

Knowledge, Barriers, and Referral Patterns Among Rehabilitation Staff in Concussion Care: A Single-Institution Study

Review began 08/30/2026

Review ended 10/06/2026

Published 10/17/2026

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DOI: 10.7759/cureus.118065

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Abstract

Introduction: Concussion is a common form of traumatic brain injury resulting from an external force to the head. Understanding this condition among rehabilitation professionals is crucial for prompt recognition, early diagnosis, appropriate referrals, and effective management plans.

Methodology: This cross-sectional descriptive study investigated 107 rehabilitation healthcare staff to assess knowledge regarding concussion, barriers, and referral patterns at King Fahad Medical City (KFMC), Saudi Arabia. Data were collected through online surveys, cleaned and coded, and analyzed using SPSS version 27 (IBM Corp., Armonk, NY) to generate meaningful findings.

Results: The study found that 60 participants (56.1%) had a high level of knowledge about concussion, whereas 47 (43.9%) had a low level of knowledge. Statistically significant associations were observed between knowledge level and age ($P = 0.048$) and current professional role ($P < 0.001$). Multivariable analysis showed that, compared with nurses, working as a physiatrist was the strongest predictor of high concussion knowledge (adjusted odds ratio (AOR) = 57.99; 95% confidence interval (CI) = 7.245-464.166; $P < 0.001$). Furthermore, compared with participants with 1-3 years of experience in their current field, those with more than 10 years of experience had significantly higher odds of demonstrating a high level of concussion knowledge (AOR = 24.65; 95% CI = 2.286-265.805; $P = 0.008$).

Conclusions: The study found that just over half of the rehabilitation healthcare staff met the predefined threshold for high knowledge regarding concussion, but their confidence in the assessment and management of the condition was limited. Training as a physiatrist was a significant positive predictor of high knowledge. This highlights the need for educational enhancement through training programs to increase knowledge and awareness of concussion among rehabilitation staff.

Categories: Trauma, Neurology, Physical Medicine & Rehabilitation

Keywords: barriers, concussion, kfmc, knowledge, rehabilitation staff, saudi arabia

Introduction

Concussion, also known as mild traumatic brain injury (mTBI), is a transient disturbance of brain function caused by an external force to the head. It often results from a bump, blow, or jolt that causes the brain to move rapidly within the skull [1]. Concussions are common, and the majority of traumatic brain injuries (TBIs) are classified as mild [2]. Globally, the incidence is high, with approximately 600 per 100,000 people experiencing a concussion each year, although this figure is likely underestimated due to underreporting and a lack of standardized definitions [3]. Although classified as *mild*, concussions can have profound consequences, particularly in cases involving repeated injury, mismanagement, or delayed recovery [4].

Concussions are frequently missed or misdiagnosed due to their often subtle and transient symptoms. Common signs and symptoms include headache, dizziness, nausea, balance disturbances, confusion, memory deficits, emotional lability, and sleep disturbances [5]. These symptoms can vary widely across individuals and may not be immediately apparent after the injury [6]. Diagnosis is largely clinical, as neuroimaging is often normal in true concussion [7]. Limited awareness among healthcare providers can lead to missed diagnoses or inappropriate management plans [8]. The importance of prompt recognition and correct referral cannot be overstated, as poorly managed concussions may evolve into persistent post-concussion syndrome or expose patients to the risk of second-impact syndrome [9].

Despite increased global awareness, concussion remains under-researched in many parts of the world, including Saudi Arabia. TBIs are common in the Kingdom, primarily due to motor vehicle accidents, yet there are limited data specifically addressing concussions [10]. A study by Alghnam et al. revealed that TBIs accounted for a substantial percentage of emergency department admissions in Saudi Arabia, with the majority related to road traffic incidents [11]. However, few published studies have assessed the awareness

How to cite this article

AlRubaysh N, Alatwi M K, Al-Sawadi A, et al. (October 17, 2026) Knowledge, Barriers, and Referral Patterns Among Rehabilitation Staff in Concussion Care: A Single-Institution Study. Cureus 18(10): e118065. DOI 10.7759/cureus.118065

and knowledge of healthcare providers, particularly within rehabilitation settings, regarding concussion recognition and management, with a cross-sectional survey among university students finding suboptimal knowledge of concussion [12].

Rehabilitation providers, including physiatrists, physical therapists, occupational therapists, speech therapists, and rehabilitation nurses, play a pivotal role in post-concussion care, especially for patients with prolonged or complex recovery trajectories [13]. A recent regional survey among residents in neurology and emergency medicine similarly revealed considerable gaps in concussion education and confidence in managing such cases [14]. This indicates a critical need for targeted research and structured educational strategies to enhance concussion-related competencies in the clinical environment. Therefore, this study aimed to assess knowledge and confidence regarding concussion among rehabilitation healthcare staff at King Fahad Medical City (KFMC), Saudi Arabia. Specifically, the study evaluated participants' knowledge of concussion, confidence in its assessment and management, referral and clinical decision-making patterns, and perceived barriers to effective concussion care.

Materials And Methods

Study design

This study employed a cross-sectional descriptive design conducted at a single institution, KFMC, in Riyadh, Saudi Arabia. The purpose of this design was to assess the current levels of knowledge, awareness, confidence, and referral practices related to concussion among rehabilitation staff at a single point in time.

Study setting and duration of the study

We conducted a cross-sectional online survey targeting rehabilitation hospital staff at a single institution, KFMC, in Riyadh, Saudi Arabia. Data were collected over 8 weeks, from September 2025 to November 1, 2025. The design was observational and descriptive, using a one-time questionnaire to capture participants' knowledge and attitudes at the time of the study.

