(p < 0.05 and p < 0.001)* with a 95% confidence interval.
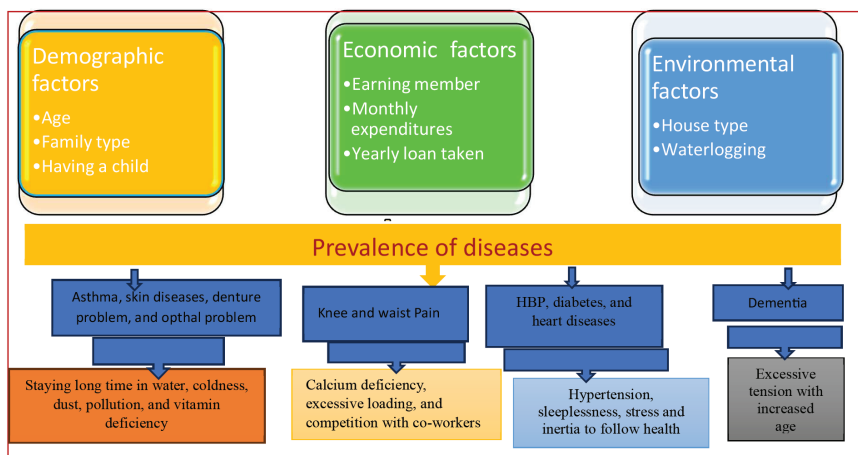
## 3. Conceptual Framework



Figure 2: Conceptual framework of the waterlogged farmers' disease prevalence

## 4. Ethical Consideration

Before data collection from farmers, their consent regarding the study was taken orally. They were not given any financial motivation, and anonymity was attested to secure data confidentiality and authenticity. They have been confirmed that these data would not be used beyond the study purpose and their matters relating to psychosocial health would be preserved strictly.

## 5. Results

### 5.1. Demographic, Economic, and Environmental Factors

Table 2 represents the demographic, economic, and environmental factors of the waterlogged farmers.

