



Charlson comorbidity index as a predictor of inpatient mortality in Intensive care unit patients

Authors

Manokaran.C¹, Sravya Nadhella², Sathiyarayanan.J³

¹Professor and Unit Chief, ²Postgraduate Resident, ³Associate Professor,
Department of Medicine, Sri Manakulavinayagar Medical College and Hospital, Pondicherry, India

Abstract

Introduction: Charlson comorbidity index (CCI) is the most widely used morbidity index worldwide. It is a weighted index used to predict the risk of death within 1 year and 6 months of hospitalization for patients. This study was done to calculate the Charlson comorbidity index in intensive care unit patients and to assess its efficacy in predicting inpatient mortality and to give a alarming cutoff value.

Methodology: A total of 156 medical Intensive care unit patients were studied. Charlson comorbidity index was calculated. Charlson comorbidity index of dead patients is compared with the recovered patients. Results were analyzed.

Results: Among the 156 ICU patients majority (60%) were of male sex and was more than 60 years (48%). Diabetes mellitus, Myocardial infarction, systemic hypertension and congestive heart failure were the most common co-morbidities associated with the study group. 38 (24%) of our study population died during the hospital stay and their mean Charlson comorbidity index was 5.34. It was found that Charlson comorbidity index was higher among the patients succumbed to death compared to patients got recovered from their illness. At CCI of 3.5 it had 97% sensitivity and 91.5% specificity.

Conclusion: Charlson comorbidity index can be used as a mortality predictor among Intensive care unit patients. CCI of 3.5 is alarming and necessary measures should be taken at the earliest to reduce the mortality of the patient.

Keywords: charlson comorbidity index, ICU mortality.

Introduction

In the past two decades, there has been tremendous growth of intensive care medicine in India. An overall mortality rate of 18.1% is observed in intensive care units in india¹. So early diagnosis and

early categorisation of severity and treatment is necessary to reduce the mortality.

Although there are many commonly used mortality indicators in intensive care units like APACHE 2 score, mostly all are investigation based. Many

comorbidity indices are being currently used like Charlson comorbidity index, Elixhauser Index, Chronic disease score and Health related quality of life comorbidity index (HRQL-CI) in predicting healthcare behaviours and outcomes of which Charlson comorbidity index is the most widely used morbidity index worldwide . It attaches weight to each comorbidity and then sums the weights of those conditions present in that individual. CCI is based on a number of conditions that are each assigned an interweight from one to six with a weight of six representing the most severe morbidity. The summation of the weighted scores results in a summary score. The validity of charlson comorbidity index for different mortalities and survival rates have been investigated. There is no proven cutoff value of CCI that divides patients into low or high risk groups. The charlson comorbidity index was first developed in 1987 by Mary charlson and colleagues as a weighted index to predict risk of death within 1year of hospitalization for patients with specific comorbid conditions. Nineteen conditions were included in the index and now according to ICD-10, seventeen conditions are included with modifications. Various studies have used charlson comorbidity indices for predicting 10year survival rates and mortality rates of 1year, 6months. very few or less than few have shown its validation in predicting inpatient mortality rate. Hence this study was done to calculate the charlson comorbidity index in Intensive Care Unit patients and to assess its efficacy in predicting inpatient mortality and to provide a alarming Charlson comorbidity value.

Aims and Objectives

1. To calculate charlson comorbidity index in Intensive care unit patients

2. To assess the validity of Charlson comorbidity index as a good predictor of inpatient mortality

Materials and Methods

Study Area and Design

This study was conducted at Sri Manakula Vinayagar medical college and hospital from May 2021 to October 2021 for a period of six months. The study design employed was a cross sectional study.

Study Participants: The sample size was calculated to be 156 by using Open Epi, Version 3, open source calculator. The software used the formula $n = [DEFF * Np(1-p)] / [(d^2 / Z^2_{1-\alpha/2} * (N-1) + p * (1-p))]$ to derive the sample size with absolute precision of 5%. Study participants were those admitted in medical intensive care units .

Patients included were all those admitted in medical intensive care units above 18years of age. Patients below 18yrs of age were excluded.

