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Review article

The Biopsychosocial Model of Military Medicine: A Scoping Review of Operationalizing Interprofessional Care for Chronic Pain and TBI

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Abstract

Background: The contemporary military setting provides a unique patient population with complex, comorbid chronic pain and traumatic brain injury (TBI). These are recalcitrant to single-specialty, biomedical models, which are prone to polypharmacy, fragmented care, and poor outcomes, necessitating a paradigm shift. **Aim:** This scoping review explores the operationalization of the Biopsychosocial Model (BPSM) by Interprofessional Care (IPC) in military and veterans with chronic pain and/or TBI. It takes into consideration the multifaceted roles of the various disciplines and the facilitative role of defense and veteran policies. **Methods:** A literature scoping review conducted from 2015 to 2025 mapped the current evidence and conceptual frameworks for integrated care models in this population. **Results:** Effective IPC, implementing

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the BPSM, requires a central triumvirate—Physiotherapy, Psychology, and Nursing—with important ancillary specialties like Dentistry (orofacial pain), Optometry (vision therapy post-TBI), and Laboratory Medicine (monitoring biomarkers). Effective implementation depends significantly on the policy and funding endorsement of bodies like the Ministry of Defense and Veterans Affairs to overcome systemic barriers.

Conclusion: The reconciliation of the BPSM and IPC is not an enhancement but an imperative for restoring function and quality of life for service members and veterans. It is the standard of care for the management of these complex, chronic diseases.

Keywords: Biopsychosocial Model, Interprofessional Care, Military Medicine, Chronic Pain, Traumatic Brain Injury

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Introduction

Military personnel are subjected to a unique set of physical and psychological stressors that predispose them to a high incidence of chronic pain and TBI. Injury mechanisms are heterogeneous, encompassing blunt trauma and blast injuries during combat deployment, as well as high-impact maneuvers and repetitive strain common to training (1). The comorbidity of chronic pain and TBI is particularly common and challenging; post-concussive symptoms can exacerbate pain, and chronic pain can interfere with the cognitive recovery process, creating a disability cycle (2). Historically, treatment of these conditions in military treatment facilities has been a siloed, reductionist model. An orthopedist may manage a service member with low back pain with analgesics, whereas another with headache and irritability following a blast may receive treatment from a neurologist. This patchwork of specialty care rarely took into consideration the interrelatedness of the biological, psychological, and social determinants that perpetuated the illness experience.

The Biopsychosocial Model (BPSM) arose as an improvement over the limitations of the biomedical model. It postulates that illness and health are caused by a complex interaction between biological causes (e.g., pathophysiology, genetics), psychological causes (e.g., beliefs, coping style, states of mind), and social causes (e.g., culture, family, socioeconomic status) (3). For the patient from the military, the triad is especially conjoined: the biological harm is compounded by the psychological harm of combat or training-related trauma and situated within the social context of military culture, which often stigmatizes help-seeking for "invisible" injuries and the transition to veteran status that follows (4). While the BPSM is theoretically compelling, its implementation requires a team-based response. Interprofessional Care (IPC) has been defined as an inter-professional practice in which diverse health workers of different professional backgrounds put hands together with patients, families, and communities in order to offer the optimal quality of care (5). IPC is the operational dynamic of the BPSM, translating its principles into holistic assessment and care.

This scoping review will map the existing evidence between 2015 and 2024 regarding the operationalization of the BPSM by IPC in military and veteran groups with chronic pain and TBI. It will synthesize evidence on the scope of practice of specific healthcare professions, contrast the structure and findings of existing IPC programs, and clarify the systemic policy-level facilitators and barriers to the implementation. By highlighting the inclusion of incompatible yet complementary specialties like Optometry and Dentistry, which are all too commonly overlooked, this review has a more international outlook on what is actually holistic rehabilitation for this group.

