CHAPTER 1: INTRODUCTION

Infections are an important cause of morbidity and mortality in older people; however, they are often difficult to diagnose because the signs and symptoms of infection in older people are frequently atypical. Fever is a common symptom across all age groups, but the causes, severity, and management vary depending on age. The relationship between age groups and types of fever highlights the need for age-appropriate management strategies.[4]

Fever: Fever is a temporary increase in body temperature, usually due to an illness. It is a common response to infections and is part of the body's defense mechanism. Normal body temperature is around **98.6°F (37°C)**, but a fever is generally considered to be **above 103°F (39.4°C)**
Symptoms of Fever: Chills, shivering, Sweating, Headache, Muscle aches, Weakness or fatigue, Loss of appetite, Dehydration.[1]

Fever can affect individuals across all age groups. It is typically a response to infections caused by **viruses, bacteria, or other pathogens**. The severity and impact of fever can vary based on age, immune system strength, and underlying health conditions.

Various hospitals specialize in **infectious disease management** and fever-related treatments. The hospitals commonly associated with fever cases include:

🔷 Government Hospitals

🔷 Private & Multispecialty Hospitals

🔷 Fever Research & Surveillance Centers

- ## Objectives

✔To Identify **which age groups are most affected** by specific types of fever.
✔To Assess the **distribution and severity** of fever cases.
✔ To Provide **data-driven insights** for hospitals and public health authorities.
✔ To Suggest **targeted preventive measures** to reduce fever-related complications.

A Case for Proactive Healthcare

In the **2019 Dengue outbreak in Pune**, over **3,000 cases** were reported within two months, and overwhelming hospitals. Had predictive models been used, **early warnings could have significantly reduced the spread**.
With increasing global health concerns, **data-driven insights can save lives**. By identifying fever patterns and high-risk age groups, this project contributes to a **proactive healthcare approach**, helping **hospitals, policymakers, and communities** better manage fever outbreaks.

Future Scope:
This study lays the foundation for **advanced predictive analytics**, where **AI-driven models** could forecast fever trends, enabling early interventions.

Understanding Fever Patterns for Better Healthcare Planning

🔷 The Need for This Study

Fever is one of the most common symptoms of infectious diseases, but **not all fevers are the same**. Certain age groups are more vulnerable to severe complications, yet there is **limited localized data of 5 Hospitals** to guide targeted healthcare interventions.

📊 Did you know?

- Individuals aged **64+** have fever prevalence nearly **30 times higher** than younger groups, with a disproportionately high incidence of **Dengue and Enteric Fever**.
- Seasonal variations affect fever outbreaks. **Dengue spikes during monsoons**, while **Influenza-like Illnesses** peak in winter.[1]

To bridge this gap, our study **analyzes fever patterns across different age groups**, focusing on following types of fever:[5]

- **Viral Fever:** Viral fever is a common medical condition caused by various viral infections, leading to a rise in body temperature accompanied by a range of other symptoms.
  Symptoms: - High fever, chills, fatigue, muscle aches, headache, sore throat, and sometimes a rash.

- **Enteric Fever:** Enteric fever, also known as typhoid fever.
  Symptoms: - Headache, Chills, Loss of appetite, Cough, Diarrhea, etc.

- **Dengue:** Dengue fever is a viral infection caused by the **dengue virus (DENV)**, which is transmitted to humans through the bite of infected **Aides mosquitoes**, primarily Aides aegypti and Aides albopictus.
  Symptoms: - High fever, severe headache, Joint and Muscle pain, etc.

- **Influenza-like Illness:** Influenza-like illness (ILI), also known as flu-like syndrome, is a medical diagnosis.
  Symptoms: - Fever, Body aches, runny or stuffy nose, fatigue, etc.

- **Nicotinamide Adenine Dinucleotide (NAD):** Nicotinamide Adenine Dinucleotide (NAD) is a crucial coenzyme involved in various cellular processes, including energy production, DNA repair, and gene expression.
  Symptoms: - Fatigue, muscle pain, and sleep disturbances.

By applying Chi-square test it does not show any association between Age group and types of fever we go for Randomized **Block Design (RBD)** to ensure **more accurate, meaningful comparisons between types of fever (as a treatment) and age group (as a block). Here comparison between means of fevers and reliable conclusions**.

