

Psychosis and diving

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Abstract

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Psychotic disorders, characterised by impaired reality testing and a spectrum of symptoms, present significant challenges in assessing fitness for diving. While diving can be a safe and rewarding activity, the unique physiological and environmental stresses of hyperbaric conditions can exacerbate psychotic vulnerability or mimic psychotic symptoms. This article reviews the literature on psychosis and diving, exploring the implications of psychotic disorders, psychotropic medications, and hyperbaric effects. It highlights the critical importance of illness insight, the absence of comorbid conditions, and complete remission in determining diving fitness. Key recommendations include avoiding deep dives, careful evaluation of medication use, and a nuanced differentiation between chronic and transient psychoses. By synthesizing existing evidence, this article aims to guide diving medicine professionals in making informed decisions about psychosis and diving suitability.

Introduction

Scuba diving combines physical endurance and mental resilience with unique environmental challenges, such as hyperbaric conditions and exposure to high-pressure gases. For individuals with psychotic disorders, these challenges may be compounded by the risks posed by altered cognition, impaired decision-making, and potential interactions between psychotropic medications and diving physiology.¹

According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, psychotic disorders are defined by abnormalities in one or more of the following domains: delusions, hallucinations, disorganised thought, disorganized behavior, and negative symptoms.² Rather than providing a rigid definition of psychosis itself, the DSM-5 emphasizes these key symptom domains, which can manifest in various psychiatric and medical conditions.

Psychosis is characterised by a loss of contact with reality, where reality testing is severely impaired, leading to a distorted perception of the external world. It involves a profound disruption in the processing of information, including perception and thought, resulting in erroneous conclusions about reality. While the presentation of psychosis varies between individuals, it may include positive symptoms such as delusions, hallucinations, and disorganized behavior, thought, and speech – and/or negative

symptoms, including emotional flattening, apathy, loss of pleasure and interest, and social withdrawal.

This review strives to assess the available evidence on psychosis and diving, addressing both clinical and practical considerations. It explores the interplay between psychotic vulnerability, medication, and hyperbaric conditions while providing a framework for assessing diving fitness. By offering evidence-based recommendations, this review aims to bridge the gap between psychiatric care and diving medicine, ensuring both safety and inclusivity for individuals with a history of psychosis.

Methods

The protocol for literature search strategies was prepared according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).³ A structured search of the literature was performed using PubMed up to 30 November 2024 to identify studies and case reports regarding diving and psychosis. A query involving diving and psychosis resulted in very few results, therefore, the keywords were expanded to include aviation and transportation by car. The search query was: ((diving[Mesh] OR dive[tw] OR diving[tw] OR divers[tw] OR hyperbaric[tw] OR scuba[tw]) OR (aviation[mesh] OR flying[tw] OR altitude[tw]) OR (driving[mesh] OR driv*[tw] OR traffic[tw])) AND ((psychosis[Mesh] OR psychosis[tw])). Additionally, several

handbooks on diving medicine that discussed psychiatry or psychology were screened for additional information.

Of the 1,314 potentially relevant studies, which were assessed by title and abstract, only nineteen deemed eligible for inclusion. The reference lists of these studies were also used to identify additional studies. After carefully reading these studies, a total of nine papers were included in the present review. More details can be found in Figure 1.

What is a psychosis?

Psychosis is the core symptom of a group of psychiatric disorders classified under the term schizophrenia spectrum disorders in the DSM-5.² Rather than a clearly defined condition, this represents a spectrum of disorders in which psychotic symptoms vary in severity, duration, and number. These symptoms can be viewed on a continuum ranging from 'normal functioning' to severe psychotic states.

The primary difference lies in the underlying cause and progression: while chronic psychosis often involves a persistent vulnerability to relapse, psychoses with a clear, identifiable cause may have a more favorable prognosis when the underlying issue is effectively addressed. However, future vulnerability cannot be ruled out entirely, as individual risk factors and recurrence patterns vary.

