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Cognitive Impairment in Pneumonia

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Abstract **Original Research Article**

***Background*:** Pneumonia is a leading source of illness and mortality throughout the world. The majority of this research agrees on the possibility of a link between pneumonia and cognitive impairment or dementia. ***Objective*:** The effect of pneumonia on cognitive impairment was examined in this study. ***Materials and Methods*:** A matched cohort study was carried out using hospitalization data from Green Life Medical College and Hospital in Dhaka from January 2020 to November 2022, with diagnostic data classified according to the International Classification of Diseases, 10th Revision (ICD-10). Adults (18 years old) who had their first hospitalization for pneumonia throughout the study period were included. Patients were excluded if they a) had been registered with the practice for less than a year prior to admission (15), b) had hospital-acquired pneumonia (admission for at least a day in the 10 days preceding the index admission), or c) had pre-existing cognitive impairment or dementia. Controls were given the same index date as their matched pneumonia patients. ***Results*:** In the pneumonia group, half of the patients (50.0%) were determined to be at low risk, 14 (28.0%) were at moderate risk, and 11 (22.0%) were at high risk of pneumonia severity index. In terms of SMMSE scores, 5(10.0%) patients in the pneumonia group and 1(2.0%) in the control group had severe cognitive impairment. The difference between the two groups was statistically significant ($p < 0.05$). ***Conclusion*:** In conclusion, persons who recover from pneumonia hospitalization had a higher likelihood of a new diagnosis of cognitive impairment than the general population.

Keywords: Cognitive Decline, Pneumonia, Elderly Patients.

INTRODUCTION

Pneumonia is a leading source of illness and mortality throughout the world.[1] Pneumonia affects over 1% of the adult population in the UK each year, resulting in over 100,000 hospital admissions. [2, 3]. Although pneumonia is an acute illness, significant long-term hazards are recognized; more than 50% mortality after 5 years and a nearly 2-fold increased risk of future pneumonia compared to people who have never had pneumonia. [1].

In adult populations, pneumonia disproportionally affects individuals >65 years and those with underlying medical conditions, who often endure high rates of hospitalizations and mortality. [4]. National data on incidence, etiology and mortality of pneumonia is not available in Bangladesh. According to Bangladeshi study done from Dhaka Medical College Hospital. The incidence of pneumonia requiring hospitalization is estimated to be 258 cases per 100,000 population and 962 cases per 100,000 persons 65 years of age. While mortality has ranged from 2% to 30% among hospitalized patients in a variety of studies, the average rate is 14%. Mortality is estimated to be <1% for patients who are not hospitalized [5].

Cognitive aging describes the process of gradual, longitudinal changes in cognitive function observed during the aging process. [6]. It is determined by several predisposing and contextual factors acting throughout the life course and shows wide interindividual differences in the rate of cognitive decline. [6, 7]**.** The cognitive decline accelerates with age. After 70, the risk of developing dementia increases significantly. [8] Cognitive dysfunction in idiopathic interstitial pneumonia is an important clinical co-morbidity that is associated with impaired lung function. [9].

Common infections are a well-established risk factor for acute cognitive impairment in older persons

(65 years and older), and growing evidence from longitudinal research suggests that they are also linked to an increased risk of dementia. [10] Studies show that even years after leaving the hospital and intensive care unit (ICU), people who have survived a serious illness are more likely to experience cognitive impairment. [11-13]. A small number of studies focusing on older persons have reported that pneumonia survivors experience diminished cognition however, these studies did not include adults across all ages. [14, 15].

MATERIALS AND METHODS

A matched cohort study was conducted using hospitalisation data from Green Life Medical College and Hospital, Dhaka during January 2020 to November 2022, with diagnostic data coded using International Classification of Diseases, 10th Revision (ICD-10). Adults (≥18 years old) with the first hospitalization for pneumonia recorded in during study period were included. Pneumonia (ICD-10 codes) was defined as the primary code for the first episode of hospitalization. Patients were excluded if they a) had less than a year of time registered to the practice before admission, b) hospital-acquired pneumonia (admission for at least a day in the 10 days preceding the index admission) or c) if they had recorded pre-existing cognitive impairment or dementia. Up to 50 randomly selected people without hospitalisation with pneumonia in CPRD were matched with each people hospitalised with pneumonia based on gender, age (±1 yr.), and general practice. Controls were assigned the same index date as their matched people hospitalized for pneumonia.