**Table 2: Diseases prevalence of the waterlogged farmers**

| Factors | % | Disease prevalence | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Asthma | Diabetes | Skin dis. | Heart dis. | Knee Pain | Waist Pain | HBP | Optical dis. | Denture Problem | Dementia |
| | | MR | MR | MR | MR | MR | MR | MR | MR | MR | MR |
| **Age** | | | | | | | | | | | |
| ≤55 | 65.2 | 242.66 | 242.60 | 238.80 | 241.13 | 245.52 | 242.59 | 252.43 | 253.63 | 242.29 | 245.10 |
| >56 | 34.8 | 236.45 | 236.57 | 243.69 | 239.31 | 231.09 | 236.59 | 218.14 | 215.90 | 237.14 | 231.88 |
| **Family Type** | | | | | | | | | | | |
| Nuclear | 80.8 | 236.72 | 239.60 | 241.20 | 239.08 | 239.76 | 237.58 | 240.77 | 240.05 | 232.55 | 238.39 |
| Joint | 19.2 | 256.46 | 244.28 | 237.57 | 246.50 | 243.63 | 252.80 | 239.37 | 242.39 | 274.02 | 249.39 |
| **Child** | | | | | | | | | | | |
| Yes | 96.7 | 240.53 | 240.19 | 241.28 | 240.29 | 238.12 | 239.09 | 240.22 | 238.79 | 238.53 | 240.10 |
| No | 3.3 | 239.50 | 249.50 | 218.00 | 246.50 | 309.50 | 281.50 | 248.50 | 290.00 | 297.50 | 252.00 |
| **Earning Member** | | | | | | | | | | | |
| 1 | 78.1 | 240.06 | 239.90 | 242.88 | 241.38 | 241.94 | 241.02 | 238.82 | 244.84 | 245.66 | 241.12 |
| ≥2 | 2.1.9 | 242.07 | 242.64 | 232.00 | 237.36 | 235.36 | 238.64 | 246.50 | 225.00 | 222.07 | 238.29 |
| **Monthly Expenditure (BDT)** | | | | | | | | | | | |
| <10000 | 81.9 | 237.74 | 242.17 | 241.89 | 239.78 | 237.17 | 234.63 | 241.25 | 240.27 | 238.87 | 242.84 |
| ≥10001 | 18.1 | 252.95 | 232.95 | 234.21 | 243.74 | 255.53 | 267.02 | 237.12 | 241.55 | 247.84 | 229.93 |
| **Yearly Loan taken (BDT)** | | | | | | | | | | | |
| 4000–25000 | 77.2 | 78.49 | 77.50 | 79.13 | 77.50 | 72.93 | 72.47 | 74.61 | 76.78 | 75.09 | 78.27 |
| 26000–47000 | 22.8 | 72.4 | 75.63 | 71.17 | 75.63 | 88.11 | 89.38 | 83.54 | 77.61 | 82.21 | 73.54 |
| **House Type** | | | | | | | | | | | |
| Kaccha | 26.7 | 228.25 | 242.00 | 242.38 | 242.75 | 230.75 | 226.00 | 221.50 | 230.00 | 213.13 | 240.75 |
| Semi-pacca | 40.8 | 246.23 | 240.93 | 238.20 | 240.38 | 258.38 | 240.54 | 245.99 | 241.33 | 253.42 | 243.43 |
| Pacca | 32.5 | 243.35 | 238.73 | 241.85 | 238.81 | 226.04 | 252.35 | 249.19 | 248.08 | 246.73 | 236.62 |
| **Yard waterlogging** | | | | | | | | | | | |
| Yes | 81.9 | 243.24 | 239.73 | 243.11 | 241.00 | 245.72 | 245.62 | 240.64 | 245.76 | 248.03 | 239.79 |
| No | 18.1 | 228.12 | 243.98 | 228.69 | 238.22 | 216.91 | 217.36 | 239.88 | 216.72 | 206.47 | 243.72 |

*Source*: Fieldwork, 2023

### 5.2. Waterborne Diseases

Most farmers did not suffer from asthma, skin diseases, optical difficulties, or denture problems (Table 3). However, among the farmers, asthma, skin diseases, optical difficulties, and denture problems prevailed at 12.1%, 3.1%, 26.9%, and 23.8%, respectively.

The third in-depth interviewee discussed their experience with asthma as- *"When it intensifies, I feel as though the inhalation is ceasing, and I will no longer be present. Coughing continues to increase. Although it remains under control during the day, it reaches its peak at night. It hurts him a lot. He did some work and sat down again due to his suffering. Coughing at night causes sleep disturbances. Medicine intake is a must. When it increases, I am going to take medicine. Otherwise, it will not do."*

**Table 3: Percentage distribution of the farmers' physical health by waterborne diseases**

| Diseases | Frequency | Percent |
|---|---|---|
| Asthma | | |
| Yes | 58 | 12.1 |
| No | 422 | 87.9 |
| Skin disease | | |
| Yes | 15 | 3.1 |
| No | 465 | 96.9 |
| Optical difficulties | | |
| Yes | 129 | 26.9 |
| No | 351 | 73.1 |
| Problem with dentures | | |
| Yes | 114 | 23.8 |
| No | 366 | 76.3 |

*Source:* Fieldwork, 2023

KII-7 defined the causes of asthma as *"Farmers have developed an addiction to various tobacco-related foods, which adversely affects their health and damages their respiratory system. However, prolonged exposure to water can lead to coldness, which is also a contributing factor to the development of asthma. Colds and coughs take time to heal naturally. As a result, asthma is on the rise. In addition, at harvesting time, they are affected by dust. Again, different types of allergic foods imply that they are asthma patients."*

We added KII-1 to address the denture problem- *"Farmers don't know the rules of tooth preservation. Even they are unaware of how to properly care for their teeth. Working in the sun and rain year-round often leads to dental problems. Additionally, during the*

*winter months, they labour in the fields, which are often chilly and misty. Consequently, their teeth become very vulnerable to gum disease and pyuria. However, they use tobacco, which contains nicotine, and this nicotine decays their teeth.”*

IDI-12 mentioned- “I have had optical difficulties since my boyhood. I use spectacles. It's not a problem in the daytime, but I don't see everything at night. However, when tension is present, I occasionally experience blurred vision. In agricultural activities, this is not a significant issue.” 5.3 Pain-related diseases- A good number of waterlogged farmers had knee and waist pain. More than 42% had waist pain and 35% had knee pain (Table 4).