The cross-sectional design was appropriate for assessing the current status of knowledge and awareness and for identifying associations between staff characteristics and their knowledge or confidence levels.

Study subjects/participants

The target population for this research was rehabilitation healthcare personnel, including physicians specializing in physical medicine and rehabilitation (physiatrists), rehabilitation nurses, physical therapists, occupational therapists, speech-language and swallowing disorders therapists, audiologists, and prosthetists and orthotists. These professionals were involved in the care continuum of patients who may experience concussions, from acute management to rehabilitation.

Inclusion criteria

Eligible participants were clinical staff from the above disciplines who were currently working in a rehabilitation hospital at KFMC in Riyadh, had at least three months of experience in their current role, and were willing to participate and provide informed consent.

Exclusion criteria

Administrative or support staff not involved in patient care were excluded.

Recruitment and sampling

Participants were recruited by convenience sampling with role-based quotas. The questionnaire was distributed as widely as possible to eligible rehabilitation staff at KFMC through official email, staff meetings, and QR code access, with reminders given to improve response. Recruitment within each professional group continued until its target allocation (Appendix A) was reached. Because the invitation was open and no fixed list of invitees was used, the exact number of staff who received the invitation could not be determined, and a conventional response rate could not be calculated. The 107 participants represent approximately 36% of the estimated eligible population of about 300 staff (Appendix A).

The sample size was estimated a priori using PASS 11.0 software (NCSS, LLC, Kaysville, UT) via the confidence interval (CI) method for a single proportion, assuming that 50% of rehabilitation staff would be aware of concussion (the most conservative assumption, which maximizes the required sample size), with a two-sided 95% CI of width 0.20 (Clopper-Pearson exact method). This yielded an optimal sample size of 104. The target of 104 was allocated proportionally across professional roles according to the size of each group in the eligible population of approximately 300 staff (Appendix A), with each role's allocation rounded up to the next whole number, giving a target of 107, which matched the achieved sample exactly.

Equipment

Data were collected using an online, structured, self-administered questionnaire developed by the research team.

The questionnaire included eight sections: Section A (Demographics and professional background), Section B (Knowledge and awareness of concussion), Section C (Confidence in clinical assessment and management), Section D (Scenario-based referral and role identification), Section E (Barriers to effective concussion care), Section F (Awareness of complications related to mismanaged concussion), Section G (Prior experience and training), and Section H (Opinions and willingness regarding concussion education). The full questionnaire, including item wording and response options for all eight sections (A-H), is provided in Appendix B.

The questionnaire consisted of multiple-choice questions and Likert-scale items. It was distributed electronically via secure institutional emails or QR code access through internal communication channels.

Data collection procedures and tools

The full questionnaire, including item wording and response options for all eight sections (A-H), is provided in Appendix B. This questionnaire was developed de novo by the research team specifically for this study; it was not adapted or modified from a previously published instrument, so no permission for adaptation was required.

The questionnaire underwent face and content validity review by a panel of experts in rehabilitation medicine and brain injury. A pilot test was conducted with a small group ($n = 10$) of eligible staff who were not included in the main analysis. Modifications were made based on feedback regarding clarity, time to complete, and relevance.

Ethical approval

Ethical approval was obtained from the Institutional Review Board (IRB) of KFMC (Riyadh Second Health Cluster) before data collection. Participation was voluntary. Participants were informed of the study's purpose and procedures and provided consent by proceeding with the survey. They could skip questions or withdraw at any time without penalty. No personal identifiers were collected, responses remained anonymous, and data were stored securely and analyzed only in aggregate for research purposes, with access limited to the research team. There were no known risks or direct benefits, and no compensation was provided. Participants with questions could contact the principal investigator or the Institutional Review Board of the Riyadh Second Health Cluster.

Knowledge and confidence scoring

The knowledge score was calculated from 15 items: the five items in Section B, the five scenario-based items in Section D, and five items assessing knowledge of complications in Section F (full item wording and response options are given in Appendix B). Each correct response was assigned one point, giving a maximum possible knowledge score of 15, with a score of $\geq 9/15$ (60%) classified as high knowledge and a score of $< 9/15$ classified as low knowledge. Confidence was assessed using five 5-point Likert-scale items (Section C; Appendix B), giving a possible total score of 5–25, with a score of $\geq 15/25$ (60%) classified as high confidence and a score of $< 15/25$ classified as low confidence.

Data analysis

Data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS), version 27 (IBM Corp., Armonk, NY). Descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated for demographic data, knowledge scores, and confidence levels. Chi-square tests and independent-samples t-tests were used to assess relationships between knowledge or confidence and demographic variables (e.g., years of experience and profession). Multivariable logistic regression models were used to identify predictors of high knowledge or confidence while controlling for key demographic factors. Statistical significance was set at $P < 0.05$.

Results

A total of 107 rehabilitation staff participated in the study. The demographic characteristics of the respondents are presented in Table 1. More than half were female (64, 59.8%), while the majority were aged 25–34 years (61, 57.0%). Nurses constituted the largest professional group (44, 41.1%), followed by physiatrists (26, 24.3%). Among the physiatrists, the largest proportion were Resident-R3 or higher (10, 38.5%). Nearly one-third of the respondents (33, 30.8%) had less than one year of practice in their current field.

