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## LENGTH OF HOSPITALIZATION OF INTESTINAL INFECTION IN NORTH MACEDONIA

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**Abstract:** Our aim was to investigate the characteristics of hospitalized intestinal infection patients with special focus on the factors that are influencing the length of hospitalization. We used the records of the clinic of infectious disease, department of intestinal infection for a period of 3 years 2015-2018 and used all available hospital records in the clinic's data base for all hospitalized patients. In a period of 3 years 988 patients with gastrointestinal infection were admitted in our department. The diagnoses were A09 (Infectious gastroenteritis) 39%, A08 (Viral and other specified intestinal infections) 20%, A04.9 (Bacterial intestinal infection, unspecified) 19% and other (32%) which included A02.\* (Salmonella) 4%. The mean age of the patients was 12.3 years whereas the median was 6.00 years with a range from 0.1 to 86. The mean duration of hospitalization was 6.82 days (range 2-18). In the linear regression analyses of duration of hospitalization, we found positive univariate correlation with number of comorbidities, age, fever, number of stools, blood pH, C-reactive protein and Salmonella infection (A02.\*), whereas negative univariate correlation we found with vomiting, blood oxygen saturation and viral intestinal infection (A08). In the multivariate linear model, as independent predictors of duration of hospitalization number of comorbidities, age, number of stool, C-reactive protein and Salmonella infections were found. Many clinical variables can impact the length of hospitalisation for patients with intestinal infections. Knowing these aspects can assist physicians in optimising patient care and reducing expenses. To produce evidence-based guidelines for the management of these patients, additional research is required.

**Keywords:** Intestinal Infections, Hospitalization, Length of hospitalization, infection seasonality

### 1. INTRODUCTION

Intestinal infections are a leading cause of hospitalisation, and hospital length of stay can have major effects on patient outcomes and healthcare expenditures (Okoro et al., 2018). Understanding these aspects is essential for optimising patient care and resource allocation, despite the fact that they are complicated and multivariate.

In this scholarly research, we will examine the factors that determine the length of hospitalisation for patients with intestinal infections. We will investigate the demographic and clinical characteristics of individuals with prolonged hospitalisation (Shah & Collins, 2011), in addition to the factors associated with early discharge (Kim et al., 2014). Also, we will investigate the influence of length of stay on patient outcomes, such as morbidity, death, and healthcare utilisation (Matsuoka & Mizoguchi, 2021).

The severity of illness (Okoro et al., 2018), the presence of comorbidities (Okoro et al., 2018), the type of pathogen causing the infection (Bachour et al., 2023) (Koo et al., 2017), and the availability of resources for outpatient management may influence the length of hospital stay for patients with intestinal infections (Okoro et al., 2018). Knowing the relative significance of these factors can assist doctors in optimising patient care and decreasing healthcare expenses.

This research will provide useful insights into the management of patients with intestinal infections and improve the establishment of evidence-based guidelines for their care by examining the factors that determine the length of hospital stay for these patients (Okoro et al., 2018). Our ultimate objective is to enhance patient outcomes and minimise the illness burden associated with intestinal infections.

### 2. METHODS AND MATERIALS

We used the 988 records of the clinic of infectious disease, department of intestinal infection for a period of 3 years 2015-2018 and used all available hospital records in the clinic's data base for all hospitalized patients.

*Statistical analysis*

Comparisons between two groups were performed with Student t-test. The comparison of 3 groups of numeric variables was done with one-way ANOVA and post-hoc LSD multiple comparison analyses. Multivariate linear regression analysis was performed for determination of independent predictors of duration of hospitalization. The seasonal distribution was presented using histogram. SPSS statistical software (version 22.0 SPSS, Inc., North Castle, NY) was used for the analysis; two-tailed  $P < 0.05$  was considered significant. Data are shown as mean  $\pm$  standard deviation if not otherwise stated.

### 3. RESULTS

In a period of 3 years 988 patients with gastrointestinal infection were admitted in our department. The diagnoses were A09 (Infectious gastroenteritis) 39%, A08 (Viral and other specified intestinal infections) 20%, A04.9 (Bacterial intestinal infection, unspecified) 19% and other (32%) which included A02.\* (Salmonella) 4%. The mean age of the patients was 12.3 years whereas the median was 6.00 years with a range from 0.1 to 86. The mean duration of hospitalization was 6.82 days (range 2-18). The mean number of comorbidities was 0.91 (range 0-7). The demographic, clinical and selected biochemical parameters are given in Table 1.