**Table 4: Percentage distribution of the farmers' physical health by pain diseases**

| Knee pain | Frequency | Per cent |
|---|---|---|
| Yes | 168 | 35.0 |
| No | 312 | 65.0 |
| Waist pain | | |
| Yes | 202 | 42.1 |
| No | 278 | 57.9 |

*Source:* Fieldwork, 2023

One of the in-depth interviewees said, *“I have knee pain. As a youth, I worked hard. I carried the overloaded items. I competed with other labourers in carrying crops. During the peak season, when labour was scarce, I took on the entire task of cultivating myself out of fear of a natural disaster. I made date juice from 60 palm trees, but it requires knee strength. Occasionally, I work at a high pace, which can lead to injury. Now that I am older, my knee doesn't work accordingly (IDI-7).”*

The farmer's knee pain was explained in KII 8- *“Most of the farmers suffer from knee pain. This happens due to the agglomeration of acid in the stomach. They work in the water for a long time and get excessively cold. They experience knee pain as a result. It is usually caused by a lack of calcium. They put in a lot of effort throughout the year, but they don't receive enough nourishment. During the harvesting season, they become overloaded. Their digestive power decreases because of uric acid. However, they must work while standing for extended periods.”*

An in-depth interviewee said, “*Farmers sometimes experience pain in the waist due to heavy labour. When they work unconsciously and quickly, they experience waist pain. However, they do not consume an adequate amount of calcium-rich food. On the other hand, as a man ages, his bones begin to lose their strength. They need a lot of vitamin-rich food, but they don't get it (KII-1).”*

### 5.4. Diseases Produced Hypertension

Most of the farmers did not have high blood pressure, heart disease, or diabetes (Table 5). However, nearly 16% of them had HBP problems, 2.5% had heart diseases, and 3.8% had diabetes.

IDI-5 mentioned HBP "*I always have low blood pressure instead of high one. Due to mental pressure, I feel weak. I can't have pressure on me. Due to my mental instability, I feel worried. There are many tensions in the body. When I am unable to manage my children's education expenses, they often ask, "If I can't afford it, who will pay for it?" I can't sleep all night.*"

**Table 5: Percentage distribution of the farmers' physical health by hypertension-related diseases**

| HBP | Frequency | Per cent |
|---|---|---|
| Yes | 76 | 15.8 |
| No | 404 | 84.2 |
| Heart disease | | |
| Yes | 12 | 2.5 |
| No | 468 | 97.5 |
| Diabetes | | |
| Yes | 18 | 3.8 |
| No | 462 | 96.3 |

*Source:* Fieldwork, 2023

Key informant interviewee 8 identified the following causes of the prevalent high blood pressure among the farmers: *"Farmers in the area suffer from various types of pain, such as back pain and knee pain. They also suffer from stomach pain, ulcers, and asthma. They don't give up smoking, drinking, or tea. Nothing is left to drink. Most farmers have less sleep. Some of them are under pressure. Financial stress contributes significantly to their stress levels. That's why many people become high-pressure patients."*

IDI-12 revealed information about heart disease- "I have a heart problem, and as a result, my heart shakes after labour. I feel abnormal doing agricultural activities. After standing a long time, water remains in the leg, and numbness seizes the ligament. Feet burns. When tension arises, it increases. I take medicine when it increases. The doctor prescribes that the medicine be taken until death."