Demographics	Category	n (%)
Gender	Female	64 (59.8%)
	Male	43 (40.2%)
Age (years)	Under 25	3 (2.8%)
	25-34	61 (57.0%)
	35-44	30 (28.0%)
	45-54	7 (6.5%)
	55 or older	6 (5.6%)
Current professional role	Nurse	44 (41.1%)
	Occupational therapist	16 (15.0%)
	Physiatrist	26 (24.3%)
	Physiotherapist	5 (4.7%)
	Prosthetist and orthotist	10 (9.3%)
	Speech and swallowing therapist	6 (5.6%)
Physiatrist position	Acting consultant	2 (7.7%)
	Consultant	7 (26.9%)
	Resident-R1	2 (7.7%)
	Resident-R2	5 (19.2%)
	Resident-R3 or higher	10 (38.5%)
Years of practice	Less than 1 year	5 (4.7%)
	1-3 years	33 (30.8%)
	4-6 years	18 (16.8%)
	7-10 years	23 (21.5%)
	More than 10 years	28 (26.2%)

TABLE 1: Demographics and professional background presented in frequencies (n) and proportions (%) (n = 107).

The knowledge and awareness of concussion (Table 2) revealed that the majority of professionals (78, 72.9%) knew the correct definition of concussion, and most (78, 72.9%) recognized palpitations as the symptom least likely to be associated with acute concussion. A considerable proportion (64, 59.8%) correctly indicated that concussion diagnosis is primarily clinical, while a notable majority (73, 68.2%) were aware that second impact syndrome involves rapid brain swelling after repeated head injury. Nearly three-quarters (77, 72.0%) were aware of the correct definition of chronic traumatic encephalopathy (CTE) as a neurodegenerative condition linked to repetitive mTBI.

Question	Option	n (%)
B1. Which of the following best defines a concussion?	A direct cortical contusion detectable on CT	4 (3.7%)
	A mild TBI characterized by diffuse axonal injury	20 (18.7%)
	A minor cerebral hemorrhage causing transient symptoms	5 (4.7%)

	A temporary alteration of brain function without visible structural damage (correct)	78 (72.9%)
B2. Which symptom is LEAST likely to be associated with acute concussion?	Confusion	7 (6.5%)
	Dizziness	8 (7.5%)
	Palpitations (correct)	78 (72.9%)
	Photophobia	7 (6.5%)
	Tinnitus	7 (6.5%)
B3. Which statement about neuroimaging in concussion is MOST accurate?	Concussion diagnosis is primarily clinical (correct)	64 (59.8%)
	CT is the gold standard for detecting concussion	20 (18.7%)
	MRI is always required for diagnosis	13 (12.1%)
	Normal CT rules out concussion	10 (9.3%)
B4. Second impact syndrome involves:	Myelin degeneration in chronic TBI	6 (5.6%)
	Progressive cerebral edema post-seizure	8 (7.5%)
	Rapid brain swelling after repeated head injury (correct)	73 (68.2%)
	Subdural hematoma after spinal trauma	2 (1.9%)
	Transient loss of consciousness with vertigo	18 (16.8%)
B5. Chronic traumatic encephalopathy (CTE) is best described as:	A neurodegenerative condition linked to repetitive mTBI (correct)	77 (72.0%)
	A reversible form of post-concussion syndrome	7 (6.5%)
	A variant of epilepsy seen in athletes	3 (2.8%)
	An acute inflammatory brain reaction post-trauma	14 (13.1%)
	An ischemic encephalopathy from reduced perfusion	6 (5.6%)

TABLE 2: Knowledge and awareness of concussion.

Knowledge and awareness of concussion are presented as frequencies (*n*) and proportions (%).

mTBI, mild traumatic brain injury

Confidence in concussion assessment (Table 3) findings showed that more than half of the staff reported confidence in performing a basic concussion assessment (54, 50.4%; “very confident” + “confident”) and in deciding when to refer a concussion patient to a specialist (57, 53.3%). However, the study revealed significant gaps: fewer than half reported confidence in identifying the signs of concussion (52, 48.6%) or

managing post-concussion symptoms such as dizziness and fatigue (51, 47.7%). Furthermore, fewer than half (46, 43.0%) felt that their current training had adequately prepared them to manage concussion cases.

Question	Category	n (%)
C1. How confident are you in identifying the signs of concussion?	Very confident	14 (13.1%)
	Confident	38 (35.5%)
	Neutral	40 (37.4%)
	Slightly unconfident	7 (6.5%)
	Not confident at all	8 (7.5%)
C2. How confident are you in performing a basic concussion assessment?	Very confident	13 (12.1%)
	Confident	41 (38.3%)
	Neutral	32 (29.9%)
	Slightly unconfident	12 (11.2%)
	Not confident at all	9 (8.4%)
C3. How confident are you in deciding when to refer a concussion patient to a specialist?	Very confident	17 (15.9%)
	Confident	40 (37.4%)
	Neutral	34 (31.8%)
	Slightly unconfident	11 (10.3%)
	Not confident at all	5 (4.7%)
C4. How confident are you in managing post-concussion symptoms (e.g., dizziness, fatigue)?	Very confident	17 (15.9%)
	Confident	34 (31.8%)
	Neutral	36 (33.6%)
	Slightly unconfident	14 (13.1%)
	Not confident at all	6 (5.6%)
C5. Do you feel your current training has adequately prepared you to manage concussion cases?	Strongly agree	9 (8.4%)
	Agree	37 (34.6%)
	Neutral	36 (33.6%)
	Disagree	14 (13.1%)
	Strongly disagree	11 (10.3%)

TABLE 3: Confidence in concussion assessment and management.