Participants were eligible for inclusion if their record was labelled as acceptable according to Clinical Practice Research Datalink (CPRD) recommendations. The outcomes of interest were the time from the index date to the first Read coded cognitive impairment and dementia, both combined and separately. The used set of codes was based on previously published lists, augmented by a manual search of all Read terms within CPRD. The power of the study size was calculated to detect the increased risk of cognitive impairment and dementia when compared to the general population. The baseline characteristics between people hospitalized for pneumonia and controls were compared by performing conditional logistic regression using the matched set as the strata variable.

Incidence rates of cognitive impairment and dementia were calculated by dividing the number of incident diagnosis by follow-up person-years for both groups. Data were process and analyses using SPSS (Statistical Package for Social Sciences) software version 25. The chi- square test and student "t" test was used to analyze the significance level of $p < 0.05$. Continuous scale data were presented as mean standard deviation and Categorical data were presented as number percentage. The summarize data were present in the table and chart.

RESULT

Table 1: Baseline characteristics of the study patients (n=100)

Variables	Pneumonia (n=50)		Control (n=50)		P value
	n	%	n	%	
Gender					
Male	21	42.0	24	48.0	[a]0.546
Female	29	58.0	26	52.0	
Mean age (years)	62.4	±5.7	59.5	±5.3	[b]**0.009**
Educational status					
Illiterate	10	20.0	6	12.0	[a]0.275
Literate	40	80.0	44	88.0	
Marital status					
Married	26	52.0	28	56.0	
Unmarred	18	36.0	15	30.0	[a]0.809
Widow/Divorced	6	12.0	7	14.0	
Mean BMI (Kg/m^2)	21.6	±3.4	22.1	±3.5	[b]0.470
Smoker	11	22.0	13	26.0	[a]0.639

[a]P value reached from chi square test
[b]P value reached from unpaired t-test

Table 1shows that mean age was found 62.4±5.7 years in pneumonia group and 59.5±5.3 years in control group. Which was statistically significant ($p<0.05$) but other variables were not statistically significant ($p>0.05$) between two groups.

Table 2: Pneumonia severity index of the study patients (n=50)

Pneumonia Severity Index	Frequency	Percentage
Low risk (1-2)	25	50.0
Moderate risk (3)	14	28.0
High risk (4-5)	11	22.0

In pneumonia group, half (50.0%) patients were found low risk, 14(28.0%) moderate and 11(22.0%) high risk of pneumonia severity index.

Table 3: Comorbidities of the study patients (n=100)

Variables	Pneumonia (n=50)		Control (n=50)		P value
	n	%	n	%	
Hypertension	40	80.0	38	76.0	[a]0.629
Diabetes mellitus	8	16.0	5	10.0	[a]0.372
Heart failure	9	18.0	2	4.0	**[a]0.025**
Ischemic heart disease	12	24.0	5	10.0	[a]0.062
Atrial fibrillation	11	22.0	3	6.0	**[a]0.021**
Depression	6	12.0	4	8.0	[a]0.505
Stroke	5	10.0	2	4.0	[a]0.239
Chronic kidney disease	24	48.0	13	26.0	**[a]0.022**
Dementia	1	2.0	0	0.0	[a]0.314
Mean number of hospitalization	3.1	±1.8	0.9	±0.6	**[b]0.001**

[a]P value reached from chi square test
[b]P value reached from unpaired t-test

Table 3 shows that 9(18.0%) patients had heart failure in pneumonia group and 2(4.0%) in control group. Eleven (22.0%) patients had atrial fibrillation in pneumonia group and 3(6.0%) in control group. Mean number of hospitalization was found 3.1±1.8 in pneumonia group and 0.9±0.6 in control group. Which were statistically significant (p<0.05) but other variables were not statistically significant (p>0.05) between two groups.

Table 4: Cognitive impairment as defined by SMMSE scores (n=100)

	Pneumonia (n=50)		Control (n=50)		P value
	n	%	n	%	
30-26 (Normal)	29	58.0	41	82.0	
25-20 (Mild)	9	18.0	6	12.0	**0.044**
19-10 (Moderate)	7	14.0	2	4.0	
9-0 (Severe)	5	10.0	1	2.0	

P value reached from chi square test

Table 4 shows that 5(10.0%) patients was found severe cognitive impairment in pneumonia group and 1(2.0%) in control group. The difference was statistically significant (p<0.05) between two groups.