### 5.5. Dementia

Most of the farmers had no dementia (Table 6). More than 95% of them had no dementia. However, nearly 5% of them had the problem.

**Table 6: Percentage distribution of the farmers' physical health by dementia**

| Dementia | Frequency | Per cent |
|---|---|---|
| Yes | 23 | 4.8 |
| No | 457 | 95.2 |
| Total | 480 | 100.0 |

*Source:* Fieldwork, 2023

KII-20 delivered as *"During waterlogging, farmers became crazy, thinking about how they would survive without work and income. They forget what is right and wrong. They wonder everywhere. They suffer from indecision. They face significant mental and social pressures. If anyone is involved with credit borrowing, the matter becomes more critical and dangerous. The instalment day seems to be more horrifying to them. They forget quickly because of excessive mental pressure."*

## 5.6. *Farmer's Disease Prevalence and its Associated Factors*

### 5.6.1. *Farmers' Demographic Factors and Disease Prevalence*

During waterlogging, we found that younger farmers suffered from high blood pressure (z = -4.080), optical difficulties (z = -3.697), and dementia (z = -2.688) (Table 7). Farmers in the joint family had more asthma (z = -2.174) problems than those in the nuclear family. Researchers found that farmers in joint families experienced denture problems more frequently (z = -3.498).

**Table 7: Differences between demographic factors and Farmers' disease prevalence**

| Diseases | Age (≤55/>56) | | | Family type (nuclear/joint) | | | Child (yes/no) | | |
|---|---|---|---|---|---|---|---|---|---|
| | U test | Z | ES | U test | Z | ES | U test | Z | ES |
| Asthma | 25458.500 | -.828 | | 16380.000 | -2.17* | .09 | 3696.000 | -.052 | |
| Diabetes | 25478.500 | -1.37 | | 17500.000 | -.884 | | 3568.000 | -.802 | |
| Skin disease | 25603.000 | -1.22 | | 17578.000 | -.749 | | 3352.000 | -2.19* | .10 |
| Heart disease | 25937.500 | -.506 | | 17296.000 | -1.70 | | 3616.000 | -.651 | |
| Knee pain | 24563.500 | -1.31 | | 17560.000 | -.291 | | 2608.000 | -2.45* | .11 |
| Waist pain | 25482.500 | -.528 | | 16716.000 | -1.10 | | 3056.000 | -1.40 | |
| HBP | 22401.500 | -4.08** | .18 | 17744.000 | -.138 | | 3584.000 | -.371 | |
| Optical difficulties | 22027.000 | -3.69** | .16 | 17674.000 | -.189 | | 2920.000 | -1.89 | |
| Dentures problem | 25574.500 | -.526 | | 14764.000 | -3.49** | .16 | 2800.000 | -2.26* | .10 |
| Dementia | 24696.000 | -2.68* | .12 | 17030.000 | -1.84 | | 3528.000 | -.912 | |

(*Source:* Field survey-2023) U- Mann-Whitney U test, ES-effect size, *p<0.05** p<0.001

*Note:* Effect size is calculated with Cohens $d = \left| \dfrac{z}{\sqrt{N}} \right|$, effect d=≤.10(small), d=≥.20 (medium)and d=≥.50 (large)

Farmers with children experienced skin diseases (z = -2.190). Farmers without children had knee pain (z = -2.450) and dental problems (z = -2.26). The effect of age on HBP, optical difficulties, and family type on dental problems was nearly medium. Other effects on the prevalence of waterlogged farmers were small.

### 5.6.2. Farmers' economic factors and diseases prevalence

From Table 8 it is seen that farmers with single-earning members reported skin diseases (z = -2.357) and denture problems (z = -2.090).