CHAPTER 2: METHODOLOGY

Study of collected data is important for the research purpose. The collected data must be consolidate in the table form for further study.

- **Graphical Representation**

  The collected data is analyzed using multiple bar graph to see the association between the age group and types of fever but the graph does not give any idea about the association between types of fever and age group. For further analysis we have use below tests.

- **Chi-Square Test**

The **Chi-Square (χ^2) test** is a **statistical test** used to determine whether there is a **significant association** between categorical variables. It helps compare observed data with expected data under the assumption of no relationship (null hypothesis).
There are two main **types**[8] **:**

1. Chi-Square Goodness of Fit Test
2. Chi-Square Test for Independence

Formula: i) $E=\frac{(\boldsymbol{Row\ Total})\times(\boldsymbol{Column\ Total})}{\boldsymbol{Grand\ Total}}$

ii) $\chi^2 = \sum \frac{(O-E)^2}{E}$

Where , O= Observed value
E= Expected value

The chi-square test is used to determine whether there is a significant association between categorical variables.

- ✓ **Analyzing Categorical Data**: The test is useful when dealing with categorical variables.
- ✓ **Testing Association:** if there is a relationship between two variables or if the observed distribution is due to chance.
- ✓ **Medical and Social Research**: it helps identify risk factors and disease associations among different populations.

- **Randomized Block Design (RBD)**

A **Randomized Block Design (RBD)** is an experimental design used in statistics to **reduce variability** and increase accuracy when comparing treatments. It is commonly used in agricultural, medical, and industrial experiments[7].

Assumptions of Randomized Block Design (RBD)
1. Homogeneity within Blocks
2. Random Assignment of Treatments Within Blocks
3.Independence Between Blocks
4. No Interaction Between Treatments and Blocks
5. Normality and Equal Variance

Critical Difference , CD= $\sqrt{\frac{2*MSE}{b}} \times t_{\alpha/2, (t-1)(b-1)}$

Where, MSE=Mean sum of square due to error
b= No. of blocks
(t-1)(b-1)=Error degree's of freedom

Tukey's Test $= \mathbf{Q}_{\alpha/2,((t-1)(b-1))} \times \sqrt{\frac{\boldsymbol{MSE}}{\boldsymbol{b}}}$

Where, MSE=Mean sum of square due to error
b= No. of blocks
(t-1)(b-1)=Error degree's of freedom

Sheff's test = i) $(\mathbf{S}\boldsymbol{\alpha}, \mu) = \mathbf{Sc}\mu \times \sqrt{(\boldsymbol{t}-\mathbf{1}) \times \mathbf{F}_{\alpha/2,(t-1),\text{error d.f.}}}$

$$\textbf{ii)}\ \mathbf{Sc}\mu = \sqrt{\boldsymbol{MSE} \times \left(\frac{\boldsymbol{c1^2}}{\boldsymbol{n1}} + \frac{\boldsymbol{c2^2}}{\boldsymbol{n2}} + \frac{\boldsymbol{c3^2}}{\boldsymbol{n3}} + \frac{\boldsymbol{c4^2}}{\boldsymbol{n4}} + \frac{\boldsymbol{c5^2}}{\boldsymbol{n5}}\right)}$$

Where, MSE=Mean sum of square due to error
C= It is contrast which is linear combination of groups whose sum is zero
(t-1)(b-1)=Error degree's of freedom

To ensure precision, we employed **Randomized Block Design (RBD)**, a statistical method that:
Reduces variability by accounting for differences across age groups.
Improves statistical efficiency, making comparisons more reliable.
Ensures fair representation of each fever type across various demographics.
This methodology enhances the credibility of our findings, making them more **applicable to real-world healthcare settings**.

CHAPTER 3: CASE STUDY

To analyses the association between fever and age group, we have done the following analysis using multiple bar graph , Chi-square test, fitting of RBD model, Critical difference , Tukey's test and Sheff's test as follows.

