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Original Article

Comparison of KRS and WBSS Clinical Scores to Assess the Severity of Bronchiolitis: Single centre Prospective Observational study

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Abstract

Introduction: Various scoring systems have been proposed to assess the severity of bronchiolitis, most common scores being Wang Bronchiolitis Severity Score (WBSS) and Kristjansson Respiratory Score (KRS). None of these scoring systems are standardised in assessing severity. The present study was aimed to compare WBSS and KRS scores in assessing severity of bronchiolitis.

Methods: Present study is a prospective observational study. Children aged less than two years, diagnosed as bronchiolitis, were included. WBSS and KRS were calculated at admission. These scores were co related with severity of bronchiolitis and duration of hospital stay.

Results: A total of 69 participants were included in the study. The two scores significantly corelated with the severity of bronchiolitis (P - 0.0001), with accuracy 89.86% and 85.51% respectively for KRS and WBSS respectively. Both scores have good sensitivity {KRS (CI= 96.6 – 100%) and WANG score (96.6- 100%)}. The two scores were significantly correlated with the duration of hospital stay, with a correlation coefficient of r2 of 0.6818 ($P < 0.001$) for WBSS and r2 of 0.6622 ($p < 0.001$) for KRS.

Conclusion: Both WBSS and KRS scores were accurate in predicting the severity of bronchiolitis at admission and also duration of hospital stay.

Introduction

Bronchiolitis refers to acute inflammation of bronchioles, which is usually triggered by viral infections. It commonly affects the children aged less than two years.[1] Depending on the severity of the infection, there are at least five hospitalizations for every 1000 children aged less than two years.[2] In India, incidence of acute bronchiolitis is 76% and 94% during first and second year of life respectively.[3] Respiratory Synctitial Virus (RSV) is the most common virus isolated, along with other viruses like rhinovirus, parainfluenza, adenovirus, human metapneumovirus, and bocavirus. Mycoplasma is more frequently implicated in older children.[3,4] It presents with clinical features of fever (usually less than 39°C), coryza, cough with tachypnoea, wheezing, crackles and rhonchi. The chest may appear hyperexpanded and may be hyper-resonant on percussion. In children aged less than six weeks, apnoea may be the only presenting symptom. In bronchiolitis, there is bronchiolar obstruction which results from edema, mucus and cellular debris. There is expiratory wheeze, air trapping and lung hyperinflation leading to ventilation perfusion mismatch. Severity of the disease is more in prematurity (less than 32 weeks of gestation), low birth weight, age less than six to 12 weeks, bronchopulmonary dysplasia, congenital heart disease, immunodeficiency, neuromuscular disorders, having older siblings, passive

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smoke, household crowding, child care attendance and lower socioeconomic status.[1-3,5,9] The diagnosis is mainly clinical. The hypoxia may be determined using pulse oximetry. In admitted severe cases, investigations such as arterial blood gas (ABG) analysis, complete blood count, CRP, serum electrolytes, and chest radiography helps in management. The management of bronchiolitis is mainly supportive. Supplemental oxygen and sometimes mechanical ventilation would be required in hospitalised babies. Nebulisation with hypertonic saline, adrenaline, salbutamol, steroids, antibiotics, antivirals (Ribavirin and RSV prophylaxis with polyclonal immunoglobulin and palivizumab), Montelukast and Ipratropium bromide have no proven clinical efficacy.[1,2,5,6]

To assess the need for hospitalization in emergency department and to prognosticate, it is crucial to know the severity of bronchiolitis at the time of admission. However, assessment of pulmonary function test is difficult in children aged less than two years. Hence various scoring systems such as wang bronchiolitis severe score (WBSS), Kristjansson Respiratory score (KRS), Tal Score, Respiratory distress assessment instrument (RDAI), Global respiratory severity score (GRSS) etc, were used.[8,10-12] The present study was planned to compare the two common scoring systems for bronchiolitis. We used WBSS and KRS scoring systems because these scores are simple, easy and less time consuming to apply in the emergency triaging.