**Table 8: Differences between economic factors and farmers' disease prevalence**

| Diseases | Earning member (1/2≥) | | | Monthly expenditure (BDT) (<10000/10001>) | | | Yearly loan taken (BDT) (4000–25000/26000–47000) | | |
|---|---|---|---|---|---|---|---|---|---|
| | U test | Z | ES | U test | Z | ES | U test | Z | ES |
| Asthma | 19522.500 | -.233 | | 16012.500 | -1.63 | | 2129.500 | -1.229 | |
| Diabetes | 19462.500 | -.544 | | 16438.500 | -1.70 | | 2240.000 | -1.653 | |
| Skin disease | 18795.000 | -2.35* | .10 | 16548.000 | -1.55 | | 2057.000 | -2.720* | .12 |
| Heart disease | 19357.500 | -.971 | | 16813.500 | -.891 | | 2240.000 | -1.653 | |
| Knee pain | 19147.500 | -.520 | | 15787.500 | -1.35 | | 1840.500 | -2.183* | .09 |
| Waist pain | 19492.500 | -.182 | | 14788.500 | -2.30* | .10 | 1788.500 | -2.414* | .11 |
| HBP | 19057.500 | -.793 | | 16801.500 | -.397 | | 2028.000 | -1.648 | |
| Optical difficulties | 18060.000 | -1.68 | | 17004.000 | -.102 | | 2271.000 | -.130 | |
| Dentures problem | 17752.500 | -2.09* | .09 | 16456.500 | -.741 | | 2082.500 | -1.122 | |
| Dementia | 19455.000 | -.500 | | 16176.000 | -2.12* | .09 | 2154.000 | -1.517 | |

(*Source:* Field survey-2023), U- Mann-Whitney U test, ES-effect size, *p<0.05** p<0.001

*Note:* Effect size is calculated with Cohens $d = \left| \dfrac{z}{\sqrt{N}} \right|$, Effect d=≤.10(small), d=≥.20 (medium)and d=≥.50 (large)

Farmers who spent less than 1000 BDT per month experienced waist pain (z = -2.305), while those who spent more than 10,000 BDT per month experienced dementia (z = -2.123). The farmers' yearly loan significantly correlated with dermatological diseases (z = -2.720), knee pain (z = -2.183), and waist pain (z = -2.414). The disease's prevalence was low (0.10).

### 5.6.2. Environmental Factors and Farmers' Diseases Prevalence

Farmers with semi-paca houses reported knee pain (H = 8.128) and denture problems (H = 12.885), while those with paca houses reported high blood pressure (H = 6.345) during waterlogging (Table 9).

**Table 9: Differences between environmental factors and farmers' disease prevalence**

| Diseases | House type (Kaccha/Semi-pacca/Pacca) | | | Yard waterlogging (yes/no) | | |
|---|---|---|---|---|---|---|
| | H test | p | Effect Size | U test | Z | Effect Size |
| Asthma | 4.390 | .111 | | 16018.500 | -1.630 | |
| Diabetes | .390 | .823 | | 16792.500 | -.787 | |
| Skin disease | 1.011 | .603 | | 16068.000 | -2.912* | .13 |
| Heart disease | .780 | .677 | | 16897.500 | -.625 | |
| Knee pain | 8.182 | .017* | .094 | 15043.500 | -2.122* | .09 |
| Waist pain | 4.542 | .103 | | 15082.500 | -2.011* | .09 |
| HBP | 6.345 | .042* | .070 | 17041.500 | -.073 | |
| Optical difficulties | 2.045 | .360 | | 15027.000 | -2.301* | .10 |
| Dentures problem | 12.885 | .002* | .137 | 14134.500 | -3.432* | .16 |
| Dementia | 1.535 | .464 | | 16815.000 | -.648 | |

(*Source:* Field survey-2023) H- Kruskal Wallis test, *p<0.05** p<0.001

*Note:* Effect size for U test is calculated with Cohens $d = \left|\frac{z}{\sqrt{N}}\right|$ and effect size for H test is calculated with $\eta^2 H = \frac{H - K + 1}{N - K}$, $f = \sqrt{\frac{n^2}{1 - n^2}}$ , Effect d=≤.10 (small), d=≥.20 (medium) and d=≥.50 (large)

Farmers with yard waterlogging had problems with skin diseases (z = -2.912), knee pain (z = -2.122), waist pain (z = -2.011), optical difficulties (z=-2.301), and problems with dentures (z=-3.432) more compared to those farmers whose yard was not inundated during waterlogging. Small effect sizes were observed for both factors except yard waterlogging on dental problems (d =.16, nearly medium).