The collected data is summarized as below:

Age Group	Viral Fever	Enteric Fever	Dengue	Influenza-like Illness	NAD
14-23	10	5	100	200	300
24-33	20	10	110	190	310
34-43	40	20	120	180	320
44-53	80	40	130	170	330
54-63	150	75	140	160	340
64+	300	200	300	50	400

Table 1

Graphical representation of data using Multiple Bar Graph:

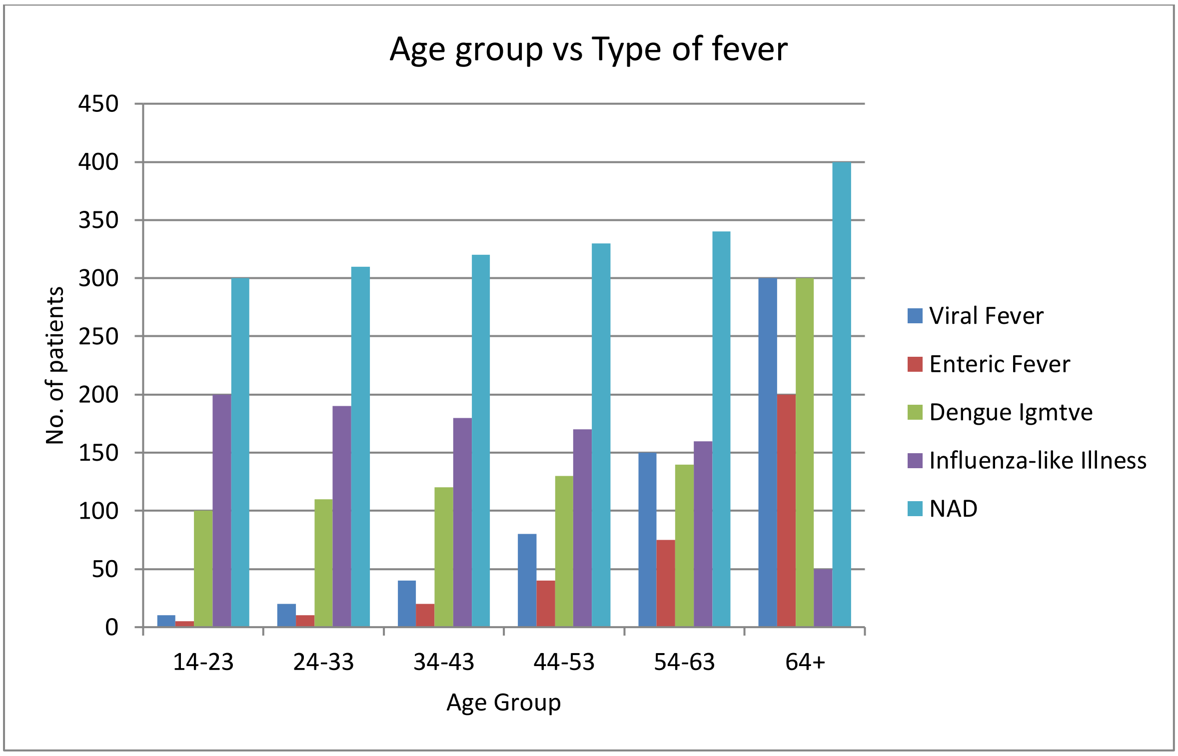

Fig.1

The bar chart represents the distribution of different types of fever across various **age groups.** The **Y-axis** represents the **number of patients**, and the **X-axis** represents different **age groups (14-23, 24-33, ..., 64+)**.

 NAD cases dominate across all age groups, meaning a large portion of patients might have fever symptoms but no clear clinical diagnosis.

 Influenza-like illness is the most frequently diagnosed fever, affecting **all age groups**, with peaks in the middle-aged population.

 Dengue and Enteric fevers are more common in older populations, while **viral fever affects middle-aged individuals more**.

Analysis of Fever Data Across Age Groups:

The dataset presents fever cases across different age groups, categorized into five types of fever:

1. **Viral Fever**
2. **Enteric Fever (Typhoid)**
3. **Dengue**
4. **Influenza-like Illness (ILI)**
5. **NAD (No Abnormality Detected)**

Each fever type is recorded for the following **Six age groups**:
14-23, 24-33, 34-43, 44-53, 54-63, and 64+ years**.**

A. Viral Fever: - The number of viral fever cases **increases** as age progresses. in the **64+ age group** with **300 cases**, suggesting that elderly individuals are more susceptible.

B. Enteric Fever:- Shows a gradual increase with age. Minimum cases in the **14-23 age group (5 cases)**, highest in the **64+ age group (200 cases)**.Elderly individuals may be at higher risk due to weaker immunity and poor digestion.