Confidence in concussion assessment is presented in frequencies (n) and proportions (%).

Scenario-based referral and decision-making (Table 4) revealed that more than half of the participants (71, 66.4%) identified the appropriate referral - to a physiatrist for concussion evaluation - for a patient presenting with a minor collision, brief loss of consciousness, and balance complaints. A considerable proportion (70, 65.4%) understood that a consultant physiatrist with team coordination is responsible for overseeing the multidisciplinary return-to-activity plan. More than half (62, 57.9%) correctly identified the test that was least appropriate during initial concussion assessment, while about half (55, 51.4%) knew that a physiatrist specializing in TBI was the most suitable referral for a patient with persistent cognitive fog and visual instability. The majority (75, 70.1%) were aware that a physiatrist for integrated rehabilitation was the most appropriate primary provider for prolonged post-concussion symptoms beyond four weeks.

Question	Option	n (%)
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D1. 28-year-old post-minor collision, brief LOC, balance complaints - most appropriate initial action	Discharge with analgesics	2 (1.9%)
	Order lumbar spine imaging	5 (4.7%)
	Prescribe vestibular suppressants and observe	6 (5.6%)
	Refer to a physiatrist for concussion evaluation (correct)	71 (66.4%)
	Schedule neuropsychological testing first	23 (21.5%)
D2. Subacute recovery - who should oversee the multidisciplinary return-to-activity plan	Case manager	5 (4.7%)
	Consultant physiatrist with team coordination (correct)	70 (65.4%)
	Neurologist unaffiliated with rehab team	4 (3.7%)
	Primary care physician	23 (21.5%)
	Senior physiotherapist	5 (4.7%)
D3. Which test is LEAST appropriate during initial concussion assessment	Balance Error Scoring System (BESS)	9 (8.4%)
	Cranial nerve screen	11 (10.3%)
	EEG monitoring for seizure focus (correct)	62 (57.9%)
	SCAT-5 symptom scale	16 (15.0%)
	Vestibulo-ocular motor screening	9 (8.4%)
D4. Persistent cognitive fog and visual instability - most suitable referral	Clinical psychologist	3 (2.8%)
	Emergency physician	7 (6.5%)
	ENT specialist	10 (9.3%)
	General neurologist	32 (29.9%)
	Physiatrist specializing in TBI (correct)	55 (51.4%)
D5. Prolonged post-concussion symptoms beyond four weeks - most appropriate primary provider	Acute care physician	22 (20.6%)
	Endocrinologist for fatigue evaluation	2 (1.9%)
	Physiatrist for integrated rehabilitation (correct)	75 (70.1%)
	Psychiatrist for mood stabilization	6 (5.6%)
	Sports trainer for general fitness	2 (1.9%)
F1. Potential complication of inadequately managed concussion	Cumulative neurocognitive impairment with activity triggers	13 (12.1%)
	Delayed psychosocial integration	3 (2.8%)
	Persistent somatic complaints without organic cause	4 (3.7%)
	All of the above (correct)	87 (81.3%)

F2. Repetitive concussions are most strongly linked to which long-term condition	Chronic traumatic encephalopathy (CTE) (correct)	88 (82.2%)
	Generalized anxiety disorder	8 (7.5%)
	Obstructive hydrocephalus	5 (4.7%)
	Parkinsonian syndromes	4 (3.7%)
	Progressive myelopathy	2 (1.9%)
F3. Delayed return to cognitive or physical activity can result in	Compensatory motor overuse syndromes	6 (5.6%)
	Secondary psychiatric comorbidities	4 (3.7%)
	Prolonged neurocognitive fatigue	3 (2.8%)
	All of the above (correct)	90 (84.1%)
	None of the above	4 (3.7%)
F4. If concussion is improperly assessed and managed, which sequela is LEAST expected	Chronic headaches	10 (9.3%)
	Irritability and mood swings	7 (6.5%)
	Memory issues	9 (8.4%)
	Sleep disturbances	13 (12.1%)
	Sudden-onset blindness (correct)	68 (63.6%)
F5. Which domain can be independently impacted by unrecognized concussion	Emotional regulation	5 (4.7%)
	Executive functioning and planning	6 (5.6%)
	Fine motor control	1 (0.9%)
	Vestibulo-ocular coordination	4 (3.7%)
	All of the above (correct)	91 (85.0%)

TABLE 4: Scenario-based referral/decision-making (D1-D5) and knowledge of complications (F1-F5).

Scenario-based referral/decision-making and concussion management are presented as frequencies (*n*) and proportions (%).

LOC, loss of consciousness; BESS, Balance Error Scoring System; EEG, electroencephalography; SCAT-5, Sport Concussion Assessment Tool - 5th edition; ENT, ear, nose, and throat; TBI, traumatic brain injury; CTE, chronic traumatic encephalopathy

Regarding knowledge of complications (Table 4), the majority of participants (88, 82.2%) correctly identified CTE as the long-term condition most strongly linked to repetitive concussion. Additionally, 87 (81.3%) correctly identified multiple possible complications of inadequately managed concussion, 90 (84.1%) correctly identified multiple possible consequences of delayed return to activity, 91 (85.0%) correctly identified multiple domains that can be independently impacted by unrecognized concussion, and 68 (63.6%) correctly identified sudden-onset blindness as the least expected sequela of improperly managed concussion.