## 6. Discussion

### 6.1. Waterborne Diseases

Asthma diseases primarily occur in wet environments. Farmers work all day in the rain and sun. So, they are caught cold. However, they smoke excessively, which causes disruptions to their meals. Very few farmers suffer from asthma due to tobacco consumption, dust inhalation, and staying in the water for a long time. For this reason, they faced a series of other physical problems, i.e., sleep disturbances and tiredness. Due to waterlogging, both men and women had asthmatic problems with low vulnerability (Saha *et al.*, 2021). When there are no jobs available in the waterlogged areas, farmers turn to the brick industry, which can lead to the development of asthmatic diseases. People who work in brick kilns suffer from respiratory problems due to emissions (Jerin *et al.*, 2016). People who live near brick kilns are more likely to suffer from

respiratory problems due to ash emissions (Joshi and Dudani, 2008). Usually, farmers in waterlogged areas are more susceptible to waterborne diseases. Farmers' skin diseases are mainly caused by the dirt environment and crop dust. They work with polluted water and clean seedbeds. However, during harvesting, a significant amount of dust from the crops enters their respiratory systems, leading to allergic symptoms. However, during waterlogging, they pull fish nets into the fish farm, where heavy pesticides are used for commercial production. Consequently, they have dermatological problems all year round. Jahid and Mahbub (2020) reported that skin diseases, dysentery, diarrhoea, and common fever prevailed in the household. Jahid and Mahbub (2020) and Saha *et al.* (2021) also found their participants to suffer from waterborne diseases like skin diseases and reproductive health disorders due to stagnant water (Saha *et al.*, 2021).

Because most farmers are not aware of their health issues, they have optical difficulties. They do not take enough vitamin-rich food. However, they have occasionally been infected. Additionally, they work under the scorching sun, which emits UV rays that can cause optical difficulties. Smoking is also responsible for optical problems. Saha *et al.*, (2021) and Jerin *et al.*, (2016) illustrate the farmers' eye irritation as a means of survival in the brick industry. In most cases, bacterial infection in the mouth causes problems with dentures. Those who do not brush their teeth two times a day have a bacterial infection. Farmers who work in unfavourable conditions in the field are reported to have caries; even missing teeth and physical pain caused by dental problems are mostly related to oral health-related quality of life (Quandt *et al.*, 2007).

## 6.2. Pain Diseases

Repeated stress on the knee causes pain. Farmers work hard; sometimes they have to stand for a long time. However, they must carry overloaded items at harvest time. In addition, as age increases, the amount of calcium taken decreases significantly. Knee pain is a common disease among farmers. In the early stages, farmers often worked carelessly in the field, especially when a disaster was imminent and crops were in danger. However, the accumulation of acid in the stomach causes knee pain. Additionally, they experienced this problem due to a calcium deficiency. The above result is similar (Palmer and Strong, 2022). They depicted risk factors for other diseases, such as knee joint injury and meniscectomy. McWilliams *et al.* (2011) and Fransen *et al.* (2011) also support the issue and marked occupational mechanical loading of the knee joint can cause or aggravate the disease. When farmers work restlessly and carry the load beyond their capacities, waist pain occurs. It generally happens to poster structures. This can

also occur as a result of abrupt changes in direction. However, a lack of calcium-rich food increases pain. Mburu (2019) and Fransen *et al.* (2011) cited in their studies that back pain was the most common musculoskeletal condition for farming workers, followed by osteoarthritis and other forms of arthritis (rheumatoid arthritis and gout arthritis).