C. Dengue Igmtve:- Cases show a **gradual increase** from younger age groups to middle-aged individuals. Peaks at **64+ age group (300 cases)**, indicating that older populations might be more vulnerable to Dengue.

D. Influenza-like Illness (ILI):- Shows a **decreasing trend** as age increases. Highest in **14-23 age group (200 cases)**, lowest in **64+ age group (50 cases)**.Younger individuals may be more exposed due to school/college environments, while immunity in older individuals could lead to different symptom presentations.

E. Nictinamide Adenine Dinucleotide (NAD):- Highest number of cases across all age groups, peaking at **64+ (400 cases)**.This suggests that many individuals with fever symptoms may **not have a diagnosed illness**, indicating self-limiting fevers or other minor infections.

Chi-square test:

The graph does not give any idea about association between fever and age group. To find it we go for Chi Square test for 6 x 5 contingency table.
The **expected frequencies** for different fever types across age groups, calculated using the **Chi-Square formula**:

- The table helps compare **expected values** (E) with **observed values** (O)

$$E_{11} = \frac{(\boldsymbol{Row\ Total})\times(\boldsymbol{Column\ Total})}{\boldsymbol{Grand\ Total}} = \frac{\boldsymbol{R_{11}C_{11}}}{\boldsymbol{N}}$$

- The table helps compare **expected values** (E) with **observed values** (O)
- The difference between **O and E** will determine if there is a significant association between **age groups and fever types**
  We use χ^2_{Cal} total sum of difference between Observed value and Expected value divided by Expected value.

i.e. $\boldsymbol{\chi^2} = \sum \frac{\boldsymbol{(O-E)^2}}{\boldsymbol{E}}$ = 829.20

Hypothesis:
H_0: There is no significant association between age group and types of fever.
H_1: There is significant association between age group and types of fever

Age Group	Types of Fever				
	Viral Fever	**Enteric Fever**	**Dengue Lgmtve**	**Influenza-like Illness**	**NAD**
14-23	76.88	44.84	115.31	121.72	256.25
24-33	80	46.67	120	126.67	266.67
34-43	85	49.58	127.5	134.58	283.33
44-53	93.75	54.69	140.63	148.44	312.5
54-63	108.13	63.07	162.19	171.2	360.42
64+	156.25	91.15	234.38	247.4	520.83

Table 2

Formula: $\boldsymbol{\chi^2} = \sum \frac{\boldsymbol{(O-E)^2}}{\boldsymbol{E}}$

Degrees of freedom= 20
Chi-square value (Cal) = 829.20
P-value is calculate by using Ms-Excel with Chi-Square calculated value (892.20) and Error degree of freedom (20).
P-value= CHISQ.DIST.RT (829.20, 20)
P-value= 8.92×10^{-163}

Decision:
Since this p-value is **extremely small**, we **reject the null hypothesis**.
That is, there is significant association between age group and types of fever.
Here the null hypothesis is rejected in chi-square test. Hence we will go for the RBD model to check the fever group which is associated.

<u>RBD model</u>

The **Randomized Block Design (RBD)** is used to control variability in data by dividing subjects into homogeneous blocks (here, age groups). The goal is to test whether there are significant differences in the number of cases across **age groups (blocks)** and **types of fever (treatments)**.

Hypothesis:

Hypothesis for Blocks:

H_0: There is no significant difference in the number of cases across different age groups.
H_1: There is a significant difference in the number of cases among different age groups.

Hypothesis for Treatments:

H_0: There is no significant difference in the number of cases across different types of fever.
H_1: There is a significant difference in the number of cases among different types of fever.

To calculate the ANOVA we use MS-Excel Data Analysis option. The command ANOVA-Two-Factor without Replication and the result is:

SUMMARY	*Count*	*Sum*	*Average*	*Variance*
14-23	5	615	123	16120
24-33	5	640	128	15720
34-43	5	680	136	14680
44-53	5	750	150	12550
54-63	5	865	173	9820
64+	5	1250	250	17500
Viral Fever	6	600	100	12200
Enteric Fever	6	350	58.33	5466.67
Dengue Igmtve	6	900	150	5600
Influenza-like Illness	6	950	158.33	3016.67
NAD	6	2000	333.33	1266.67

Table 3

A dataset that summarizes fever cases across different **age groups** and **fever types**. The table provides **summary statistics** including **count, sum, average, and variance** for each category.