Methods

This was a hospital based prospective, observational study. The study was conducted at Shri Dharmasthala Manjunatheshwara College and Hospital, Dharwad, India. The study was commenced after receiving the approval from the Institutional Ethical Committee. The study was undertaken for a period of six months from April 2023 to September 2023. All children diagnosed with bronchiolitis as per Indian Academy of Paediatrics Standard Treatment Guidelines (IAP STG) 2022, were included in the study. All the relevant data were collected in pre designed proforma after obtaining informed consent. Those with underlying congenital heart disease, history of prematurity, bronchopulmonary dysplasia, immunodeficiency syndromes were excluded. All children were assessed by single observer, using both WBSS and KRS at the time of admission. WBSS score (Table 1) consists of respiratory rate, wheezing, chest retraction and general condition, each clinical sign was scored from 0 to 3, except for general condition, which was scored 0 for normal and 3 for irritability and lethargy, with the total score 12. KRS (Table 2) consists of five clinical signs, with scores for each sign ranging from 0 to 2, with total score of 10. Respiratory rate was determined by counting the number of breaths cycles for one minute. Both scores were compared with severity of bronchiolitis, duration of hospital stay and mortality.

Table 1: Kristjansson Respiratory Score (KRS)

Score	0	1	2
Respiratory Rate (breaths/minute)	< 40	40 - 60	> 60
Chest Recession	None	Moderate (costodiaphragmatic)	Severe (as in 1 plus rib & jugular retraction)
Breath Sound	Vesicular	Wheeze + / - rhonchi / rale	Severe wheeze + / - rhonchi / rale
Skin Color	Normal	Pallor	Cyanosis
*General Condition	Not affected	Moderately affected	Severely affected

Notes: *(a) Not affected if activity and feeding is normal; (b) moderately affected if activity and feeding is less than normal and (c) severely affected if child looks ill and feeds poorly.

Table 2: Wang Bronchiolitis Severity Score (WBSS)

Score	0	1	2	3
Respiratory Rate (breaths/minute)	< 30	30 - 45	46 - 60	> 60
Wheezing	None	Terminal expiration or only with stethoscope	Entire expiration or audible on expiration without stethoscope	Inspiration and expiration without stethoscope
Retraction	None	Intercostal recession	Trachea-sternal recession	Severe with nasal flow Irritable / lethargic / poor
General Condition	Normal			feeding

All the data were entered in Microsoft Excel version 2203 and analysed using the SPSS software version 23.0 for Windows (IBM Corp., Armonk, NY, USA). The categorical variables were described as percentages. Differences between categorial variables were calculated using Chi-square tests. Both the scores were validated using parameter such as sensitivity, specificity, positive and negative predictive value. Univariate and multivariate analysis is used to assess the independent association of both the scores. Correlation of severity of bronchiolitis using KRS and WBSS respiratory score and duration of stay was done by Spearman's rank correlation. A P value of less than 0.05 was considered statistically significant.

Results

Out of 300 children admitted to PICU during study period, 78 children who met the criteria for bronchiolitis as per STG, were included in the study. Eight out of 78 children had underlying CHD and two did not give consent and two took discharge against medical advice. The demographic characteristics of the study population is shown in Table 3. Table 4 is presented to show the comparative scores of two scoring systems.

Table 3: Demographic details of study participants

	Number	%
Sex		
Male	46	66.67
Female	23	33.33
Risk factors		
Age <3 months	19	27.54
Sibling having similar infection	11	15.94
Age <mnths, sibling having similar infection	4	5.80
Total	69	100.00

Table 4: Comparative scores of the two scorings systems of KRA and WBSS scores

Statistic	KRS		WANG	
	Value	95% CI	Value	95% CI
Sensitivity	100.00%	92.60% to 100.00%	100.00%	92.60% to 100.00%
Specificity	66.67%	43.03% to 85.41%	52.38%	29.78% to 74.29%
PPV	87.27%	78.93% to 92.62%	82.76%	75.40% to 88.26%
NPV	100.00%	76.84% to 100.00%	100.00%	71.51% to 100.00%
Accuracy	89.86%	80.21% to 95.82%	85.51%	74.96% to 92.83%

In all the study participants the median for WBSS was 8 (Quarntile Range 3) and for KRS was 6 (Quarntile Range 3).