In the linear regression analyses of duration of hospitalization, we found positive univariate correlation with number of comorbidities, age, fever, number of stools, blood pH, C-reactive protein and Salmonella infection (A02.\*), whereas negative univariate correlation we found with vomiting, blood oxygen saturation and viral intestinal infection (A08). In the multivariate linear model, as independent predictors of duration of hospitalization number of comorbidities, age, number of stool, C-reactive protein and Salmonella infections were found.

In figure 1, 2 and 3 the correlations of duration of hospitalization and age, number of comorbidities and C-reactive protein are shown. We used inverted axis for better visual representation. On figure 4 duration of hospitalization and numbers of stool is shown. Using one-way ANOVA we found a significant difference for the groups. In the post-hoc LSD analysis there was a significant difference between the lower 2 groups and the group with highest number of stool per day. The Figure 5 represent the duration of hospitalization in patients with Salmonella infections and other infection, Salmonella infections have significantly longer duration of hospitalization than non-Salmonella infections. The seasonal frequencies of gastrointestinal infection is highest in late summer and lowest in late autumn as shown in Figure 6.

### 4. DISCUSSION

The diagnoses were Infectious gastroenteritis, Viral and other specified intestinal infections, Bacterial intestinal infection, unspecified and Salmonella. The mean duration of hospitalization was 6.82 days (range 2-18). In the linear regression analyses of duration of hospitalization, we found positive univariate correlation with number of comorbidities, age, fever, number of stools, blood pH, C-reactive protein and Salmonella infection, whereas negative univariate correlation we found with vomiting, blood oxygen saturation and viral intestinal infection. In the multivariate linear model, as independent predictors of duration of hospitalization number of comorbidities, age, number of stool, C-reactive protein and Salmonella infections were found.

Many clinical indicators have been found as possible hospitalisation length predictions for patients with intestinal infections. The intensity of the infection is one of the most crucial variables. According to studies, people with serious illnesses, such as Salmonella or Shigella, are more likely to require extended hospitalisation (Karakonstantis et al., 2016; Rajan et al., 2021). Moreover, the existence of comorbidities, such as diabetes or chronic kidney disease, has been linked to prolonged hospital admissions (Rajan et al., 2021).

The type of microorganism causing the infection may also affect hospitalisation duration. For instance, Clostridioides difficile infections have been linked to lengthier hospital admissions than other bacterial illnesses (Koo et al., 2017). This may be attributed to the increased risk of consequences, such as infection recurrence and the need for more intensive treatment. Moreover, viral diseases like norovirus and rotavirus have been linked to lengthier hospital admissions (Barton et al., 2017).

Age and immunological condition are additional variables that may affect hospitalisation duration. Those who are older or whose immune systems are impaired may be more prone to severe infections and require lengthier hospital stays (Matsuoka & Mizoguchi, 2021). Gender may also be a factor, as male patients with intestinal illnesses have lengthier hospital stays than female ones (Karakonstantis et al., 2016).

Furthermore, the availability of outpatient management resources may potentially affect the length of hospitalisation. Individuals who have limited access to outpatient care or who require close monitoring may be hospitalised for lengthier durations (Okoro et al., 2018).

Many clinical variables can impact the length of hospitalisation for patients with intestinal infections. Knowing these aspects can assist physicians in optimising patient care and reducing expenses. To produce evidence-based guidelines for the management of these patients, additional research is required.