The Biopsychosocial Facets of Chronic Pain and TBI in Military Populations

The Biological Domain: Pathophysiology and Comorbidity

The biological underpinnings of chronic pain and TBI in service members are often severe and interconnected. Blast injuries, a hallmark of modern warfare, cause polytrauma, including fracture, soft tissue injury, and damage to peripheral nerves, which may evolve into chronic neuropathic or nociceptive pain conditions (6). Similarly, mild TBI is also a multifaceted cascade of neuropathological alterations, including axonal shearing, neuroinflammation, and dysregulation of neurotransmitters, which may manifest as chronic headache, dizziness, and sleep disorder (2). Most significant is the huge neurobiological overlap; TBI can lead to central sensitization, a state of hyper-reactivity of the central nervous system that lowers the pain threshold and enhances pain transmission and is therefore implicated in the maintenance and generation of chronic pain (7). This kind of biological synergy requires a diagnostic and treatment approach that doesn't concentrate on a single organ system (Figure 1).

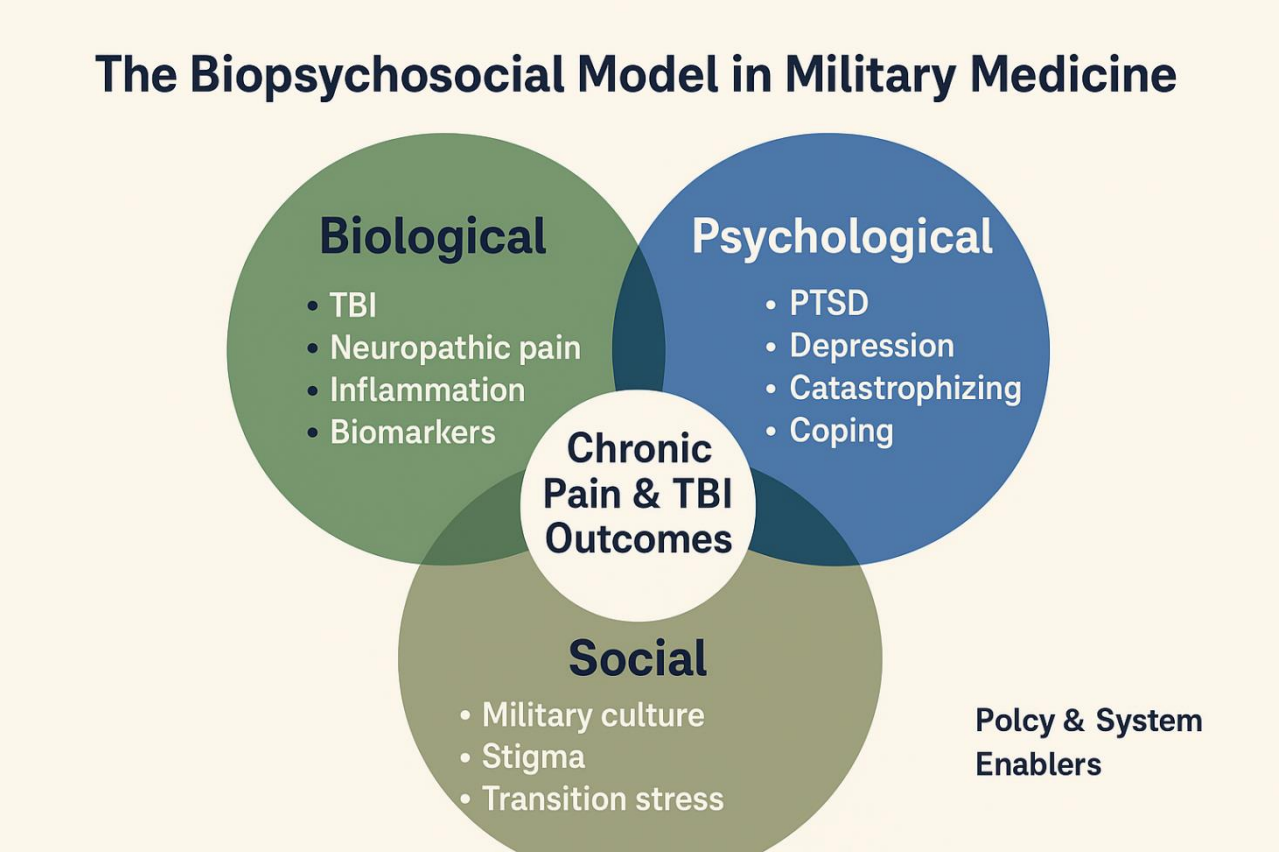

Figure 1: The Biopsychosocial Model in Military Medicine

The Psychological Domain: The Role of Comorbid Mental Health

The psychological domain is inherently linked to the condition of chronic pain and the recovery process from TBI. Post-Traumatic Stress Disorder (PTSD), depression, and anxiety are extremely common comorbidities within this population. The relationship is bidirectional: the constant reminder of a traumatic incident may give rise to chronic pain, fueling symptoms of PTSD, and the hyperarousal and avoidance symptoms of PTSD may exacerbate pain and facilitate disability outcomes (8). Catastrophizing, a habitual way of thinking with a tendency to overestimate the threat potential of pain and feel helpless when faced with it, is a significant predictor of ratings of pain, disability, and inadequate response to treatment (9). After TBI, psychological distress may exacerbate post-concussive symptoms like concentration difficulty and irritability, leading to a confounding clinical presentation where it is difficult to delineate neurological from psychological sequelae (10).

The Social Domain: Culture, Stigma, and Transition

The social environment of the military member is an important determinant of outcome. Military culture, valuing hardness, toughness, and mission-readiness, can create a formidable barrier to seeking care for pain or psychiatric symptoms, as they are viewed as a weakness (11). This stoicism-based culture can lead to a delay in presentation, increased symptomatology, and self-medication, most typically alcohol or abused prescription medication. Moreover, the shift from active duty to veteran status is a critical social stressor that contains the aspects of potential loss of employment, community, and identity, which can destabilize recovery and lead to chronicity of pain and TBI symptoms (12). Social support from the family, peers, and unit has been consistently identified as a protective factor, and its absence is a severe risk factor for poor long-term adjustment (13).