Sampling Procedure

All patients admitted in Medical intensive care unit of Sri Manakula Vinayagar Medical College Hospital and Research Centre in the department of General Medicine satisfying inclusion criteria and exclusion criteria were enrolled in the study on a random basis after getting proper informed and written consent from the participants. Questionnaire was used to collect demographic details, comorbidity details and Charlson comorbidity Index was calculated. In patients with altered sensorium history about the comorbidities was collected from the patient attenders who were reliable and the previous documents available. Shock index was also calculated in all these patients. Charlson comorbidity index of dead patients is compared with the recovered patients. Later Charlson comorbidity index was evaluated whether it is a good predictor of inpatient mortality or not.

Shock index and charlson comorbidity index correlation was observed.

Statistical Analysis: Data was entered into Microsoft excel data sheet and was analysed using SPSS 22m version software. Categorical data was represented in the form of frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data

was represented as mean and standard deviation. p value (probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

MS Excel and MS Word was used to obtain various types of graphs such as pie diagram and ROC curve. SPSS version 22(IBM SPSS statistics, Somers NY, USA) was used to analyse data.

Results

Table 1: Demographic details of the patients (N=156)

		Number	Percentage
Age Category	< 40 years	23	14.7%
	41- 60 years	58	37.2%
	> 60 years	75	48.1%
Gender	Male	94	60.3%
	Female	62	39.7%
Socio Economic Status	Upper Middle	10	6.4%
	Middle	68	43.6%
	Lower	78	50.0%

From the above table, majority of the study population were above 60 years and are of male sex.

Table 2: Risk Factor profile of the patients

	Yes		No	
	Number	Percentage	Number	Percentage
Alcohol Intake	79	50.6%	77	49.4%
Smoking status	77	49.4%	79	50.6%

From the above table, 50.6% participants were alcoholics and 49.4% were smokers.

Table 3: Co-morbidities of the patients

	Yes		No	
	Number	Percentage	Number	Percentage
Systemic Hypertension	59	37.8%	97	62.2%
Diabetes Mellitus	66	42.3%	90	57.7%
Myocardial Infarction	66	42.3%	90	57.7%
Congestive Cardiac Failure	58	37.2%	98	62.8%
Peripheral vascular disease	4	2.6%	152	97.4%
Cerebrovascular disease	25	16.0%	131	84.0%
Dementia	3	1.9%	153	98.1%
COPD	30	19.2%	126	80.8%
Rheumatic Heart Disease	6	3.8%	150	96.2%
Peptic Ulcer	15	9.6%	141	90.4%

Mild Liver Disease	27	17.3%	129	82.7%
Diabetes without complication	0	0.0%	156	100.0%
Diabetes with complication	60	38.5%	96	61.5%
Hemiplegia/paraplegia	24	15.4%	132	84.6%
Renal disease	54	34.6%	102	65.4%
Any Malignancy without metastasis	8	5.1%	148	94.9%
Moderate/ Severe Liver Disease	11	7.1%	145	92.9%
Metastatic solid tumor	1	0.6%	155	99.4%
AIDS	2	1.3%	154	98.7%

From the above table, Diabetes mellitus, Myocardial infarction, systemic hypertension, Renal disease and congestive heart failure were the most common co-morbidities associated with the study group.