**Table 1. Demographic, clinical and biochemical parameters of Gastrointestinal infections**

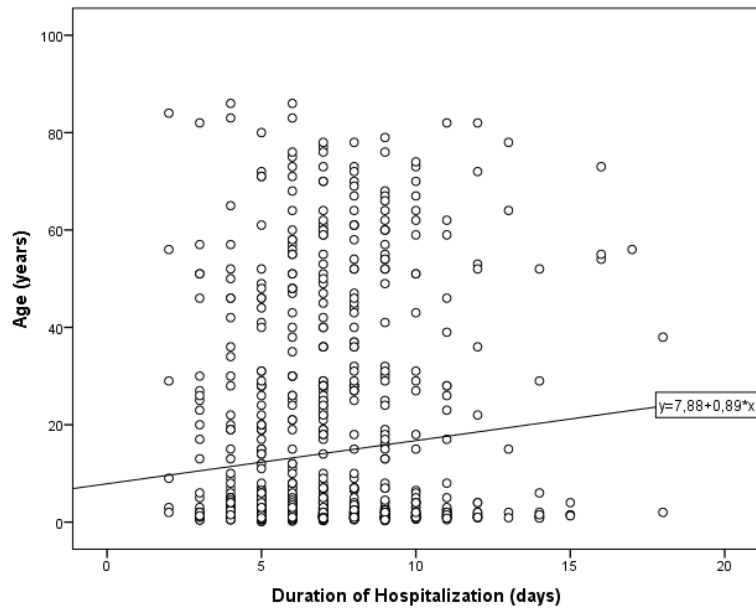
Variable	Reference Values	N=988
<i>Demographic and Clinical Parameters</i>		
Age (years)		6.00*
Gender (Female)		44%
Location (Urban)		72%
Duration of Hospitalization (days)		6.82±2.38
Number of comorbidities		0.91±1.00
Numbers of diarrheas		
0-4		23%
5-8		38%
9+		36%
Fever		80%
Vomiting		79%
<i>Biochemical Parameters</i>		
Hemoglobin	120-180 g/L	121±18.3
Hematocrit at admission	0.35-0.45	35.3±5.5
Glucemia	4.1-6.3 mmol/L	4.69±1.93
Blood urea	1.7-8.3 mmol/L	3.37±2.9
Potassium	3.5-5.1 mEq/L	4.24±1.6
Sodium	134-146 mEq/L	138±3.9
Blood pH	7.35-7.45	7.38±0.07
C-reactive protein	<5 mg/L	22.00*
Blood oxygen saturation %	95-100	91.66±5.5

\*Median

**Table 2. Linear regression analysis of duration of hospitalization of 988 patients with gastrointestinal infections**

Variable	Univariate Analysis Beta-Value	Univariate Analysis p-value	Multivariate Analysis Beta-value	Multivariate Analysis p-value
Number of comorbidities	0.65	0.001	0.73	0.001
Age	0.01	0.003	0.03	0.049
Fever	0.90	0.001		
Number of stools	0.49	0.001	0.63	0.010
Vomiting	-0.70	0.001		
Blood oxygen saturation	-0.10	0.044		
Blood pH	3.36	0.036		
C-reactive protein	0.05	0.001	0.06	0.004
Viral intestinal infections	-0.73	0.001		
Article I. Salmonella infections	1.44	0.001	1.90	0.012

*Figure 1. Scatterplot of duration of hospitalization and age of patients with gastrointestinal infection*



*Figure 2. Scatter plot of duration of hospitalization and number of comorbidities of patients with gastrointestinal infections*

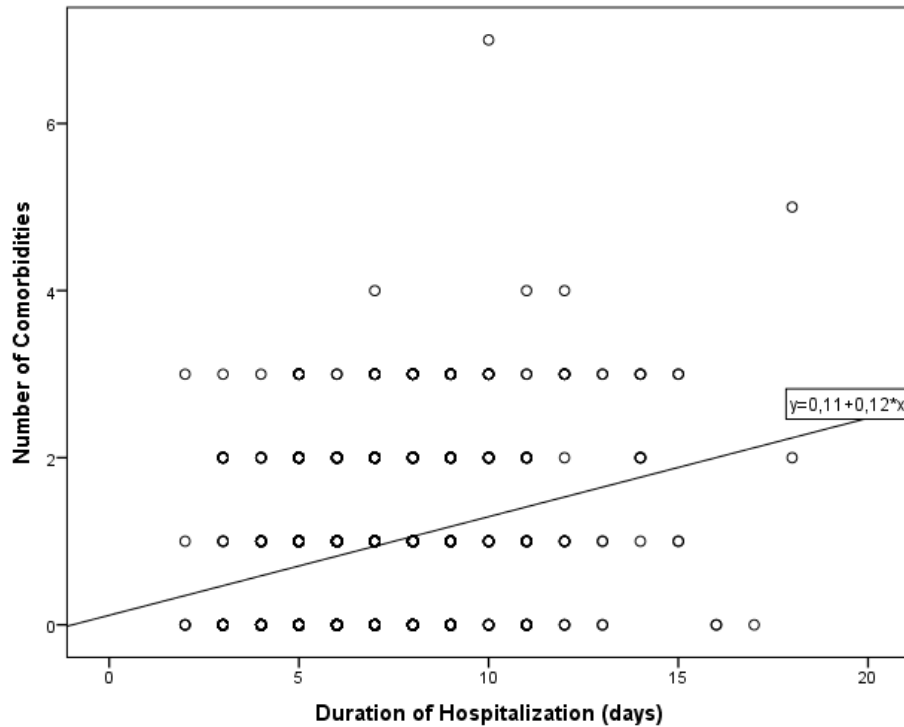


Figure 3. Scatter plot of duration of hospitalization and C-reactive protein in patients with gastrointestinal infection