DISCUSSION

In current study showed that mean age was found 62.4±5.7 years in pneumonia group and 59.5±5.3 years in control group. Which was statistically significant (p<0.05) but other variables were not statistically significant (p>0.05) between two groups. Hendel *et al.*, [6] reported 62.36% were females, age, education, and several clinical and functional measures were distributed differently between participants with and without pneumonia (*p* <0.05). Girard *et al.*, [16] reported median age was found 57 years with range from 48 to 64 years. Forty patients were female and 27 were male. Chalitsios *et al.*, [17] reported the median age was 75 years (IQR 61 to 84) and 74 (IQR 59 to 83) for people hospitalised for pneumonia and controls, respectively. More persons hospitalised for pneumonia were current smokers than controls (21.1% vs 13.4%, p <0.0001). Naruishi *et al.*, [18] reported there were significant differences of age and BMI (p <0.0001) between patients with or without aspiration pneumonia.

In pneumonia group, half (50.0%) patients were found low risk, 14(28.0%) moderate and 11(22.0%) high risk of pneumonia severity index. Girard *et al.*, [16] reported similar observation they showed 46% patients were found low risk, 28.0% were moderate and 25.0% were high risk of pneumonia severity index. In this study observed that 9(18.0%) patients had heart failure in pneumonia group and 2(4.0%) in control group. Eleven

(22.0%) patients had atrial fibrillation in pneumonia group and 3(6.0%) in control group. Mean number of hospitalization was found 3.1±1.8 in pneumonia group and 0.9±0.6 in control group. Which were statistically significant ($p<0.05$) but other variables were not statistically significant ($p>0.05$) between two groups. Hypertension, heart failure, ischemic heart disease, atrial fibrillation, stroke and chronic kidney disease were significantly higher in pneumonia group than control group. Increased risks of heart failure [19], myocardial infarction [20], atrial fibrillation [21,22] and stroke [23] have been reported in older people after pneumonia episodes. Chalitsios *et al.,* [17] reported more persons hospitalised for pneumonia had more comorbid diseases than controls (74.1% vs 51.5%, $p <0.0001$).

In this study observed 5(10.0%) patients was found severe cognitive impairment in pneumonia group and 1(2.0%) in control group. The difference was statistically significant ($p<0.05$) between two groups. The relationship between decline in cognition over time and risk of pneumonia. Joint modeling fits a longitudinal model for 3MS scores over time to determine cognitive function at the time of pneumonia.[24] Davydow *et al.,* [14] examined cognitive outcomes from the Health and Retirement cohort to see if patients hospitalized with pneumonia during this long-term longitudinal cohort of adults over the age of 50 had cognitive losses related with pneumonia. After controlling for several potential confounders, pneumonia hospitalization was linked to a 2.46-fold increase in the risks of moderate-to-severe cognitive impairment, which impacted 25% of patients following pneumonia. Hendel *et al.;* [6] reported 39 participants that had developed dementia by the time of pneumonia occurrence, the effect of pneumonia on MMSE change over 2.5 years of follow-up was slightly attenuated, yet statistically significant.

Chalitsios *et al.,* [17] reported during the whole study period the crude incidence of cognitive impairment and dementia was higher in people hospitalised for pneumonia than the controls with the incidence rates equal to 18 (95% CI 17.3 to 18.7) and 13.2 (95% CI 13 to 13.5) per 1000 person-years, respectively. Similarly, a significantly higher probability of cognitive impairment and dementia (as separate outcomes) was displayed in those with previous hospitalisation for pneumonia than in controls (log-rank test; $p<0.0001$). Previous studies which included older patients examined whether patients hospitalised for pneumonia have an increased risk of a decline in cognition or developing dementia. Davydow *et al.,* [14] found increased odds (aOR = 2.46; 95%CI 1.60 to 3.79) of moderate to severe cognitive impairment in people aged 50 years or older who were hospitalised with pneumonia. Similarly, a study which included people aged 65 or more years found that participants with pneumonia were at increased risk of developing dementia (aHR = 1.57; 95%CI 1.11 to 2.22). [15] Tate *et al.,* [25] reported that pneumonia hospitalization was associated with a 1.9-fold (95%CI 1.40 to 2.80) increase in the hazard of dementia in older people.

CONCLUSION

People who have been hospitalized for pneumonia are more prone to develop cognitive impairment and dementia. Advanced age is also correlated with increased incidence of cognitive impairment in pneumonia. Significant comorbidities including heart failure, atrial fibrillation, and chronic kidney disease were observed, with females predominately suffering from cognitive impairment from pneumonia.

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