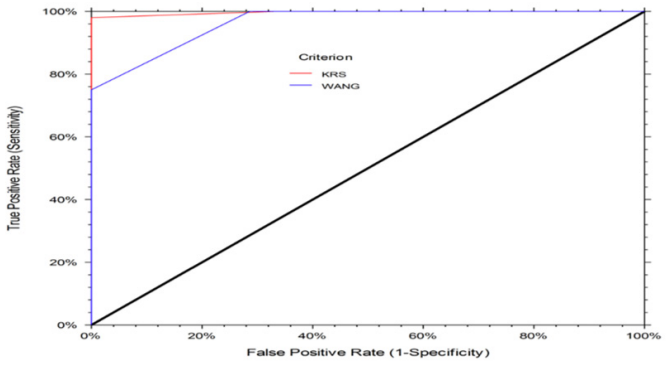

Figure 1: Receiver operating characteristic curve of two score

Figure 1 shows ROC curve shows that both WBSS (78%) and KRS (98%) scores increases with the severity of bronchiolitis. In assessing the severity of bronchiolitis, KRS score had significant P value of 0.0001, with 95% confidence limit (Ranges between 0.97 – 0.99) with AUC of 0.99. Similarly, WBSS had P value of 0.0001, with 95% confidence limit (Ranges between 0.90 – 0.98) with AUC of 0.96.

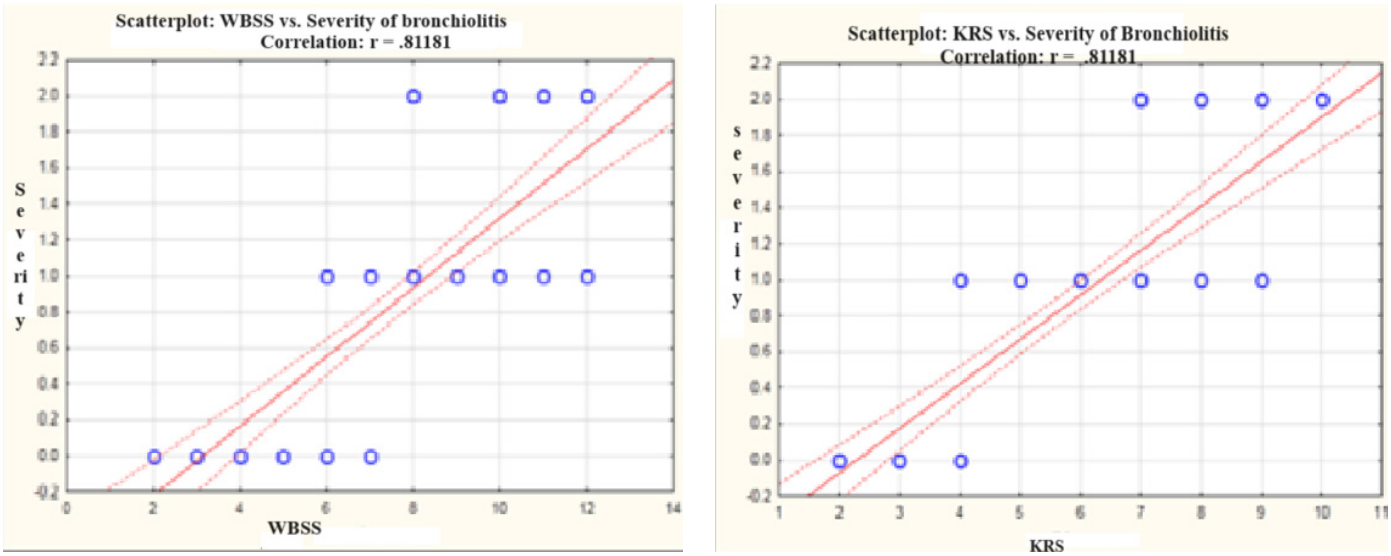

Figure 2: Spearman correlation of two scores

As shown in figure 2, both the scores were significantly correlated with the severity of bronchiolitis, with a correlation coefficient r2 = 0.856 for KRS (P value 0.0001) and r2 = 0.8027 for WBSS (P value 0.001).