Operationalizing the Biopsychosocial Model Through Interprofessional Care (IPC)

The Biopsychosocial Model (BPSM) offers the theoretical framework that is needed—the "what" and "why"—for understanding the multifaceted nature of chronic pain and Traumatic Brain Injury (TBI) in the military population. But realization in practice sounds depends entirely on the operational machinery of Interprofessional Care (IPC), that ever-present, yet elusive "how." Quality IPC to such complex, comorbid conditions requires more than a team of experts; it requires a well-integrated team founded upon an agreed conceptual model, precisely defined roles, and robust, enduring communication pathways. Within military medicine, this vision is most often achieved via formal, system-level programs within the Veterans Health Administration (VHA) or designated Department of Defense (DoD) centers of excellence, including the Polytrauma System of Care. These interventions are designed to escape the limitations of a siloed referral system, developing a culture of co-located, collaborative care in which providers from cross-disciplinary settings interact via shared decision-making and real-time consultation to develop an uninterrupted, patient-centered treatment plan (Figure 2).

Figure 2: Interprofessional Care (IPC) Model for Operationalizing the BPSM

Major Components of an IPC Team for Chronic Pain and TBI

The foundation of an effective IPC team for military-related chronic pain and TBI lies in a core triad of specialties that address head-on the principal battlegrounds of the BPSM. Physiotherapy is the foundation of care for the biological and physical elements of these syndromes. The physiotherapist's contribution extends way beyond passive modality management to active, functionally oriented intervention. For chronic pain, this entails the application of techniques such as graded exposure therapy to gradually reduce fear-avoidant behavior, neuromuscular re-education to restore normal patterns of movement, and pain neuroscience education to reframe the patient's understanding of their pain (14). For TBI, professional advice from the physiotherapist becomes imperative to manage vestibular deficits and postural instability through individually prescribed vestibular rehabilitation and balance training, instrumental in reducing the risk of falls, alleviating dizziness, and preserving confidence in mobility (15).

