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Research Paper

Paramedic measurement of GCS versus GCS-P in Qatar

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ABSTRACT

Background: The Glasgow Coma Scale (GCS) has been a prominent tool for assessing the severity of traumatic brain injury (TBI) since its inception in 1974 and continues to be regarded as the gold standard. Research indicates that ambiguous interpretations of terminology may lead to inaccurate patient's inter-user scoring. The GCS-P (Glasgow Coma Scale-Pupils) tool was introduced in 2018, yet it has not been tested in prehospital settings. Therefore, the aim of this study was to assess the accuracy of scores reported by paramedics using the traditional GCS tool compared to those using the revised GCS-P tool. In addition, the study aimed to evaluate the perceived ease of use of these tools among paramedics in Qatar.

Methods: This quantitative study focused on comparing the scores given by two groups of paramedics who were randomly assigned to use one of the two GCS tools while assessing two video scenarios depicting TBI. The participants (n = 202) were randomly divided into groups: one using the traditional GCS tool (n = 115) and the other using the revised GCS-P tool (n = 87) to assess TBI video scenarios with simulated patients. Data collection was conducted through online questionnaires, with the GCS-P group receiving additional information on pupil reactivity score (PRS). Descriptive statistics were used for data analysis.

Results: A total of 202 paramedics participated in this study. In scenario 1, 40.9% of GCS users and 21.8% of GCS-P users accurately assessed the patient's condition. In scenario 2, correct assessments were made by 68.7% of GCS users and 17.2% of GCS-P users. Only 30.4% of GCS users and 8% of GCS-P users were able to correctly assess both scenarios. Despite the lower accuracy rates, 99.1% of GCS users and 92% of GCS-P users reported that their respective tools were easy to use. Among the GCS-P users, 65.5% were familiar with the tool, and 88.5% expressed a preference for a simplified calculation method that involved subtracting unreactive pupils from the total GCS score.

Conclusion: The results show that the GCS tool yielded more accurate scores than the GCS-P tool. Enhancing the GCS-P training or revising the GCS-P tool could improve its reliability.

Keywords: Glasgow Coma Scale, paramedic, pupil reactivity score, patient assessment

1. INTRODUCTION

The Glasgow Coma Scale (GCS) tool, initially introduced in 1974, was designed only to assess the severity of traumatic brain injury (TBI) or medical etiology.[1] Since then, the GCS tool has undergone numerous modifications aimed at improving its validity, leading to its widespread adoption across

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Table 1. Illustration of the Glasgow coma scoring system (adapted from Teasdale and Jennett, 1974).[1]

Behavior	Response	Score
Eyes open (E)	Spontaneously	4
	To speech	3
	To pain	2
	No response	1
Best verbal response (V)	Oriented (to time, place, and person)	5
	Confused conversation	4
	Inappropriate words	3
	Incomprehensible sounds	2
	No response	1
Best motor response (M)	Obeys commands	6
	Moves to localized pain	5
	Flexion withdrawal from pain	4
	Abnormal flexion (decorticate)	3
	Abnormal extension (decerebrate)	2
	No response	1
Total score	Best response	15
	Comatose patient	8 or less
	Totally unresponsive	3

various medical fields. It is also used to assess reduced levels of consciousness in patients who exhibit no obvious signs of brain injury.[2–4] The scale assesses three components: eye opening (four result categories), best verbal response (five result categories), and best motor response (six result categories).[1] Each result category includes a descriptor to assist the user in interpreting the findings during patient assessment and assign a score for each component to add for a total score out of 15.[5] The GCS tool is also commonly used as a key component of patient assessment during handovers to another team, particularly when the prehospital care team interacts with the Emergency Department team.[6] The standard GCS tool is presented in Table 1.