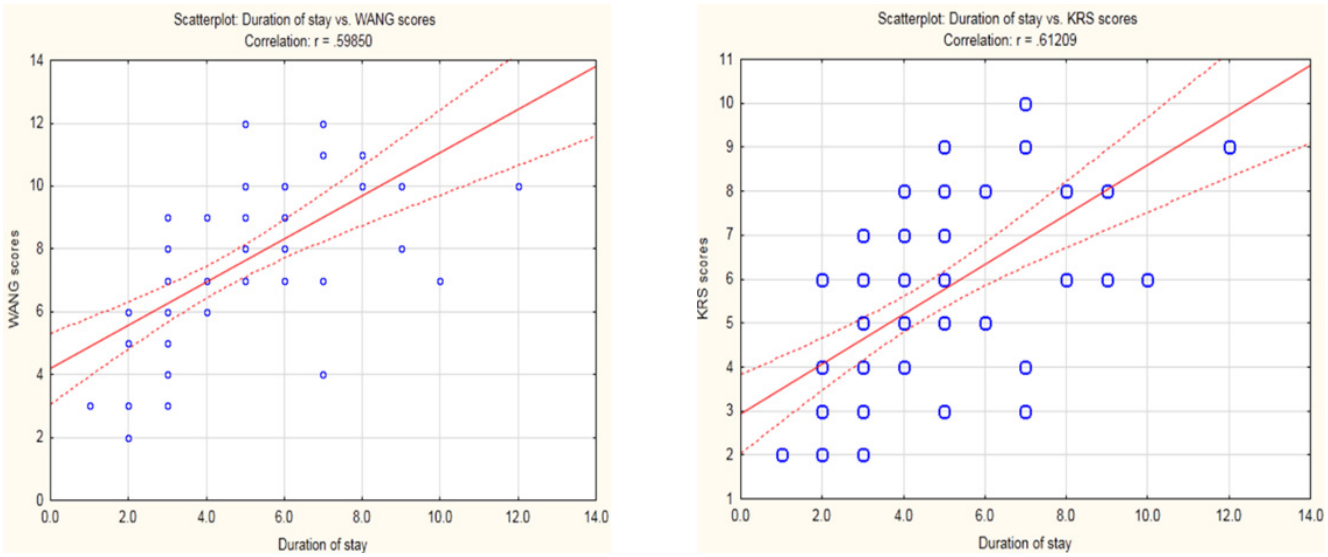

Figure 3: Scatter diagram for relationship between duration of hospital stay with KRS and WBSS

As shown in the figure 3, both scores were significantly correlated with the duration of hospital stay, with a correlation r2 of 0.6818 ($p < 0.001$) for WANG and r2 of 0.6622 ($p < 0.001$) for KRS.

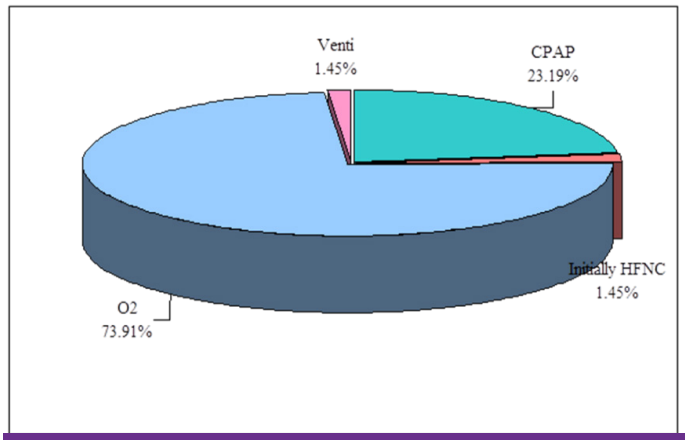

Figure 4: Mode of oxygen delivery among study participants

Figure 4 shows pie chart, 73.91% children required supplemental oxygen via nasal prong and 1.45% children were mechanically ventilated. And mortality was 3% (N = 2).