At the same time, Psychology and Mental Health practitioners are faced with negotiating the complex psychological terrain that sustains and emerges due to chronic pain and TBI. The psychological consequences, such as PTSD, depression, anxiety, and negative coping strategies like catastrophizing, are not comorbidities but potent perpetuators of the cycle of chronic disability. Hence, provision of evidence-based, trauma-informed psychotherapy is essential. These consist of modalities such as Cognitive Behavioral Therapy (CBT) to address the cognitive distortions and the behavior patterns which fuel insomnia and pain, and specialized trauma therapies such as Cognitive Processing Therapy (CPT) or Prolonged Exposure (PE) to address specifically the underlying PTSD so often enmeshed with the physical trauma (16). Furthermore, neuropsychological testing and rehabilitation are essential to the diagnosis and treatment of resultant cognitive deficits in memory, attention, and executive function that are typical following a TBI, employing compensatory strategies

and cognitive retraining to promote successful return to duty or civilian life (10).

The coordination of efforts among these and other specialists is the Nursing professional, who frequently is the key figure of the Care Coordinator or Case Manager. This role is the "glue" that binds the IPC team, ensuring the theoretically integrated model actually works that way in practice. The nurse conducts comprehensive initial and follow-up assessments, integrating information from all disciplines to formulate a complete picture of the patient's status. They provide consistent patient and family education, breaking down complex medical information and enabling the service member to take charge of his own rehabilitation. They closely monitor medication compliance, manage complex medication regimens (e.g., high-risk opioid tapers), and, most notably, serve as the patients' and families' main, stable point of contact (17). This stable interaction is central to developing trust, maintaining continuity across the various specialties, and preventing the patient from slipping through the cracks of a complex health care system.

IPC Team Augmentation: The Critical but Often Overlooked Disciplines

A perfect and maximally realized model of IPC will proactively include specialty disciplines that exclusively address each of the prevalent but commonly underdiagnosed blast and combat injury sequelae. Their inclusion is often the difference between merely good care and truly outstanding, solution-focused rehabilitation. The integration of Dentistry, particularly with an emphasis on orofacial pain, is imperative because of the strong pathophysiological relationship between TBI, chronic pain, and temporomandibular region disorders. The biomechanical forces of a blow or impact directly traumatize the temporomandibular joint (TMJ) and its musculature, resulting in temporomandibular disorders (TMD) and sleep bruxism (teeth grinding), and are independent causes of headache and facial pain (18). An orofacial pain specialist, or a dentist who has special training in orofacial pain, can make such oft-overlooked diagnoses, providing treatments such as occlusal splints, trigger point injections, and behavioral therapy. These problems are not an ancillary concern; left untreated, orofacial pain can interfere with greater pain management and cognitive rehabilitation efforts by perpetuating central sensitization and sleep disturbance (19).

No less importantly, the role of Optometry and Neuro-optometry cannot be overstated as visual impairment is among the most common and functionally disabling consequences of TBI, presenting in the majority of patients. The neural convergence relationships of the visual pathway are highly sensitive to shearing forces, leading to convergence insufficiency (inability to converge on near points), accommodative dysfunction (blurred vision), visual field deficiencies, and severe photophobia (20). These impairments directly produce typical post-concussive symptoms like headaches, dizziness, and inability to read or work on a computer, thereby severely disrupting rehabilitation participation and hindering return to duty or work. Neuro-optometrists provide essential, targeted vision therapy to relearn neural pathways and prescribe targeted lenses (e.g., prisms, filters) to address these impairments, treatments oftentimes central to successful participation in other therapy exercises (15).