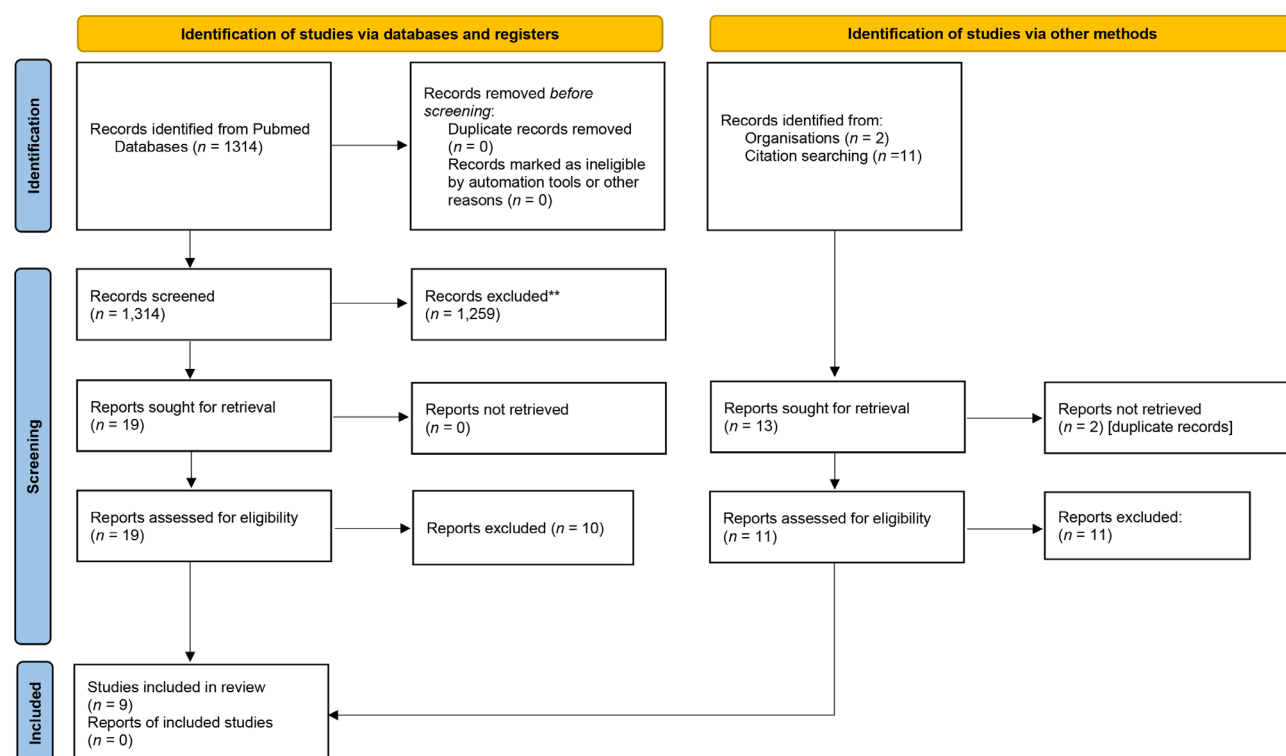
Several studies illustrate that psychoses with clear, identifiable causes, such as substance-induced psychosis, may have different trajectories compared to chronic psychotic disorders like schizophrenia.^{4,5} While some individuals may develop persistent symptoms, others may experience remission, especially when the underlying cause is addressed. This supports the notion that psychoses with identifiable causes can have a more favorable prognosis, though individual outcomes can vary.

Psychotic disorders arise from a complex interplay between genetic predisposition and environmental factors, such as childhood traumatic experiences. Overall, early childhood trauma appears to be a critical factor in the vulnerability to psychotic disorders, they can result in a heightened sensitivity of the stress response system, increasing vulnerability to stressors in later life.⁶

The underlying mechanism by which prior stress experiences lead to enduring psychotic vulnerability and heightened stress reactivity is referred to as sensitisation.⁷

Lifetime prevalence of psychotic disorders varies widely across studies. Across studies that use household-based survey samples, clinical diagnostic interviews, and medical records, estimates of the prevalence of schizophrenia and related psychotic disorders in the U.S. range between 0.25% and 0.64%.⁸⁻¹⁰ Estimates of the international prevalence of

Figure 1
PRISMA 2020 flow diagram for new systematic reviews which included searches of databases, registers and other sources



schizophrenia among non-institutionalised persons is 0.33% to 0.75%.^{11,12}

Fitness for driving and aviation

It is evident that naval aviators who have experienced psychiatric issues require thorough evaluation before being deemed fit to resume flight duties, in order to mitigate the risk of recurrence.¹³ In a review of five cases of naval aviators who developed psychiatric symptoms due to severe psychosocial stress, two individuals (without a definitive psychiatric diagnosis) were subsequently returned to unrestricted flight duties. The remaining three aviators discontinued aviation duties, with two diagnosed with brief reactive psychosis and one with bipolar disorder.

The literature on psychosis and driving reveals a nuanced picture. Collectively, the findings indicate that while individual evaluations are necessary, schizophrenia does not inherently make patients unfit to drive or pose a substantial risk to public safety.^{14–18}

Research consistently highlights that limitations such as medication dosage, age, and cognitive or psychomotor impairments must be considered when evaluating the driving capabilities of individuals with schizophrenia.^{15,16,19} Psychomotor impairments related to driving skills are prevalent in a significant subset of patients, and these deficits cannot always be attributed to psychopharmacological side effects.¹⁸

Even with stabilisation achieved through antipsychotic medication, a significant subset of individuals with schizophrenia may remain unfit to drive.²⁰