Discussion

In present study, two scoring systems, WBSS and KRS were used in assessing the severity of bronchiolitis at the time of admission. To the best of our literature search this is the first study from India which has compared these two bronchiolitis scoring systems. The present study has noted that both of these scoring systems have a good reliability for accessing the clinical severity of acute bronchiolitis in emergency department. The parameters of both the scoring systems include general condition, respiratory rate, breath sounds and chest retractions and hence, these parameters can be easily assessed by bedside clinicians or health personnel, without aid of any other tools. Both the scores can be used as an aid in triaging children with acute bronchiolitis attending emergency department. The severity of score determines the need for hospital admission or home-based management.

The two scores significantly correlate with the severity of bronchiolitis, with P value of 0.0001 for both the scores. Two scores have good sensitivity for the diagnosis of bronchiolitis. The present study noted accuracy of 89.86% and 85.51% respectively for KRS (CI = 96.6% – 100%) and WBSS (96.6% - 100%) scoring systems. These study results are in par with the study done by Pinto FR et al where sensitivity 0f 85.71% (CI 75.3- 92.9%) for KRS score and 75.71% (CI- 64.0- 85.2%) for WBSS were reported.[8] Another study done by De Rose et al had noted sensitivity of 85.75% (CI- 75.3 to 92.9%) and specificity of 80.77% (CI 60.6- 93.4%) for WBSS and sensitivity of 75.71% (CI- 64.0 to 85.2%) and specificity of 92.31% (CI 74.8 to 98.8%) for KRS.[7]

In the present study, the total score for WBSS and KRS were 12 and 10 respectively. Cut off score of 5 and 6 is taken as optimal in assessing the severity of bronchiolitis with AUC of 0.9643 and 0.9965 for KRS and WBSS respectively. The study done by Pinto FR et al had cut off of 3 for both the score with an AUC of 0.903 and 0.904.[8] Other study done by De Rose et al had recommended AUC of 0.903 and 0.904 for WBSS and KRS respectively.[7] This discrepancy in the present study may have been noted as the present study was conducted in a tertiary referral center, there were more severe cases of bronchiolitis requiring PICU admissions and hence the cut off may have been high.

The two scoring systems were significantly correlated with the duration of hospital stay with a correlation coefficient of r2 of 0.6818 ($P < 0.001$) for WBSS and r2 of 0.6622 ($P < 0.001$) for KRS. These results are in accordance with the study done by Pinto FR et al.[8] Hence, applying any of these two scoring systems for bronchiolitis during admission, it is likely that the higher score necessitates the need for admission to PICU and these children tend to have prolonged duration of hospital stay as per the scores. This concludes that both of these two scoring systems are equally effective in predicting the duration of hospital stay.

The present study has found that the younger age children are more likely to suffer from more severe bronchiolitis. This result is in congruence with another study done by pinto FR et al[8] and Gupta S et al[4], where younger the age, more was the severity of bronchiolitis. However, there was no association of severity of bronchiolitis with the sex of the baby. This result is also consistent with the result in the study done by Gupta S et al in the past.[4] As younger age (Six to 12 weeks) is considered as one of the risk factors for higher severity of bronchiolitis[1], this fact has also been proven by the present study.

The present study indicates that both of these scoring systems for bronchiolitis are valid and reliable for assessing the severity of bronchiolitis. As both of these scores are assessed with clinical parameters without any medical devices or invasive investigations, both of these scoring systems can have more meaningful impact in a resource limited set up like ours. It could prove to be a very useful tool for primary healthcare works in the remote areas as well as help in deciding for the need of referrals.

Although the results from this study appear promising, this is a relatively small sized study done in a single centre. This is a major limitation of the present study. Secondly, one of the parameters used for scoring was skin colour which might have been affected by anemia and increased pigmentation or dark color of skin which could alter the total score. Thirdly, the diagnosis of bronchiolitis is clinical and hence, the study participants may not have had bronchiolitis as this disease can be easily confused with pneumonia or bronchial asthma. However, we recommend that the present findings should prompt more larger, multi centric trials to derive clear

conclusions from the present study.