Finally, Laboratory Medicine as a specialty provides an objective reference point for the "bio" of the biopsychosocial model beyond mere use of reported symptoms to offer quantitation of underlying physiologic dysfunction. Laboratory professionals are required to monitor an array of biomarkers disrupted by the injuries themselves, as well as their treatments. This includes checking inflammatory biomarkers (e.g., cytokines IL-6, TNF-α) that have been proven to be linked with chronic pain and

neuroinflammation, assessing endocrine function through the assessment of cortisol levels to identify the HPA-axis dysfunction present in PTSD and chronic stress conditions, and conducting complete metabolic panels to check for side effects of polypharmacy (21-23). Furthermore, emerging research is already in the process of discovering more precise markers for axonal injury and neuroinflammation (e.g., tau, NF-L) following TBI, which are promising to one day be used for prognostication, monitor treatment response, and guide rehabilitation interventions in a manner that cannot be achieved at present (24). Table 1 shows the core and expanded interprofessional team members and their roles in managing military chronic pain and TBI.

Table 1: Core and Expanded Interprofessional Team Members and Their Roles in Managing Military Chronic Pain and TBI

Profession	Primary Focus in BPSM	Key Interventions & Responsibilities
Physiotherapy	Biological (Physical)	Graded exercise, manual therapy, vestibular rehab, gait and balance training, and pain neuroscience education.
Psychology	Psychological	CBT for pain/insomnia, trauma-focused therapies (CPT, PE), neuropsychological testing, and coping skills training.
Nursing (Care Coordinator)	Social & Integration	Comprehensive assessment, patient education, care coordination, medication management, and continuity of care.
Dentistry (Orofacial)	Biological (Orofacial)	Diagnosis and management of TMD, bruxism, occlusal issues; fabrication of oral appliances.
Optometry (Neuro-)	Biological (Visual)	Diagnosis and treatment of post-TBI visual dysfunction (e.g., convergence insufficiency); vision therapy.
Laboratory Medicine	Biological (Biomarkers)	Monitoring inflammatory, endocrine, and metabolic biomarkers; supporting pharmacogenomic testing.
Physiatry	Biological (Overall)	Serves as a common team lead; directs overall rehabilitation strategy, manages spasticity, and administers injections.
Pharmacy	Biological (Pharmacological)	Manages complex medication regimens, reviews for interactions, and oversees opioid safety and tapering.

Evidence for Integrated Biopsychosocial and Interprofessional Care Programs

Evidence mounting for the efficacy of IPC models founded on the BPSM in military and veteran populations. These models have a few characteristics in common: interdisciplinary assessment, collaborative treatment planning, group education, and simultaneous delivery of multiple therapies.

Pain Management Programs

The Stepped Care Model of Pain Management by the VHA is an exemplary BPSM system-level application. This model refers patients to the appropriate level of care, from primary care management to specialized interdisciplinary pain teams (25). Interdisciplinary pain programs that include physical therapy, psychology, pharmacy, and medicine have been shown in research to produce important reductions in pain intensity, functional disability, and depressive symptoms and a reduction in opioid use in veterans compared to usual care (26, 27). These programs specifically target the psychological (e.g., fear-avoidance) and social (e.g., role functioning) factors that contribute to the continuation of the pain cycle.

TBI/Polytrauma Rehabilitation Programs

DoD and VHA have established a network of Polytrauma System of Care centers specific to IPC management of complex TBI patients, frequently accompanied by comorbid pain and psychiatric disorders. Research at these centers shows that intensive interdisciplinary rehabilitation leads to improvement in cognitive functioning, return to the community, and overall quality of life (28,29). How well the neurology, physiatry, neuropsychology, physical and occupational therapy, speech-language pathology, and the extended team members, like optometry and audiology, are coordinated determines the effectiveness of these programs (30).

New and Specialized Models

New models are being developed and trialed on an ongoing basis. The "Collaborative Care" model, in which a primary care physician is augmented by a care manager and psychiatric consultant, has proved beneficial in the treatment of depression and PTSD in primary care clinics, which occur together in TBI and chronic pain (31). Further, new telehealth and technology-based solutions are also being explored to extend beyond rural or geographically remote veterans with IPC to offer them equal access to the spectrum of expertise (32). Table 2 illustrates the exemplar Interprofessional Care Programs in Military and Veteran Healthcare

The Enabling Role of Policy: MoD and Veterans Affairs Systems

Effective implementation of IPC is not merely a clinical endeavor; it is also strongly determined by policy, finance, and organizational structure. The MoD and Veterans Affairs (or their counterparts globally) are the ultimate enablers or facilitators of integrated care.