The results showed statistically significant associations between knowledge level and age ($P = 0.048$) and current professional role ($P < 0.001$) (Table 5). Younger rehabilitation staff and those aged 55 or older demonstrated significantly higher knowledge about concussion. Additionally, working as a physiatrist ($P < 0.001$) was associated with significantly higher concussion knowledge than other professional roles. Other variables were not statistically significant.

Variable	Category	Low knowledge	High knowledge	df	P-value
Gender	Female	28 (43.8%)	36 (56.3%)	1	0.964
	Male	19 (44.2%)	24 (55.8%)		
Age (years)	Under 25	0 (0.0%)	3 (100.0%)	4	0.048*
	25-34	26 (42.6%)	35 (57.4%)		
	35-44	17 (56.7%)	13 (43.3%)		
	45-54	4 (57.1%)	3 (42.9%)		
	55 or older	0 (0.0%)	6 (100.0%)		
Current professional role	Nurse	26 (59.1%)	18 (40.9%)	5	<0.001*
	Occupational therapist	4 (25.0%)	12 (75.0%)		
	Physiatrist	2 (7.7%)	24 (92.3%)		
	Physiotherapist	5 (100.0%)	0 (0.0%)		
	Prosthetist and orthotist	8 (80.0%)	2 (20.0%)		
	Speech and swallowing therapist	2 (33.3%)	4 (66.7%)		
Years of practice	Less than 1 year	3 (60.0%)	2 (40.0%)	4	0.067
	1-3 years	14 (42.4%)	19 (57.6%)		
	4-6 years	13 (72.2%)	5 (27.8%)		
	7-10 years	8 (34.8%)	15 (65.2%)		
	More than 10 years	9 (32.1%)	19 (67.9%)		

TABLE 5: The association between demographic variables and participants' knowledge level about concussion.

Note: Pearson's chi-square test was used to assess associations between categorical variables. A *P*-value < 0.05 was considered statistically significant.

Figure 1 illustrates the rehabilitation hospital staff's knowledge level about concussion. The study found that the majority of staff (60, 56.1%) had a high level of knowledge, while 47 (43.9%) had a low level of knowledge about concussion.

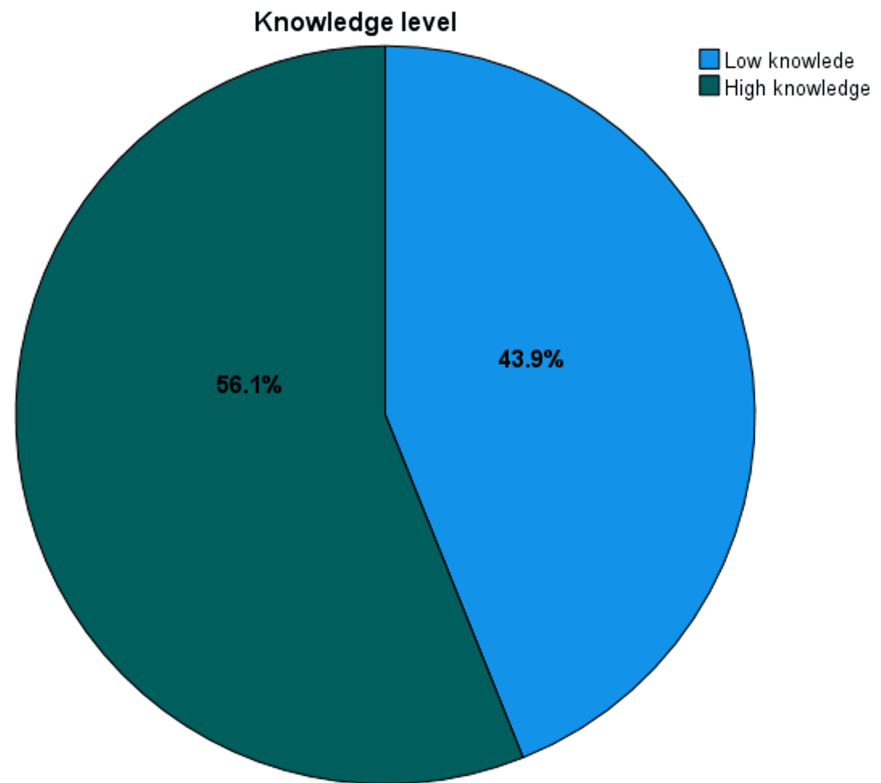


FIGURE 1: Knowledge level about concussion.

In the multivariable logistic regression model (Table 6), compared with nurses, physiatrists had significantly higher odds of high concussion knowledge (AOR = 57.99; 95% CI = 7.245-464.166; $P < 0.001$). Compared with participants with one to three years of practice, those with more than 10 years of experience in their current field also had significantly higher odds of high concussion knowledge (AOR = 24.65; 95% CI = 2.286-265.805; $P = 0.008$). Other categories were not statistically significant.

Variable	AOR	95% CI	P-value
Gender			
Female (Reference)	-	-	-
Male	0.88	0.211-3.675	0.861
Age (years)			
25-34 (Reference)	-	-	-
35-44	0.47	0.065-3.420	0.457
45-54	0.22	0.012-4.203	0.316
55 or older	0.00	0.000-	0.999
Under 25	0.00	0.000-	0.999
Current professional role			
Nurse (Reference)	-	-	-
Occupational therapist	5.97	0.855-41.667	0.072
Physiatrist	57.99	7.245-464.166	<0.001*
Physiotherapist	0.00	0.000-	0.999
Prosthetist and orthotist	0.57	0.062-5.150	0.614
Speech and swallowing therapist	4.03	0.349-46.536	0.264
Years of practice			
1-3 years (Reference)	-	-	-
Less than 1 year	2.94	0.166-52.015	0.463
4-6 years	0.57	0.083-3.852	0.560
7-10 years	2.97	0.473-18.706	0.245
More than 10 years	24.65	2.286-265.805	0.008*

TABLE 6: Multivariable logistic regression - predictors of high knowledge about concussion.