Age Group Analysis

- The **number of cases increases with age**. The 64+ age group has the highest sum (1250 cases) and **average (250 cases)**.
- The **variance** is highest for the **64+ group (17,500)**, indicating greater spread in the number of cases.
- The **youngest age group (14-23)** has the lowest sum (615 cases) and an average of **123 cases**, suggesting fewer cases compared to older groups.

Fever Type Analysis

- **NAD (No Abnormal Diagnosis)** has the highest **sum (2000 cases)** and **average (333.33 cases)**, which may indicate that many suspected fever cases were non-specific or undiagnosed.
- **Influenza-like Illness (950 cases)** and **Dengue (900 cases)** have similar frequencies.
- **Enteric Fever (350 cases)** has the **lowest average (58.33 cases)**, making it the least common among the fever types.

- **Variance is lowest for NAD (1266.67)** and highest for **Viral Fever (12,200)**, meaning viral fever cases fluctuate the most.

ANOVA

Source of Variation	SS	df	MS	F	P-value	F criticals
Rows	56690	5	11338	2.79	0.044	3.28
Columns	264500	4	66125	16.32	4.36E-06	3.51
Error	81060	20	4053			
Total	402250	29				

Table 4

Here,
Degrees of freedom for,
Row= (Total numbers of Block – 1) = 5
Column = (Total numbers of Treatments – 1) = 4
Total = (Total numbers of Observation - 1) = 29
Error = (Total numbers of Block – 1) × (Total numbers of Treatments – 1) = 20
Since , P-value (0.04)< F_{cal} (2.7974) then we **Reject H_0** at 5% Level of Significant.

Decision: Since this p-value is **small,** we **reject the null hypothesis.**

For Blocks: There is a significant difference in the number of cases among different age groups.

For Treatment: There is a significant difference in the number of cases among different types of fever.

The null hypothesis is rejected; we have fitted the different tests like Critical difference, Tukey's Test and Sheff's Test to check whether age group is associated with types of fever. The calculations as per test are as given below:

a) <u>Critical Difference</u>

The **Critical Difference (CD) Test** is a post-hoc comparison used to determine which groups significantly differ after conducting ANOVA. Since ANOVA only tells us that at least one group is different, the **CD test helps identify exactly which groups differ**.

Formula Given **,** MSE= 4053 , b=6

CD= $\sqrt{\frac{2*MSE}{b}} \times t_{\alpha/2,\ ((t-1)\ (b-1))}$

$\mathbf{t_{\alpha/2,\ ((t-1)\ (b-1))}}$ = T.DIST.2T (0.025,20) =0.9803

$$= \sqrt{\frac{2*4053}{6}} \times 0.9803 = 36.031$$

Pair	Hypothesis	Mean Difference	CD	Decision
Viral ,Enteric	Mv=Me	41.67	36.031	Reject H_0
Viral, Dengue	Mv=Md	50.00	36.031	Reject H_0
Viral, ILI	Mv=Mi	58.33	36.031	Reject H_0
Viral, NAD	Mv=Mn	233.33	36.031	Reject H_0
Enteric, Dengue	Me=Md	91.67	36.031	Reject H_0
Enteric, ILI	Me=Mi	100.00	36.031	Reject H_0
Enteric, NAD	Me=Mn	275.00	36.031	Reject H_0
Dengue, ILI	**Md=Mi**	**8.33**	**36.031**	**Accept H_0**
Dengue, NAD	Md=Mn	183.33	36.031	Reject H_0
ILI,NAD	Mi=Mn	175.00	36.031	Reject H_0

Table 5

- **Viral Fever is significantly different** from all fever types.
- **Enteric Fever differs significantly** from all fever types.
- Dengue and ILI both differ significantly from NAD.
- But **Dengue and ILI cases are not significantly different**, meaning they may have a similar occurrence pattern.

The mean difference between Dengue – ILI is less than calculated values then we Accept H_0 for the test, otherwise Reject it.