Policy Directives and Strategic Frameworks

In the US, legislation such as CARA and the VA MISSION Act has pushed the VHA toward non-pharmacological, integrated pain care (34). Mandated congressional requirements have also pushed the DoD and VHA to create and maintain the Polytrauma System of Care. Top-down directives are needed for allocation of resources, uniformity in practice, and systems accountability for providing evidence-based, interprofessional care. Absent policy mandates of this type, IPC programs remain as stand-alone pilot projects vulnerable to budgetary cuts and lacking systemic support.

Table 2: Exemplar Interprofessional Care Programs in Military and Veteran Healthcare

Program/Model Name	Setting	Core Disciplines Involved	Documented Outcomes
Interdisciplinary Pain Rehabilitation Program	VHA Medical Centers	Physiatry, Psychology, Physical Therapy, Nursing, Pharmacy, Occupational Therapy	Reduced pain disability, decreased opioid use, improved mood and function, and higher rates of return to work (26, 27).
Polytrauma System of Care	DoD/VHA (Tiered Centers)	Neurology, Physiatry, Neuropsychology, PT/OT/SLP, Social Work, Optometry, Audiology	Improved cognitive and physical function, successful community reintegration, and enhanced quality of life for complex polytrauma patients (11,28).
STEADY (Service member Training and Evaluation to Avoid Disability)	Military Treatment Facilities	Primary Care, Psychology, Physical Therapy, Care Coordination	Proactive early intervention for musculoskeletal pain; shown to reduce disability and medical separation from service (33).
Collaborative Care for PTSD/Depression	Primary Care (VHA)	Primary Care Provider, Care Manager, Psychiatric Consultant	Improved symptoms of PTSD and depression, greater patient satisfaction, and more efficient use of mental health resources (31).

Financing and Reimbursement Arrangements

Fee-for-service payment systems, which reimburse for isolated visits and procedures, discourage the inherent time-intensive collaboration that defines IPC. Value-based purchasing and care episode bundled payments (like an integrated TBI rehabilitation package) align incentives for health systems to make investments in outcome-enhancing interdisciplinary teams with reduced long-term expenses (17). Policy must shift to compensate for the process of collaboration, rather than for the individual clinical encounters.

Shattering Systemic Barriers:

In spite of the intention in policy, still, powerful barriers still exist. Some of these include bureaucratic silos between the DoD (serving active duty) and the VHA (serving veterans) that lead to disruptive transitions and loss of continuity of care (35). Moreover, inconsistency of IPC model implementation between facilities, shortage of personnel in high-priority specialties like psychology and pain medicine, and lingering cultural stigma within the military itself remain pressing problems (13,36). Effective policy will have to bridge such gaps in implementation science to ensure evidence-based models are regularly and effectively implemented.

Gaps in the Literature and Future Directions:

While progress has been made, this scoping review finds many significant gaps in current research. First among them is a greater demand for randomized controlled trials comparing directly robust IPC

models with standard care for targeted subpopulations of military personnel, particularly those with the triple comorbidity of chronic pain, TBI, and PTSD. Second, the fiscal case for IPC needs to be stronger; more cost-benefit research is required to persuade policymakers of the long-term value of these resource-intensive programs (17). Third, research on the specific contribution made by the "expanded" team members---Dentistry, Optometry, and Laboratory---is just starting and requires more focused outcome research (24,37, 38).

It must provide for the formation and verification of standard screening tools to properly triage the patient to the appropriate level of IPC. Integration of new technologies, such as virtual reality for exposure therapy and motor rehabilitation or telehealth platforms for virtual visits, holds vast promise to improve access and compliance (39). Finally, additional emphasis on implementation science is needed to clarify the optimal strategies for embedding and sustaining these complex IPC models into the special cultural and bureaucratic context of the military healthcare systems.