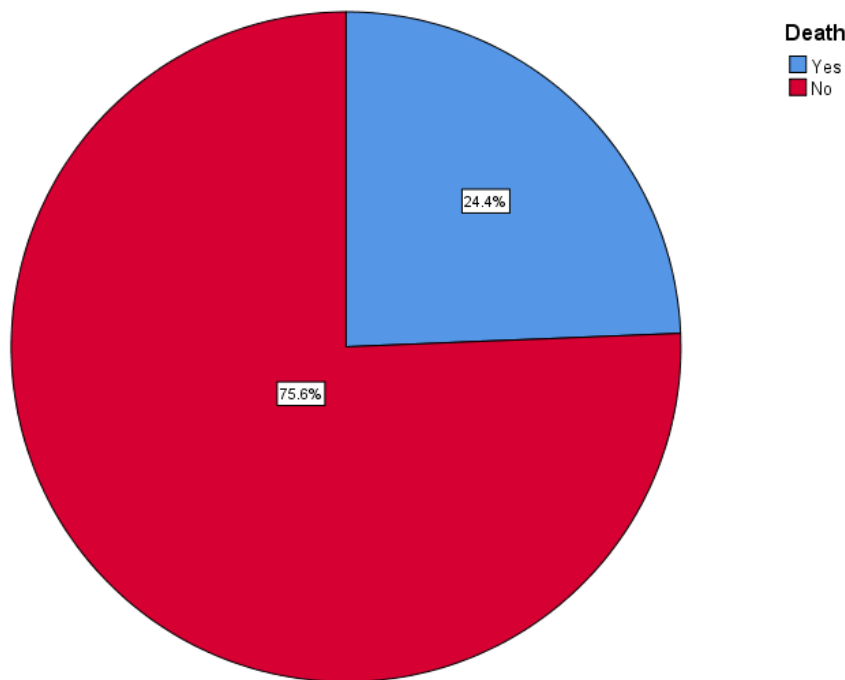


Figure 1: Proportion of death among the Intensive care unit patients

Table 4: Charlson Comorbidity Index comparison among groups

Group Statistics					
	Death	N	Mean	Std. Deviation	Std. Error Mean
Charlson Comorbidity Index	Yes	38	5.34	1.258	.204
	No	118	2.08	1.258	.116

From the above table, CCI was found to be higher among ICU patients who died during the course of stay compared to the patients who got recovered. 24% of our study population died during the hospital stay and their mean Charlson comorbidity index was 5.34.

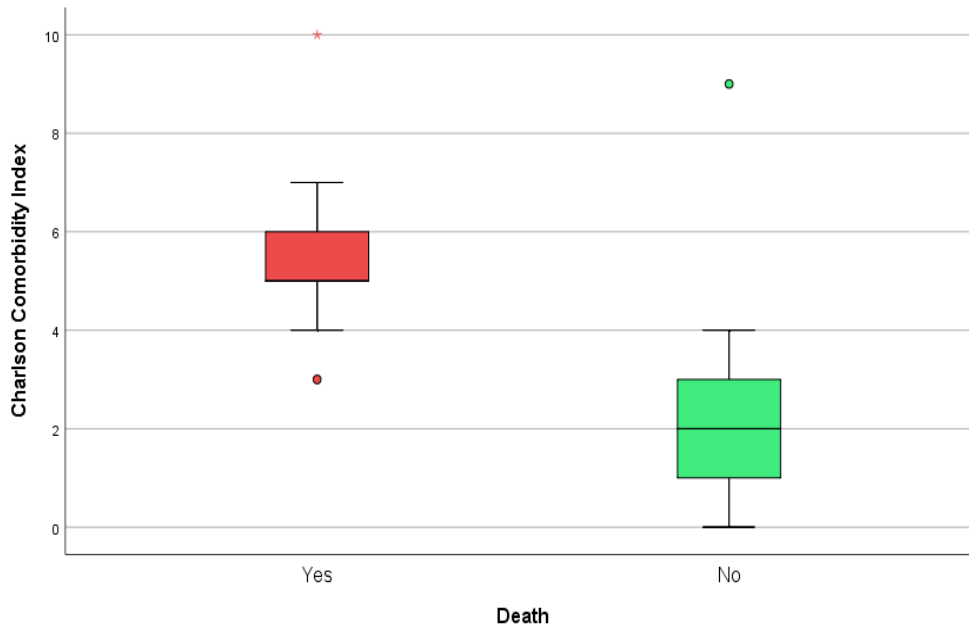


Figure 2: Death proportion

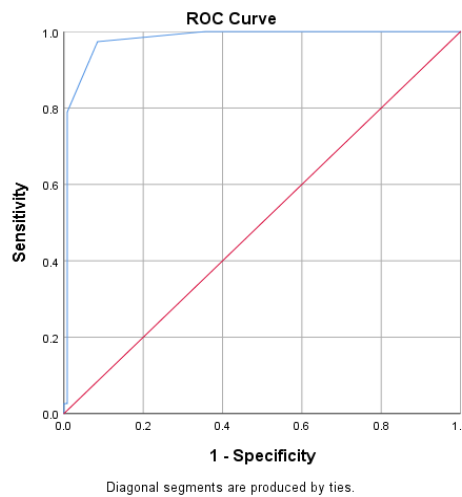


Figure 3: ROC curve

Table 5: Area under the curve

Area	Std Error	Asymptomatic sig	Lower bound	Upper bound
.979	.011	.000	.958	1.000

Area under the curve is 0.97 which is statistically significant.