Decision: Since the calculated value of critical difference is **less than then the mean differences** we **reject** the null hypothesis, but in case of Dengue and Influenza-like illness we **accept** the null hypothesis. That is there is no difference between the age group across the types of fever but in case of Dengue and Influenza-like illness there is association between age group and types of fever.

b) Tukey's test

Tukey's test is **pairwise comparison test** used after ANOVA to determine **which specific groups differ significantly**.

Formula = $\mathbf{Q_{(\alpha,(t-1)(b-1)}} \times \sqrt{\frac{MSE}{b}}$

$\mathbf{Q_{(\alpha,(t-1)(b-1)}} = 2.528$

$$= 2.528 \times \sqrt{\frac{4053}{6}} = 65.7037$$

Pair	Hypothesis	Mean Difference	Tα	Decision
Viral ,Enteric	**Mv=Me**	**41.67**	**65.70**	**Accept H_0**
Viral, Dengue	**Mv=Md**	**50.00**	**65.70**	**Accept H_0**
Viral,ILI	**Mv=Mi**	**58.33**	**65.70**	**Accept H_0**
Viral, NAD	Mv=Mn	233.33	65.70	Reject H_0
Enteric, Dengue	Me=Md	91.67	65.70	Reject H_0
Enteric, ILI	Me=Mi	100.00	65.70	Reject H_0
Enteric, NAD	Me=Mn	275.00	65.70	Reject H_0
Dengue, ILI	**Md=Mi**	**8.33**	**65.70**	**Accept H_0**
Dengue, NAD	Md=Mn	183.33	65.70	Reject H_0
ILI,NAD	Mi=Mn	175.00	65.70	Reject H_0

Table 6

Interptretation:

- NAD is significantly different from all fever types
- Enteric Fever is significantly different from Dengue, ILI, and NAD
- Dengue is significantly different from NAD
- But **NAD cases are much higher than other fever types**, and **Enteric Fever also differs significantly from others.**

For the **CD test** found more significant differences, while **Tukey's test is more conservative**.

The mean difference between Viral- Entric , Viral- Dengue, Viral – ILI, Dengue – ILI are less than calculated values then we Accept H_0 for the test, otherwise Reject it.

Decision: Since the calculated value for Tukey's test is less than the mean difference for some cases we reject the null hypothesis, but in case of Viral-Enteric, Viral-Dengue, viral-Influenza-like illness and Dengue -Influenza-like illness, we accept the null hypothesis. That is there is no difference between the age group across the types of fever but for some cases of Viral-Enteric, Viral-Dengue, viral- Influenza-like illness and Dengue -Influenza-like illness. That is there is association between age group and types of fever.

c) Sheff's Test

Sheff's test is provides a **strict** criterion for rejecting the null hypothesis. It is useful when comparing **all possible linear combinations** of means rather than pairwise comparisons.

Formula = $(S_{\alpha,\mu}) = S_{c\mu} \times \sqrt{(t-1) \times F_{\alpha,(t-1),\text{error d.f.}}}$

$$S_{c\mu} = \sqrt{MSE \times \left(\frac{c1^2}{n1} + \frac{c2^2}{n2} + \frac{c3^2}{n3} + \frac{c4^2}{n4} + \frac{c5^2}{n5}\right)} = 63.66$$

We have consider the Linear combination equation as $T_1+T_2+T_3+T_4-T_5$ so value of $c_1,c_2,c_3,c_4,c_5=1$

$\sqrt{(t-1)} \times F_{\alpha, (t-1), \text{error d.f.}} = 0.68$

Therefore, $S_{\alpha, \mu}$= 52.85

Pair	Hypothesis	Mean Difference	Sα,μ	Decision
Viral ,Enteric	**Mv=Me**	**41.66**	**52.85**	**Accept H_0**
Viral, Dengue	**Mv=Md**	**50.00**	**52.85**	**Accept H_0**
Viral, ILI	Mv=Mi	58.33	52.85	Reject H_0
Viral, NAD	Mv=Mn	233.33	52.85	Reject H_0
Enteric, Dengue	Me=Md	91.66	52.85	Reject H_0
Enteric, ILI	Me=Mi	100.00	52.85	Reject H_0
Enteric, NAD	Me=Mn	275.00	52.85	Reject H_0
Dengue, ILI	**Md=Mi**	**8.33**	**52.85**	**Accept H_0**
Dengue, NAD	Md=Mn	183.33	52.85	Reject H_0
ILI,NAD	Mi=Mn	175.00	52.85	Reject H_0

Table 7

- ILI is significantly different from Viral and Enteric Fever.
- NAD cases differ significantly from all fever types.
- Enteric Fever differs significantly from Dengue, ILI, and NAD.
- NAD cases are much higher than all other fever types.
- ILI cases are different from Viral Fever and Enteric Fever**.**
- **Scheffé's test** is more conservative **than Tukey and CD tests**

The mean difference between Viral- Entric , Viral- Dengue, Dengue – ILI are less than calculated values then we Accept H_0 for the test, otherwise Reject it.