Conclusion:

Chronic pain and TBI care in military and veteran populations is one of the most difficult problems of modern medicine. The situations are biopsychosocial in presentation and etiology and therefore need a therapeutic response equally multifaceted. The Biopsychosocial Model itself provides the theoretical framework, but it is through deliberate and proficient utilization of Interprofessional Care that this framework is actualized. As this review has demonstrated, productive IPC relies on the synergistic interaction of an interdisciplinary group of core professions—Physiotherapy, Psychology, and Nursing—aided by the special skills of Dentistry, Optometry, and Laboratory Medicine in order to address the complete spectrum of the service member's injuries. The evidence, although still emerging, strongly supports that an integrated approach yields superior outcomes in function, symptom reduction, and quality of life compared to fragmented, single-specialty treatment.

Last, it is the commitment of the MoD and Veterans Affairs bureaucracies themselves that makes such models viable and scalable. With visionary policy, funding prioritization, and a steadfast commitment to breaking through cultural and bureaucratic barriers, such institutions can ensure that those women and men who have paid the physical and psychological price of service receive the far-reaching, generous, and effective treatment they richly deserve. Implementing the biopsychosocial model in practice through interprofessional practice is not merely a clinical best practice; it's an ethical issue.

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النموذج البيولوجي النفسي الاجتماعي في الطب العسكري: مراجعة نطاقية لتفعيل الرعاية متعددة التخصصات للألم المزمن وإصابة الدماغ الرضحية

الملخص

الخلفية :يوفر السياق العسكري الحديث فئة سكانية فريدة من المرضى الذين يعانون من حالات معقدة ومتزامنة من الألم المزمن وإصابة الدماغ الرضحية .(TBI) هذه الحالات مقاومة للنماذج الطبية أحادية التخصص التي تميل إلى تعدد الأدوية، الرعاية المجزأة، والنتائج السيئة، مما يتطلب تحولًا نموذجيًا.

الهدف :تستعرض هذه المراجعة النطاقية تفعيل النموذج البيولوجي النفسي الاجتماعي (BPSM) من خلال الرعاية متعددة التخصصات (IPC) في الجنود والمحاربين القدامى الذين يعانون من الألم المزمن و/أو إصابة الدماغ الرضحية. وتأخذ في الاعتبار الأدوار متعددة الأوجه للتخصصات المختلفة والدور التيسيري لسياسات الدفاع والمحاربين القدامى.

الطرق :تم إجراء مراجعة نطاقية للأدبيات من 2015 إلى 2025 لرسم خريطة الأدلة الحالية والأطر المفاهيمية لنماذج الرعاية المتكاملة في هذه الفئة السكانية.

النتائج :تتطلب الرعاية متعددة التخصصات الفعالة، التي تنفذ النموذج البيولوجي النفسي الاجتماعي، ثلاثية مركزية - العلاج الطبيعي، علم النفس، والتمريض - مع تخصصات مساعدة مهمة مثل طب الأسنان (لألم الفموي الوجهي)، طب العيون (للعلاج البصري بعد إصابة الدماغ الرضحية)، والطب المختبري (لمراقبة العلامات الحيوية). يعتمد التنفيذ الفعال بشكل كبير على تأييد السياسات والتمويل من قبل هيئات مثل وزارة الدفاع وشؤون المحاربين القدامى للتغلب على العوائق النظامية.

الاستنتاج :التوفيق بين النموذج البيولوجي النفسي الاجتماعي والرعاية متعددة التخصصات ليس تحسينًا بل ضرورة لاستعادة الوظيفة وجودة الحياة لأفراد الخدمة والمحاربين القدامى. إنه معيار الرعاية لإدارة هذه الأمراض المزمنة المعقدة.

الكلمات المفتاحية :النموذج البيولوجي النفسي الاجتماعي، الرعاية متعددة التخصصات، الطب العسكري، الألم المزمن، إصابة الدماغ الرضحية