Table 6: Coordinates of the Curve

Positive if greather than or equal to ^a	Sensitivity	1-Specificity
-1.00	1.000	1.000
.50	1.000	.907
1.50	1.000	.695
2.50	1.000	.356
3.50	.974	.085
4.50	.789	.008

5.50	.342	.008
6.50	.158	.008
8.00	.026	.008
9.50	.026	.000
11.00	.000	.000

From the above table, at CCI of 3.5 it has 97.4% sensitivity and 91.5% specificity which is statistically significant.

Table 7: Death proportion among patients with co-morbidities

		Death			
		Yes		No	
		Number	Percentage	Number	Percentage
Systemic Hypertension	Yes	14	23.7%	45	76.3%
	No	24	24.7%	73	75.3%
Diabetes Mellitus	Yes	22	33.3%	44	66.7%
	No	16	17.8%	74	82.2%
Myocardial Infarction	Yes	21	31.8%	45	68.2%
	No	17	18.9%	73	81.1%
Congestive Cardiac Failure	Yes	24	41.4%	34	58.6%
	No	14	14.3%	84	85.7%
PVD	Yes	2	50.0%	2	50.0%
	No	36	23.7%	116	76.3%
CVD	Yes	6	24.0%	19	76.0%
	No	32	24.4%	99	75.6%
Dementia	Yes	2	66.7%	1	33.3%
	No	36	23.5%	117	76.5%
COPD	Yes	13	43.3%	17	56.7%
	No	25	19.8%	101	80.2%
Rheumatic Heart Disease	Yes	4	66.7%	2	33.3%
	No	34	22.7%	116	77.3%
Peptic Ulcer	Yes	11	73.3%	4	26.7%
	No	27	19.1%	114	80.9%
Mild Liver Disease	Yes	22	81.5%	5	18.5%
	No	16	12.4%	113	87.6%
DM without complication	Yes	0	0.0%	0	0.0%
	No	38	24.4%	118	75.6%
Dm with complication	Yes	22	36.7%	38	63.3%
	No	16	16.7%	80	83.3%
Hemi/paraplegia	Yes	6	25.0%	18	75.0%
	No	32	24.2%	100	75.8%
Renal disease	Yes	24	44.4%	30	55.6%
	No	14	13.7%	88	86.3%
Any Malignancy	Yes	4	50.0%	4	50.0%

without Metastasis	No	34	23.0%	114	77.0%
Moderate/ Severe Liver Disease	Yes	5	45.5%	6	54.5%
	No	33	22.8%	112	77.2%
Metastatic solid tumors	Yes	0	0.0%	1	100.0%
	No	38	24.5%	117	75.5%
AIDS	Yes	1	50.0%	1	50.0%
	No	37	24.0%	117	76.0%

About 24.4% (38) of the study patients died during the course of ICU stay. Among the dead patients- congestive cardiac failure(CCF), diabetes mellitus, myocardial infarction, liver and renal disease were

the commonly associated co-morbidities. The association of death among ICU patients with Congestive cardiac Failure, diabetes, liver and renal disease was found to be statistically significant.