In 2018, two additional changes were introduced to the traditional GCS tool. These modifications involved the "simplification" of the terminology used to assess the three components that constitute the GCS, as well as the inclusion of the subtraction of the Pupil Reactivity (to light) Score (PRS) from the total score (Table 2).[7] This latter change resulted in the most remarkable modification, as the lowest score that can now be assigned to a patient is 1/15, rather than the previous 3/15. The revised tool is called the GCS-P, standing for "GCS minus pupil score". The simplification of the terms used to describe findings in the three components stems from years of research questioning the reliability and accuracy of inter-user application and reporting of the GCS tool.[2,3,8–10]

Despite efforts to improve the usability of the GCS system, its reliability continues to be a subject of scrutiny, particularly as the inclusion of pupillary assessment introduces a new element that may potentially reduce interrater reliability among clinicians.[11,12] Accurately determining the severity of a TBI initially is crucial for determining the patient's prognosis. Factors that contribute to improved TBI diagnosis include the presence of hypoxia, hypotension, a precise calculation of a GCS score ‹8, an accurate assessment of pupillary response, and a computed tomography (CT) scan of the head.[13] Although the traditional GCS tool remains the gold standard for determining TBI severity, researchers have consistently sought more accurate measures for evaluation. This study aimed to compare the accuracy of scores obtained using the traditional GCS tool with those derived from the GCS-P tool, as well as to assess their perceived ease of use by paramedics working in the State of Qatar. Qatar's prehospital care services are provided by the Hamad Medical Corporation Ambulance Service

Table 2. Breakdown of the Glasgow Coma Scale score for two scenarios using the GCS and GCS-P tools.

Scenarios	GCS (traditional tool)	Pupil reactivity score (PRS)	GCS-P (revised tool)
Scenario 1	Eyes = 2	Left = None	Eyes = 2
(traumatic brain injury)	Verbal = 2	Right = Reacts	Verbal = 2
	Motor = 5	Equates to 1	Motor = 5
	Total = 9/15	PRS = 9 – 1	**Total = 8/15**
Scenario 2	Eyes = 1	Left = None	Eyes = 1
(pedestrian–motor vehicle accident)	Verbal = 1	Right = None	Verbal = 1
	Motor = 3	Equates to 2	Motor = 3
	Total = 5/15	PRS = 5 – 2	**Total = 3/15**

(HMCAS).[14] This government-operated ambulance service is both modern and well established, employing paramedics who are trained in advanced life support and are registered and licensed by the Department of Healthcare Professions under the Ministry of Public Health.

2. METHODS

2.1. Study Design

This study used a cross-sectional survey design to compare the accuracy of GCS and GCS-P assessments among paramedics. The updated terms of the revised GCS tool are presented in Table 1. The structure of the article followed the STROBE checklist for observational studies.

2.2. Setting

The study was conducted online during the COVID-19 pandemic, targeting HMCAS Ambulance Paramedics (AP) working in Qatar. These APs were employed from various countries, including India, the Philippines, Jordan, and Tunisia, with medical degrees in nursing and anesthesia. During their onboarding process at HMCAS, these recruits underwent a rigorous three-month AP program, equipping them with the knowledge, skills, exposure, and experience.[15]

2.3. Participants

The study population consisted of 1,300 HMCAS APs. Using the Raosoft sample size calculator, a minimum sample size of 297 respondents was calculated. The participants were randomly assigned to two groups: group 1 evaluated simulated patients using the traditional GCS tool, while group 2 used the GCS-P tool. The participants were required to read the online consent form and indicate their agreement to the terms of participation. If they selected “No”, the online form would automatically log them out.

2.4. Variables

The primary outcome variables were the accuracy of GCS and GCS-P assessments in two TBI scenarios. Secondary variables included the ease of use, confidence in assessment, and familiarity with the GCS-P tool.

2.5. Content Validity

The content validity of the questionnaires was established through face validity, using a panel of three experts, senior consultants, and paramedics in prehospital care in HMCAS. During a meeting, they meticulously reviewed the clarity of each question for the intended readers and its relevance to the study’s objectives. They then engaged in thorough discussions, providing suggestions for the refinement and improvement of each item in the questionnaire to ensure that it addressed the intended constructs. A consensus was reached on the final version of the questionnaire, confirming its suitability for the research purpose. The questionnaires included two videos uploaded onto the YouTube platform, which can be accessed via the following links: http://youtube.com/

watch?v=VXog96ClQbM and http://youtube.com/watch?v=rXLMvyvd_tM. The content of these videos was specifically designed to meet the study's objectives. The scenarios were enacted by qualified emergency care practitioners, demonstrating patient assessment techniques for effective application of the GCS tools.