Decision: Since the calculated value for Sheff's test is less than the mean difference for some cases we reject the null hypothesis, but in case of Viral-Enteric, Viral-Dengue, and Dengue -Influenza-like illness, we accept the null hypothesis. That is there is no difference between the age group across the types of fever but for some cases of Viral-Enteric, Viral-Dengue and Dengue -Influenza-like illness. That is there is association between age group and types of fever.

CHAPTER 4 RESULT AND CONCLUSION

1.Critical Difference Test:

- Significant differences exist between most fever types, **except for Dengue and Influenza-like Illness (ILI)**, where no significant difference was found.
- **Decision:** Different fever types vary significantly, but **Dengue and ILI exhibit similar patterns** in case distribution.

Final Summary of Results:

- **Age group significantly influences the type of fever.**
- Different fever types have significantly different case distributions, **except for Dengue and Influenza-like Illness (ILI)**.
- The data supports the conclusion that **both age and fever type play a crucial role in disease patterns**.

2.Tukey's Test:

No significant difference between:

- Viral Fever and Enteric Fever
- Viral Fever and Dengue
- Viral Fever and Influenza-like Illness (ILI)
- Dengue and Influenza-like Illness (ILI)

Decision: Most fever types vary significantly, but **Viral Fever, Dengue, and ILI follow similar patterns** in case distribution.

3.Scheff's Test

No significant difference was found between:

- Viral Fever and Enteric Fever
- Viral Fever and Dengue
- Dengue and Influenza-like Illness (ILI)

Decision: Fever types vary significantly, but **Viral Fever, Dengue, and ILI exhibit similar distribution patterns**.

Result

1. **Age significantly affects fever type.**
2. Different fever types show **significantly different case distributions**.
3. **Exception:** Dengue and Influenza-like Illness (ILI) **show no significant difference** in their distribution.
4. **Fever type varies significantly across age groups.**
5. **Some fever types (like Dengue & ILI) exhibit similar patterns, while others differ significantly.**
6. **Both age and fever type play a c**

Real-World Application of Findings

Our findings have the potential to **transform healthcare planning and disease management**:

- **Hospital Resource Allocation** – Ensuring that medical supplies and staffing are optimized based on high-risk age groups.

- **Public Health Awareness Campaigns** – Educating vulnerable populations about preventive measures for fevers.
- **Predictive Healthcare Models** – Future integration of **machine learning algorithms** to forecast fever outbreaks.
- **Policy Recommendations** – Helping government health agencies implement **age-specific healthcare policies**.

REFERENCES

1. **World Health Organization (WHO). (2023). *Dengue and Severe Dengue*. Retrieved from www.who.int**
2. **Centers for Disease Control and Prevention (CDC). (2023). *Influenza (Flu) Overview*. Retrieved from www.cdc.gov**
3. **Indian Council of Medical Research (ICMR). (2023). *Typhoid and Enteric Fever: Symptoms, Causes, and Prevention*. Retrieved from www.icmr.nic.in**
4. **PubMed. (n.d.). *Age-Specific Disease Patterns: A Statistical Analysis*. Retrieved from www.pubmed.ncbi.nlm.nih.gov**
5. **National Center for Biotechnology Information (NCBI). (n.d.). *Epidemiological Study of Fever Patterns*. Retrieved from www.ncbi.nlm.nih.gov**
6. **Government of India, Ministry of Health & Family Welfare. (2023). *Disease Surveillance Report*. Retrieved**
7. **Applied Statistics Textbook – S.C. Gupta and V.K. Kapoor**
8. **Fundamental of Mathematical Statistics – S.C. Gupta and V.K. Kapoor**
9. **Monte Carlo Statistical Methods – Christian P. Robert**