## 6.3. Hypertension

High blood pressure among farmers is caused by eating too much salt, not eating enough fruit, smoking, and experiencing high levels of stress. The majority of farmers tend to smoke and experience high levels of stress during disasters. Therefore, it is not uncommon for farmers to suffer from high blood pressure. Sleeplessness is another cause of high blood pressure. Studies by Bromet (2012), Moscona *et al.* (2019) and Dong *et al.* (2014) revealed that natural or man-made disasters can exacerbate hypertension. People typically assume that farmers do not have diabetes because they work hard all their lives. But nowadays, adulterated food and lifestyle habits cause diabetes in farmers. Diabetes is prevalent among those who perform poor physical labour and are addicted to various substances. However, elderly farmers may experience minor complications. Bromet (2012) and Moscona *et al.* (2019) revealed in their study that diabetes had increased due to natural or man-made disasters. Dong *et al.* (2014) also found the same results. According to them, diabetes poses a significant burden on family members during disasters. Despite engaging in physical labour, farmers are at risk of developing heart disease due to chain smoking. However, some farmers tend to sleep late at night, which can lead to increased blood pressure and indigestion, ultimately resulting in heart problems. Some farmers were suffering from heart diseases due to tobacco smoking. Due to these issues, they also experienced other physical complications such as numbness, burning feet, and body tension. Swerdel *et al.* (2014), Kitamura *et al.*, (2013), and Nozaki *et al.* (2013) have reported on the prevalence of heart diseases associated with disasters. Cardiovascular diseases (CVDs), including ischemic heart disease and stroke, tend to occur more frequently after large disasters, such as earthquakes, tsunamis, and hurricanes.

## 6.4. Dementia

Though dementia is not a common problem among farmers, some have it. Dementia can occur due to incorrect medication, smoking, insomnia, depression, stress, and

nutritional deficiencies. This finding is consistent with the hypothesis of (Nakamura *et al.*, 2019). They portrayed a robust association between psychological distress and incident dementia in victims of a large disaster. In addition, Machado *et al.* (2014) and Greenberg *et al.* (2014) resemble the above result and imply that chronic stress due to disaster leads to hippocampal damage and impaired cognitive function.

## 7. Limitations of the Study

This study does not represent the whole Bangladesh scenario, but rather the southern part. A large sample would produce better results. These diseases are self-reported, not medically or clinically tested. The study did not record the prevalence of the diseases before waterlogging. However, we should illustrate a comparison of the impact of various factors on the prevalence of diseases caused by waterlogging, as well as the sufferings experienced before and after waterlogging.

## 8. Conclusion

This study aimed to explore the disease prevalence among waterlogged farmers and their associated factors. We classified the farmers' self-reported diseases into waterborne, pain-related, and hypertension-induced diseases. Dementia also prevailed among them. Apart from waterlogging, their diverse lifestyles also contributed to these diseases. However, their inability to meet the demands of their families left them physically, mentally, and socially vulnerable. The study found significant differences between their diseases and their demographic, economic, and environmental factors. Almost all of these factors had a small effect on disease prevalence. Further studies can delve deeper into the prevalence of diseases among farmers, examining a wider range of factors using larger sample sizes. We can implement a variety of GO-NGO initiatives to reduce the incidence of diseases among flood-affected farmers.

## *Note*

1.  The Formula for calculating sample size is: $SS = \dfrac{Z^2 \times P \times (1-P)}{C^2}$

    Where; SS = Sample size, Z = Z value (e.g., 1.96 for 95% confidence level), P = Percentage picking a choice, expressed as decimal (.5 used for sample size needed), C = Confidence interval, expressed as decimal

    $$SS = \frac{(1.96)^2 \times 0.5 \times (1-0.5)}{(0.05)^2} = \frac{2.845 \times 0.5 \times 0.5}{0.0025} = \frac{0.9604}{0.0025} = 384.16$$

    Sample Size according to population, $SS_1 = \dfrac{SS}{1 + \dfrac{SS-1}{POP}}$

    Sample Size according to population, $SS_1 = \dfrac{SS}{1 + \dfrac{SS-1}{POP}}$

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