2.6. Data Sources/Measurements

Data collection was conducted using two identical online questionnaires designed with Google Forms, with the only difference being the scoring tool used. Each questionnaire included two video-based brain injury cases for assessment. For the GCS-P group (group 2), additional illustrations showing pupil reactivity were included.

Two video clips, each lasting 90 seconds, with simulated patients were used in the study. The scenarios included:

1. A female patient who sustained a TBI due to a falling concrete block.
2. A female victim of a pedestrian–motor vehicle accident (PMVA) who presented with multiple injuries.

Validated GCS and GCS-P scores for each scenario were predetermined by a panel of expert paramedics specializing in medical education (Table 2). The participants were asked about the ease of calculation and their confidence in the assessments, using a five-point Likert scale that ranged from "Extremely Confident" to "Not Confident at All".

2.7. Data Collection

Participants who provided consent received a link to the questionnaire via email. Follow-up reminder emails were sent at 30, 60, 90, and 120 days following the initiation of the study (June 19, 2021 to February 1, 2022).

2.8. Data Analysis

Descriptive statistics were used. Frequencies and percentages were calculated for correct responses in both the GCS and GCS-P groups. For the GCS group, the proportion of correct assessments was determined for each scenario (TBI and PMVA) and combined for both scenarios. A similar analysis was conducted for the GCS-P group. "Ease of use" of both tools was assessed by calculating the percentage of respondents who found each tool easy to use. Confidence levels were evaluated using a five-point Likert scale, with the results presented as frequencies and percentages for each confidence level. The percentages of correct assessments for both scenarios were calculated for each group to compare the accuracy between groups 1 and 2. Additionally, familiarity with the GCS-P tool was assessed as the percentage of respondents who reported familiarity with it.

The preference for a simplified GCS-P calculation method (subtracting unreactive pupils from the total GCS score) was analyzed by calculating the percentage of respondents who found this method easier to use in practice.

2.9. Ethics

The study was approved by the Hamad Medical Corporation (HMC) Medical Research Centre (MRC) (MRC-01-21-391). The MRC at HMC oversees the governance of all research activities within the organization. This mandated research governance adheres to the policies and procedures of HMC, the regulations set forth by the Ministry of Public Health in Qatar, and internationally recognized standards as outlined in the Declaration of Helsinki.

3. RESULTS

A total of 202 respondents fully completed the online questionnaires. Among these, 115 (56.93%) participants were randomly assigned to use the traditional GCS tool (group 1), while 87 (43.06%) participants used the revised GCS-P tool (group 2). In the GCS questionnaire, 47 (40.9%) APs accurately assessed the TBI patient's GCS as 9/15. In the PMVA scenario, 79 (68.7%) APs correctly identified the GCS as 5/15. In group 1, only 35 (30.4%) respondents correctly assessed the GCS in both scenarios, while 99.1% (n = 114 out of n = 115) reported that they found it easy to calculate the GCS for the patients in both scenarios, with only one respondent indicating difficulty.

As shown in Figure 1, the majority of group 1 respondents (54.8%) expressed confidence in the accuracy of their GCS calculations, while 46 (40%) participants reported feeling extremely confident