*Significant at $P < 0.05$.

AOR, adjusted odds ratio; CI, confidence interval

In the multivariable logistic regression model (Table 7), training as a physiatrist (AOR = 37.57; 95% CI = 6.805-207.467; $P < 0.001$) was the strongest predictor of high knowledge about concussion. Furthermore, having more years of practice in the current field (AOR = 1.78; 95% CI = 1.134-2.797; $P = 0.012$) showed a positive association with a high knowledge level; however, other attributes were not statistically significant.

Variables	AOR	95% CI	P-value
Gender	2.53	0.905-7.057	0.077
Age	0.84	0.465-1.507	0.553
Current professional role - physiatrist	37.57	6.805-207.467	<0.001
Years of practice in your current field	1.78	1.134-2.797	0.012

TABLE 7: Multivariable logistic regression analysis of independent predictors of high knowledge about concussion.

*Significant at $P < 0.05$.

AOR, adjusted odds ratio; CI, confidence interval

Figure 2 presents the confidence levels of rehabilitation professionals in assessing and managing patients with concussion. The study observed that nearly one-third (38, 35.5%) had high confidence levels, while the majority (69, 64.5%) demonstrated low confidence levels.

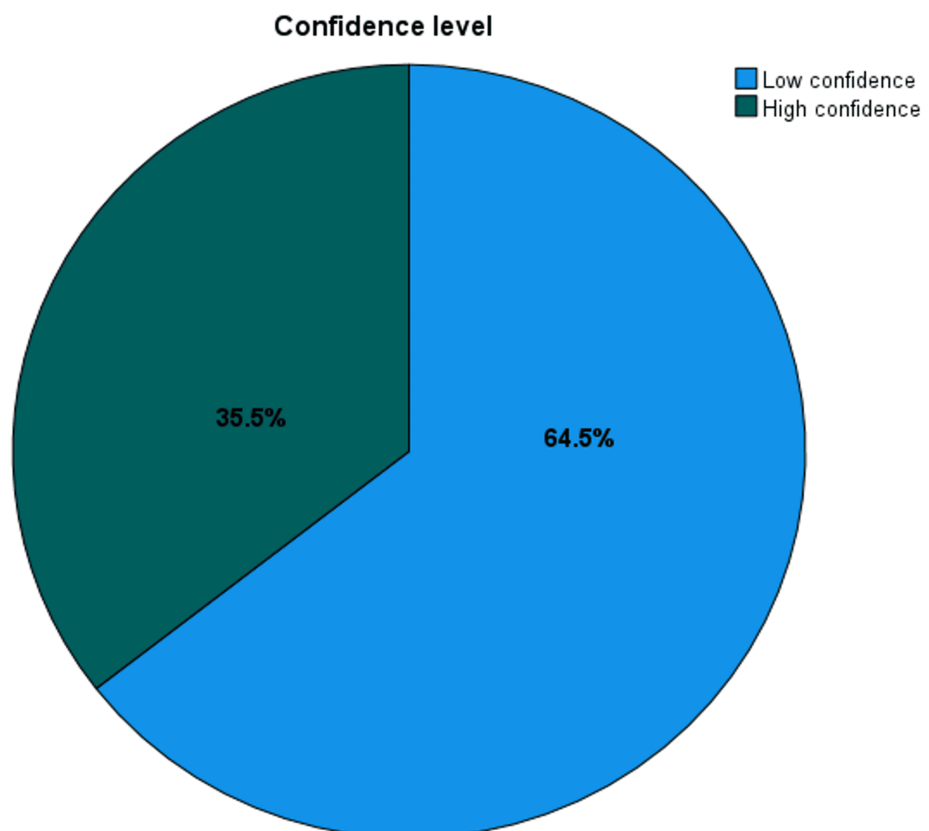


FIGURE 2: Confidence levels of rehabilitation professionals in assessing and managing patients with concussion.

Discussion

TBI is a significant global public health challenge commonly caused by road traffic accidents [10,11]. Despite this growing concern, there are limited local data regarding concussion in Saudi Arabia. This study aimed to bridge this gap by assessing knowledge levels about concussion, barriers, and referral patterns among rehabilitation healthcare staff at KFMC, Saudi Arabia.

The study found that 60 of 107 rehabilitation healthcare staff (56.1%) met the predefined threshold for high

knowledge ($\geq 9/15$ items correct), while 47 (43.9%) did not. This is consistent with other Saudi studies, including one by Almalki et al., who reported good knowledge regarding concussion among 68.3% of medical students [15], and a study conducted in Riyadh by Almansour et al., who reported good overall knowledge, with about 65.0% of therapists demonstrating adequate knowledge in managing concussion cases [16].

Younger rehabilitation staff and those aged 55 or older demonstrated significantly higher knowledge about concussion than other age groups, likely due to exposure to more recent education and training among younger staff and extensive clinical experience among older staff. Additionally, multivariable results showed that working as a physiatrist (AOR = 57.99; 95% CI = 7.245–464.166; $P < 0.001$) was associated with high knowledge about concussion. This finding is consistent with that of Salisbury et al., who found that brain injury training among physiatrists was a significant predictor of higher knowledge about concussion [17], emphasizing the invaluable role of specialized training in imparting knowledge to healthcare professionals.