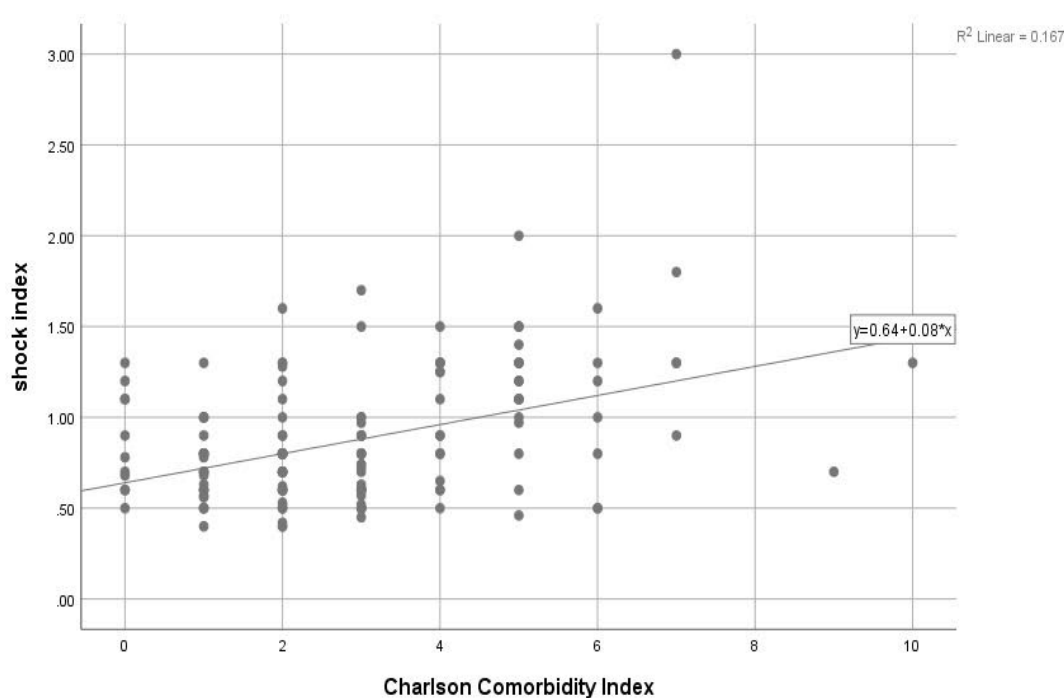


Figure 4: Correlation between two indices

Pearson correlation value between shock index and CCI is 0.409 (medium positive correlation) which is statistically significant

Discussion

Though there are advancements in critical care, mortality in critical care units is still alarming and so early diagnosis and aggressive treatment is necessary to prevent mortality. In this study 48.1% of study population was more than 60years, predominantly being males (60.3%). 50.6% were alcoholics and 49.4% were smokers. Diabetes, systemic hypertension, Renal disease, Myocardial

infarction and congestive cardiac failure were the most common comorbidities associated with the study group. 38(24.4%) participants died in the hospital during the study with their mean CCI being 5.34 and the mean CCI among the recovery group was 2.08 which implied that CCI was high among the dead patients. Area under the ROC curve was 0.97 which is statistically significant and much higher compared to V. Sundararajan et al study²

which was 0.85 and Valentin Neuhaus et al study³ which was 0.65. Atcharlson comorbidity index of 3.5 it had 97.4% sensitivity and 91.5% specificity which implies any patient admitted in ICU with CCI more than 3.5 is alarming and suggests high chances of mortality and so early diagnosis and aggressive treatment should be provided at the earliest to prevent mortality. Such alarming cutoff values was not mentioned in any other studies. Congestive cardiac failure(24) and renal disease (24) were the most common comorbidities among the dead patients group. Shock index and charlson comorbidity index were compared and the pearson correlation value between the two was 0.409 (medium positive correlation) which is statistically significant. There are many indices of inpatient mortality but charlson comorbidity index can be calculated just with history of comorbidities given by the patient or by the documents provided without any laboratory investigations or the haemodynamic status of the patient at the time of presentation is necessary. As per our knowledge there are no Indian studies present on CCI giving its validity for inpatient mortality or a cutoff value.

Limitations

Single center study, short duration and the comorbidities were taken into consideration with the history and the documents available with the patient which led to recall and information bias. There is no comparison with APACHE 2, SOFA scoring systems. Many Indian studies are needed to validate its usage in Indian scenario and can be done with updated ICD-11

Conclusion

Charlson comorbidity index can be used as a Inpatient mortality predictor among Intensive care unit patients. CCI of 3.5 is alarming and necessary earliest measures should be take to reduce the mortality.

Reference

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