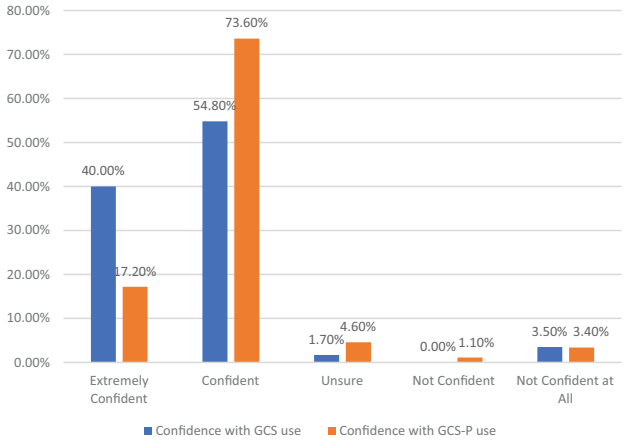

Figure 1. Study participants' confidence level in scoring the two video scenarios using the GCS and GCS-P tools.

in their assessments. This perception is in sharp contrast to the actual accuracy of the respondents' calculations.

A total of 87 participants completed the questionnaire related to the GCS-P tool. Among these, only 19 (21.8%) and 15 (17.2%) respondents accurately determined the GCS-P scores of patients in scenarios 1 and 2, respectively. Furthermore, only 7 (8%) respondents from group 2 correctly assessed both scenarios using the GCS-P tool.

To assess the GCS in relation to the revised GCS-P score, group 2 respondents were asked about their familiarity with the revised GCS-P tool, with 65.5% indicating that they were familiar with it. Additionally, when asked about the ease of using the tool, 92% of group 2 participants reported that they found it easy to calculate the GCS-P score. As in the first questionnaire, the respondents' confidence in their calculations was assessed using a Likert scale format (Figure 1). Of the respondents, 15 (17.2%) expressed that they were "Extremely Confident" in their calculations, while 64 (73.6%) reported being "Confident" in their calculations.

In accordance with the aim of this study, respondents were asked whether the approach of simply subtracting the number of unreactive pupils from the total calculated GCS to determine the GCS-P score was easier to use in practice. This method would produce the same result as the original design of the GCS-P score. However, this approach can be considered a simpler or quicker calculation compared to initially counting the unreactive pupils and subsequently subtracting that number from the calculated GCS score.

A significant majority (n = 77, 88.5%) of the respondents in group 2 indicated that the simple subtraction of unreactive pupils was easier to use in practice.

4. DISCUSSION

The aim of this study was to compare the accuracy of scores reported using the traditional GCS tool in comparison to the GCS-P tool, as well as to assess their perceived ease of use among paramedics working in the Middle Eastern country of Qatar. The study findings showed that the GCS score determined using the GCS-P tool was less accurate than that obtained from the traditional GCS tool. In scenario 1, the accuracy of the GSC was 40.8%, while the GCS-P achieved only 21.8%. In scenario 2, the GCS demonstrated an accuracy of 68.7%, while the GCS-P's accuracy was lower at 17.2%.

4.1. Importance of Accurate GCS Assessment in the Prehospital Setting

In the prehospital setting, paramedics often depend on basic assessment techniques, such as the GCS tool, to accurately determine the severity of a patient suffering a TBI.[7] This assessment is crucial in determining the appropriate course of patient care. Patients with a GCS score of ‹8/15 may require advanced airway placement due to the patient's inability to protect their airway and mitigate hypoxia.[16] Consequently, paramedics may need to administer paralytics, sedation, and analgesics to facilitate the placement of the advanced airway and minimize associated risks. However, in the process of providing care, there is a risk of diminishing the ability of other caregivers to effectively

assess the patient's GCS. Therefore, it is essential for the paramedic to report the patient's initial GCS to the next caregiver in the hospital upon patient handover, as this information significantly influences the patient's ongoing and future care.[17]

Several studies have highlighted the challenges associated with the traditional GCS tool, particularly regarding terminology, which can lead to inconsistent scoring among different users.[18] To address these challenges, the GCS-P tool was introduced to enhance the accuracy of TBI severity assessment. Recent research has focused on validating the GCS-P tool in hospital settings, yielding promising results in certain contexts.[19] In the hospital setting, CT scans and MRI (Magnetic Resonance Imaging), if available, may be used to determine the severity of a TBI and to formulate the necessary care plan for the patient moving forward.[20]