Four of the five scenario-based items (Section D) used to derive the knowledge score had *physiatrist* as the correct response, which may have inflated the knowledge scores specifically for physiatrist respondents and could partly explain the strength of the association between physiatrist training and high knowledge; this is discussed further under Limitations.

The study also revealed significant knowledge gaps regarding the role of neuroimaging in concussion diagnosis, highlighting the need for educational enhancement through training programs and clinical guidelines.

The study observed significant gaps in rehabilitation professionals' confidence in assessing and managing concussion cases, with only 38 (35.5%) reporting high confidence and the majority, 69 (64.5%), reporting low confidence. This finding aligns with a study by Finn, who reported low confidence levels among the majority of therapists, particularly those lacking clinical experience with concussion [18], underscoring the importance of clinical exposure and guided supervision in promoting staff confidence in managing concussion cases.

The study found that the majority of staff demonstrated the ability to identify appropriate referrals (71, 66.4%), management plans (70, 65.4%), and the appropriate primary care provider for prolonged post-concussion symptoms beyond four weeks (75, 70.1%). These findings reflect the multidisciplinary nature of concussion rehabilitation, in which recovery includes both symptom control and functional restoration.

The most frequently reported barrier to effective concussion management was lack of knowledge (16, 15.0%), consistent with studies by Yorke et al. [19] and Schneider et al. [20], who also reported lack of knowledge as a common barrier to proper concussion management in rehabilitation centers. Lack of experience (21, 19.6%) and lack of training (15, 14.0%) were also common barriers limiting staff confidence, highlighting the need for targeted educational and training programs.

Limitations

A major limitation of this study is its cross-sectional design, which allows for the identification of associations but does not establish causality. The use of online surveys for data collection may have introduced bias, as it was not possible to verify the accuracy of staff responses. The conclusions cannot be generalized beyond KFMC, a single institution.

Participants were recruited by convenience sampling with role-based quotas, and the number of staff who received the invitation could not be determined; therefore, a conventional response rate could not be calculated. The 107 participants represent approximately 36% of the estimated eligible population of about 300 staff. Participants may differ from nonparticipants, for example, in their level of interest in concussion, raising the possibility of nonresponse or selection bias even within this single institution.

The questionnaire was newly developed for this study and has not been formally validated against an external standard. This, together with self-report bias, limits the certainty of the findings.

The estimate for physiatrists (AOR = 57.99; 95% CI = 7.245–464.166) is large but highly imprecise, as are the estimates for more than 10 years of practice (AOR = 24.65; 95% CI = 2.286–265.805) and for 7–10 years of practice in the confidence model (AOR = 67.00; 95% CI = 4.074–1101.649). All three estimates reflect small cell counts in some categories. Four of the five Section D scenario items used in the knowledge score have *physiatrist* as the correct response, which may have advantaged physiatrist respondents in their knowledge scores and could partly explain the association between being a physiatrist and high knowledge. Scenario responses also reflect stated referral intentions rather than observed clinical performance.

Conclusions

The study found that just over half of rehabilitation healthcare staff met the threshold for high knowledge regarding concussion, but their confidence in assessing and managing the condition was limited. Working as

a physiatrist was a significant positive predictor of high knowledge. This highlights the need for educational enhancement through training programs to increase knowledge and awareness of concussion among rehabilitation staff.

Appendices

Appendix A

Role	Population frequency (n)	Population Proportion Sample (PPS)
Nurse	126	44
Physiatrist	75	26
Occupational Therapist	45	16
Prosthetist & Orthotist	27	10
Speech & Swallowing Therapist	15	6
Physiotherapist	12	5

TABLE 8: Sample size allocation by professional role (Population Proportion Sampling).

Appendix B

Section / Item	Question	Response options
A1	What is your gender?	Male / Female
A2	To what age group do you belong?	Under 25 / 25-34 / 35-44 / 45-54 / 55 or older
A3	What is your current professional role?	Physiatrist / Nurse / Physiotherapist / Occupational Therapist / Speech & Swallowing Therapist / Audiologist / Prosthetist & Orthotist
A4	If you are a physician (physiatrist), please specify your current position	Consultant / Acting Consultant / Resident-R1 / Resident-R2 / Resident-R3 or higher
A5	How many years have you been practicing in your current field?	Less than 1 year / 1-3 years / 4-6 years / 7-10 years / More than 10 years
B1	Which of the following best defines a concussion?	A temporary alteration of brain function without visible structural damage / A minor cerebral hemorrhage causing transient symptoms / A mild TBI characterized by diffuse axonal injury / A condition resulting from cerebrospinal fluid imbalance / A direct cortical contusion detectable on CT
B2	Which of the following symptoms is LEAST likely to be associated with acute concussion?	Photophobia / Tinnitus / Palpitations / Dizziness / Confusion
B3	Which statement about neuroimaging in concussion is MOST accurate?	Normal CT rules out concussion / MRI is always required for diagnosis / Concussion diagnosis is primarily clinical / Neuroimaging confirms all mTBI cases / CT is the gold standard for detecting concussion
B4	Second impact syndrome involves:	Subdural hematoma after spinal trauma / Progressive cerebral edema post-seizure / Rapid brain swelling after repeated head injury / Myelin degeneration in chronic TBI / Transient loss of consciousness with vertigo
B5	Chronic Traumatic Encephalopathy (CTE) is best described as:	A reversible form of post-concussion syndrome / A neurodegenerative condition linked to repetitive mTBI / A variant of epilepsy seen in athletes / An acute inflammatory brain reaction post-trauma / An ischemic encephalopathy from reduced perfusion
C1	How confident are you in identifying the signs of concussion?	Very confident / Confident / Neutral / Slightly unconfident / Not confident at all
C2	How confident are you in performing a basic concussion assessment?	Very confident / Confident / Neutral / Slightly unconfident / Not confident at all