Conclusion

Both WBSS and KRS are sensitive in predicting the severity of bronchiolitis at the time of admission. As accuracy of both the scores are statistically similar, either of the scores can be used to assess the severity of bronchiolitis. These scores significantly co related with the duration of hospital stay.

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References

1. Dalziel SR, Haskell L, O'Brien S, Borland ML, Plint AC, Babl FE, et al. Bronchiolitis. Lancet Lond Engl. 2022 Jul 30;400(10349):392-406.
DOI: 10.1016/S0140-6736(22)01016-9
PMID:35785792
2. House AS, Ralston LS last. 418.1 Wheezing in infants: Bronchiolitis. In: Nelson Textbook of Pediatrics. 20th ed. Phialdelphia, PA: Elsevier; 2015. p. 2217-20.
3. Shah S CP, Sehgal V. Ch-027-STG-Bronchiolitis. In: Standard treatment guidlines 2022. New delhi: Indian Academy of Pediatrics; 2022.
4. Gupta S, Shamsundar R, Shet A, Chawan R, Srinivasa H. Prevalence of respiratory syncytial virus infection among hospitalized children presenting with acute lower respiratory tract infections. Indian J Pediatr. 2011 Dec;78(12):1495-7.
DOI: 10.1007/s12098-011-0491-0
PMID: 21660398
5. Overview | Bronchiolitis in children: diagnosis and management | Guidance. NICE; 2015 . Available from: https://www.nice.org.uk/guidance/ng9
6. Ralston SL, Lieberthal AS, Meissner HC, Alverson BK, Baley JE, Gadomski AM, et al. Clinical Practice Guideline: The Diagnosis, Management, and Prevention of Bronchiolitis. Pediatrics. 2014 Nov 1 ;134(5):e1474-502.
DOI: 10.1542/peds.2014-2742
PMID: 25349312
7. De Rose DU, Maddaloni C, Martini L, Braguglia A, Dotta A, Auriti C. Comparison of three clinical scoring tools for bronchiolitis to predict the need for respiratory support and length of stay in neonates and infants up to three months of age. Front Pediatric. 2023 ;
DOI:10.3389/fped.2023.1040354
PMID: 36873647 PMCID: PMC9983816
8. Pinto FR, Correia-Costa L, Azevedo I. Comparison of Kristjansson Respiratory Score and Wang Respiratory Score in infants with bronchiolitis in a hospital emergency department. Hong Kong Physiother J . 2020 Dec;40(2):145-53.
DOI: 10.1142/S1013702520500146
PMID: 33005078 PMCID: PMC7526056
9. Corneli HM, Zorc JJ, Holubkov R, Bregstein JS, Brown KM, Mahajan P, et al. Bronchiolitis: clinical characteristics associated with hospitalization and length of stay. Pediatr Emerg Care. 2012 Feb;28(2):99-103.
DOI: 10.1097/PEC.0b013e3182440b9b
PMID: 22270499
10. Kubota J, Hirano D, Okabe S, Yamauchi K, Kimura R, Numata H, et al. Utility of the Global Respiratory Severity Score for predicting the need for respiratory support in infants with respiratory syncytial virus infection. 2021 Jul 1;16(7):e0253532.
DOI: 10.1371/journal.pone.0253532
PMID: 34197495 PMCID: PMC8248615
11. Fernandes RM, Plint AC, Terwee CB, Klassen TP, Offringa M, Lee JH van der. Measurement properties of RDAI and RACS and their suitability as outcome measures in bronchiolitis trials. Eur Respir J . 2014 Sep 1;44(Suppl 58).
DOI: 10.1542/peds.2014-3557
PMID: 25986025
12. Golan-Tripto I, Goldbart A, Akel K, Dizitzer Y, Novack V, Tal A. Modified Tal Score: Validated score for prediction of bronchiolitis severity. Pediatr Pulmonol. 2018 Apr 14;53.
DOI: 10.1002/ppul.24007
PMID: 29655288