Additionally, recent research has compared the GCS with other physiological scoring systems to assess their effectiveness in predicting outcomes for trauma patients. Findings indicate that, although the GCS is a crucial tool, other scoring systems, such as the REMS (Rapid Emergency Medicine Score), showed superior performance in predicting in-hospital mortality. This is attributed to their inclusion of additional physiological parameters, which enhance prognostic accuracy in trauma settings.[21]

The ability of paramedics to accurately assess a patient's GCS is essential for determining the severity of a TBI, as it significantly influences ongoing care.[17] Several previous studies on the use of the traditional GCS tool have revealed that ambiguous interpretation of terminology can lead to inaccurate inter-user scoring of patients by healthcare providers.[9,12] This inaccuracy has informed the development of the GCS-P tool, with the aim of reducing ambiguity and improving the accuracy of GCS score interpretation. The GCS-P tool is a relatively recent development. Its application in the hospital setting is currently being validated by numerous researchers to accurately determine the severity of TBI experienced by patients.[13,17,19]

4.2. Perceived Ease of Use Versus Actual Accuracy

The findings of this study showed that the perceived ease of use for both the GCS and GCS-P tools was observed at higher percentiles than the actual accuracy of calculations performed by the participants. A higher proportion (99.1%) of respondents found the traditional GCS to be easier to use compared to the GCS-P tool (92.0%). This may be attributed to the respondents' familiarity and long-term use of the GCS tool. Paramedics in group 1 reported slightly greater confidence in their GCS assessment than those in group 2. The results indicate that 88.5% of the respondents in group 2 find the simple calculation of subtracting the number of unreactive pupils to be easier than determining the PRS before calculating the difference. The discrepancy between the perceived ease of use and the actual accuracy raises important questions about the effectiveness of existing training methods and the potential need for recalibrating self-assessment skills among paramedics. Recent research has emphasized the critical role of continuous education and skill reinforcement in maintaining accurate neurological assessment capabilities in prehospital settings.[22]

The findings of this study indicate that although the GCS remains a crucial tool for neurological assessment, it is advisable to use more comprehensive scoring tools that include additional physiological parameters. This has important implications for paramedic training and practice, suggesting that familiarity with various assessment tools may enhance the accuracy of patient evaluation and triage.

5. STUDY LIMITATIONS

This study only recruited APs from Qatar's National Ambulance Service, omitting critical care paramedics (CCPs) who have a more advanced scope of practice.[23] This choice was made for logistical reasons, as CCPs represent less than 10% of Qatar's prehospital healthcare workforce, have busier schedules, and are therefore less likely to participate in such studies. Despite this choice, we encountered a notable lack of engagement from APs and did not reach the expected sample size, even after sending multiple reminders over a 6-month period, as the COVID-19 pandemic significantly increased their workload. Furthermore, the majority of training activities transitioned to online platforms, which likely led to staff experiencing fatigue from being asked to participate in additional voluntary online activities. Consequently, many preferred to "switch-off" from work-related matters whenever possible. Finally, an area that could have been investigated was identifying which sections of the GCS tool presented difficulties in each scenario. However, this was not pursued as it fell outside the scope of this study.

6. CONCLUSION

The accurate assessment of a patient's GCS by paramedics in the prehospital setting is essential, as it significantly influences ongoing medical care in the hospital. In this study, paramedics reported a strong level of confidence in using both assessment tools. However, the accuracy of scoring was found to be higher among participants using the traditional GCS tool compared to those using the GCS-P tool. It is recommended that education and training on the GCS-P tool be enhanced to improve the accuracy of score reporting. Additionally, investigating whether an alternative method of calculating the pupil reaction score could further refine its accuracy is suggested. Therefore, further research into the use of the GCS-P tool in the prehospital setting is warranted.

AUTHORS' CONTRIBUTION

ZJ, HS, JN, JG, PG, GA: Research concept, Proposal drafting, Ethical clearance application, Data collection. PG, HF, GA: Data analysis. ZJ, HS, JN, JG, PG, HF, GA: Article writing and finalization. All authors approved the final version of the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare.

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