C3	How confident are you in deciding when to refer a concussion patient to a specialist?	Very confident / Confident / Neutral / Slightly unconfident / Not confident at all
C4	How confident are you in managing post-concussion symptoms (e.g., dizziness, fatigue)?	Very confident / Confident / Neutral / Slightly unconfident / Not confident at all
C5	Do you feel your current training has adequately prepared you to manage concussion cases?	Strongly agree / Agree / Neutral / Disagree / Strongly disagree
D1	A 28-year-old presents post-minor collision with brief LOC and balance complaints. What is the most appropriate initial action?	Prescribe vestibular suppressants and observe / Discharge with analgesics / Refer to a physiatrist for concussion evaluation / Order lumbar spine imaging / Schedule neuropsychological testing first
D2	During subacute recovery, who should oversee the multidisciplinary return-to-activity plan?	Primary care physician / Senior physiotherapist / Consultant physiatrist with team coordination / Neurologist unaffiliated with rehab team / Case manager
D3	Which test is LEAST appropriate during the initial concussion assessment?	SCAT-5 symptom scale / Cranial nerve screen / Balance Error Scoring System (BESS) / EEG monitoring for seizure focus / Vestibulo-ocular motor screening
D4	If a patient demonstrates persistent cognitive fog and visual instability, the most suitable referral is:	General neurologist / Physiatrist specializing in TBI / Clinical psychologist / ENT specialist / Emergency physician
D5	For prolonged post-concussion symptoms beyond 4 weeks, who is the most appropriate primary provider?	Acute care physician / Psychiatrist for mood stabilization / Physiatrist for integrated rehab / Sports trainer for general fitness / Endocrinologist for fatigue evaluation
E1	What do you perceive as the biggest barrier to effective concussion management?	Lack of knowledge / Limited access to specialists / Time constraints / No formal protocols / All of the above
E2	Do you believe institutional protocols for concussion are available?	Yes, and I'm familiar with them / Yes, but I don't know them / Not sure / No / We don't need them
E3	What limits your confidence in managing concussion cases?	Lack of experience / Lack of training / System-level barriers / Limited supervision / All of the above
E4	Are patients in your facility promptly referred to appropriate specialists for concussion?	Always / Often / Sometimes / Rarely / Never
E5	Do you think interdepartmental communication affects concussion care?	Always / Often / Sometimes / Rarely / Never
F1	Which of the following best describes a potential complication of inadequately managed concussion?	Persistent somatic complaints without organic cause / Cumulative neurocognitive impairment with activity triggers / Delayed psychosocial integration / Chronic sleep disturbances with vestibular mismatch / All of the above
F2	Repetitive concussions are MOST strongly linked to which long-term condition?	Generalized anxiety disorder / Parkinsonian syndromes / Chronic traumatic encephalopathy (CTE) / Obstructive hydrocephalus / Progressive myelopathy
F3	Delayed return to cognitive or physical activity can result in:	Compensatory motor overuse syndromes / Secondary psychiatric comorbidities / Prolonged neurocognitive fatigue / All of the above / None of the above
F4	If concussion is improperly assessed and managed, which sequela is LEAST expected?	Chronic headaches / Irritability and mood swings / Sudden-onset blindness / Memory issues / Sleep disturbances
F5	Which of the following domains can be independently impacted by unrecognized concussion?	Executive functioning and planning / Vestibulo-ocular coordination / Emotional regulation / Fine motor control / All of the above
G1	Have you previously managed or	Yes - more than 10 cases / Yes - 5-10 cases / Yes - 1-4 cases / No, but I've observed /

	been involved in a concussion case?	No experience
G2	Have you received formal training on concussion management?	Yes, multiple times / Yes, once / No, but self-read / No / Not applicable
G3	Do you think prior experience affects your clinical judgment in concussion care?	Strongly agree / Agree / Neutral / Disagree / Strongly disagree
G4	Do you encounter patients with possible concussion in your current role?	Daily / Weekly / Monthly / Rarely / Never
G5	Are you interested in gaining more experience in managing concussion cases?	Yes / Maybe / No / Not sure / Prefer not to answer
H1	Do you believe additional training is needed in concussion assessment?	Strongly agree / Agree / Neutral / Disagree / Strongly disagree
H2	What format would you prefer for educational programs?	Workshops / Online courses / Lectures/seminars / Simulation training / All of the above
H3	Would you participate in a concussion-focused workshop if offered at KFMC?	Yes / Maybe / No / Not sure / Prefer not to say
H4	Do you think interdisciplinary training improves concussion care?	Strongly agree / Agree / Neutral / Disagree / Strongly disagree
H5	What is the best method to improve awareness among staff?	Monthly CME events / Mandatory training modules / Departmental case discussions / Posters and flyers / Social media campaigns

TABLE 9: Structure and content of the study questionnaire (Sections A-H).

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. The Institutional Review Board (IRB) of King Fahad Medical City, Riyadh Second Health Cluster issued approval 25-459, on September 7, 2025, in accordance with Good Clinical Practice guidelines. Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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