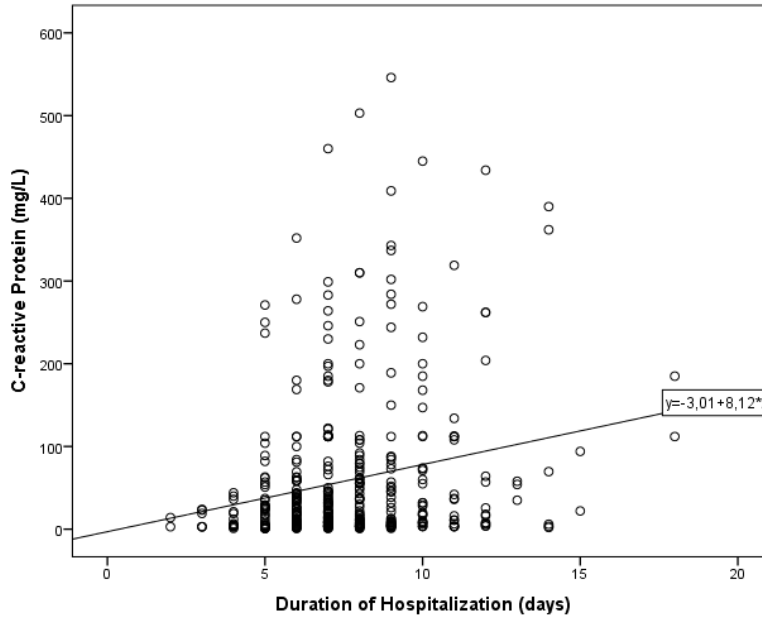


Figure 4. Number of stools at admission and duration of hospitalization in patients with gastrointestinal infection

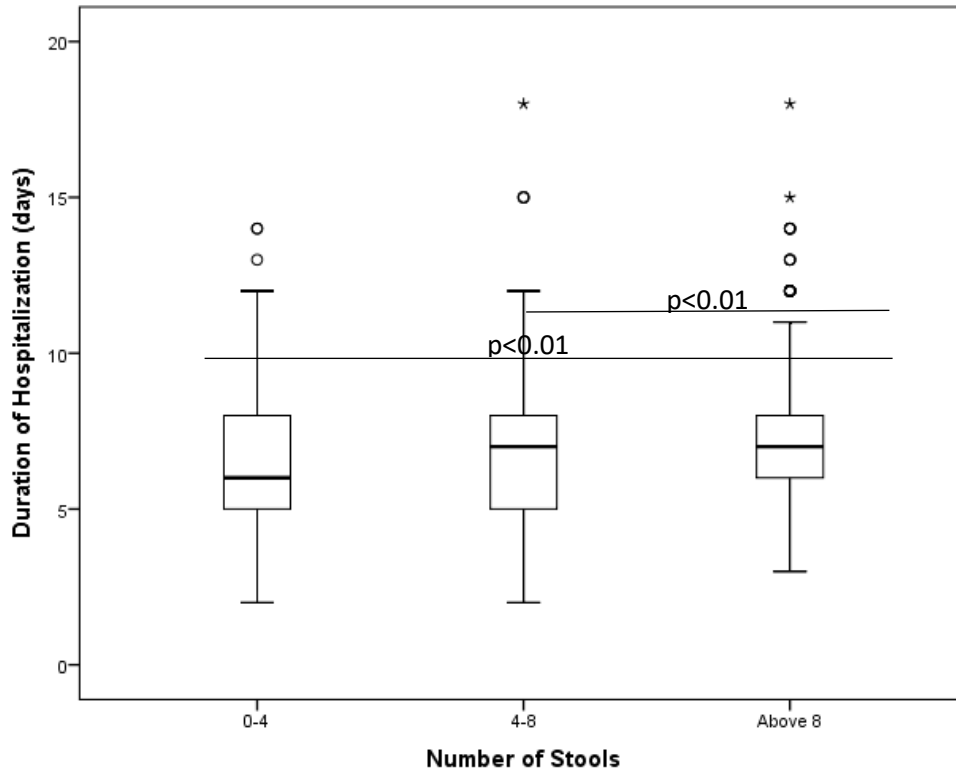


Figure 5. Duration of hospitalization in patients with Salmonella and non-Salmonella gastrointestinal infection

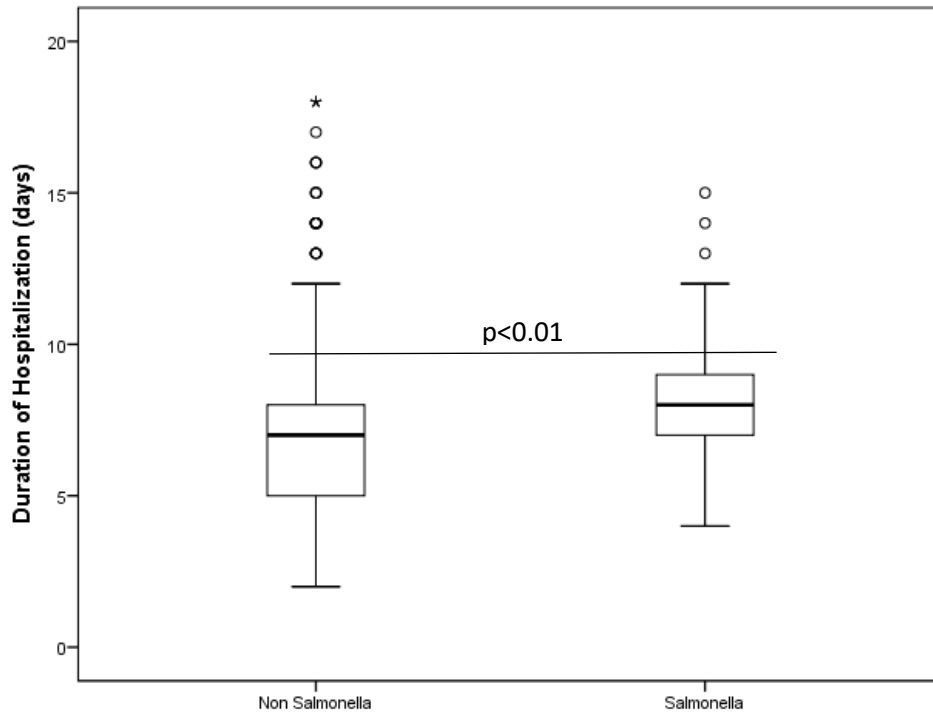
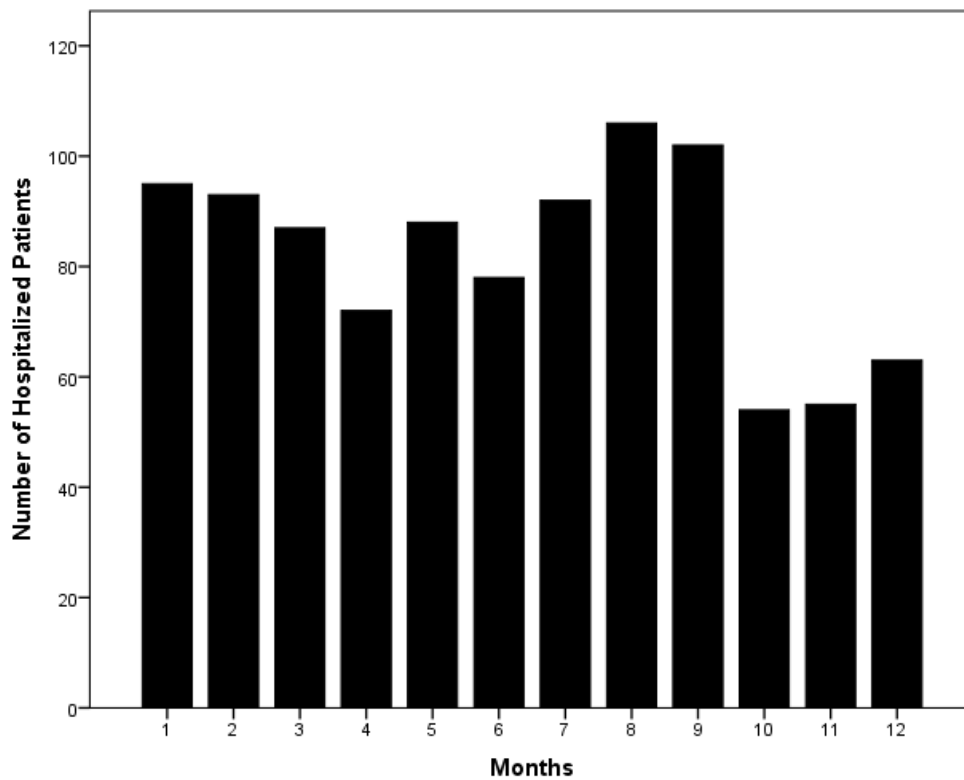


Figure 6. Seasonal distribution of number of hospitalized patients with gastrointestinal infections



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