The influence of hyperbaric conditions

Nitrogen narcosis, a reversible alteration in consciousness caused by the anesthetic effects of gases at high partial pressures, typically occurs at depths greater than 30 metres (100 ft) or around 4 bar of ambient pressure. In rare cases, symptoms may emerge at shallower depths, such as 10 metres (33 ft). These effects resolve quickly upon ascending to a shallower depth and have no long-term consequences. When breathing air at depths of 90 metres (300 ft) – an ambient pressure of about 10 bar – narcosis in most divers leads to hallucinations, loss of memory, and unconsciousness.²¹

High-pressure nervous syndrome (HPNS) is a still not entirely understood neurological condition that affects divers exposed to extremely high pressures, typically during very deep dives below 150 metres (492 ft) while using mixed gases like helium-oxygen (heliox). HPNS results from the rapid compression of the nervous system under high pressures and is marked by symptoms that can range from mild to severe. It is characterised by neurological symptoms

(tremors, dizziness, and problems with coordination and balance), cognitive impairment, anxiety, confusion and hallucinations.

These hyperbaric effects illustrate how high pressure and gas interactions can significantly alter perception, mood, and cognition, sometimes mimicking features of psychosis. Just as nitrogen narcosis and HPNS can induce hallucinations, memory disturbances, and loss of control in divers, these conditions create profound disruptions in reality perception, similar to those seen in psychosis.

Experimental deep dives using various breathing mixtures have documented psychotic-like symptoms such as hallucinations, mood disturbances, agitation, and paranoia.²² These episodes are likely caused by a combination of factors, including increased partial pressures of inert gases (e.g., nitrogen or helium), hydrostatic pressure, psychological stress, and individual susceptibility. Such findings emphasise the complexity of hyperbaric environments and their potential to induce symptoms resembling psychosis.

While nitrogen narcosis and HPNS can induce transient alterations in perception and cognition in otherwise healthy individuals, it remains uncertain whether these conditions could precipitate or exacerbate psychosis in those with a predisposition. The combination of altered neurochemical states, high-pressure gas effects, and environmental stressors could theoretically increase the risk of psychotic decompensation in susceptible individuals. Additionally, a history of psychosis may heighten sensitivity to these hyperbaric stressors, potentially leading to more severe or prolonged psychiatric symptoms. However, direct evidence on this relationship is limited, and further research is needed to determine whether individuals with a history of psychosis are at increased risk for more severe forms of hyperbaric-related cognitive and perceptual disturbances.

We found only one case report in the period 1968–2024 that discusses two cases where divers presented with psychosis after diving.²³ The two cases were determined to be unrelated to decompression sickness (DCS) or other hyperbaric effects of diving. However, they may have been influenced by psychological stress associated with the diving experience itself. Both patients denied a history of psychiatric or neurologic illness. Based on the case description of the first patient and the psychiatric evaluation, a diagnosis of dissociative disorder due to a traumatic underwater event is more likely. The second patient was admitted to psychiatry due to ‘auditory hallucinations and abnormal behavior,’ and the discharge diagnosis was psychosis of uncertain cause.

Considerations in assessing fitness-to-dive

When assessing suitability for diving in individuals with psychotic vulnerability, we propose a model that evaluates functioning across the following domains.

1. SYMPTOMATIC STABILITY

Active psychosis, defined as a loss of contact with reality, is a contraindication for diving due to the significant risks it poses. A psychotic disorder is characterised by the presence of at least one psychotic symptom (delusions, hallucinations, disorganised speech, disorganised behavior, or catatonia), often accompanied by negative, cognitive symptoms or affective symptoms.

Individuals with psychosis often struggle to accurately assess their surroundings, respond effectively to emergencies, and make rational decisions – skills essential for safe diving. In the underwater environment, where clear and immediate judgment can mean the difference between life and death, these impairments pose significant risks.

Moreover, the effects of hyperbaric conditions and potential risks of narcosis may exacerbate symptoms, endangering both the diver and their buddy.

Studies estimate that 50–80% of individuals with schizophrenia lack insight into their illness.²⁴ Developing insight – a fundamental prerequisite for recognising illness – requires awareness of personal changes and acknowledgment of the disorder's presence. Understanding the nature of their condition and its impact on their life is crucial for effective treatment and prognosis. Limited illness insight can lead to poor treatment adherence, increased risk of relapse due to neglecting early warning signs, and impaired recovery by reducing engagement in rehabilitation and support programs.

We define symptomatic stability as the absence of relevant symptoms, intact reality testing, and, at most, mild residual symptoms. Additionally, it includes a history of only brief episodes, the ability to reliably predict relapse, good illness insight, awareness of the condition, and strong adherence to treatment. For individuals with a history of psychosis, achieving and maintaining symptomatic stability is a fundamental requirement for being considered fit to dive.

2. CHRONIC PSYCHOSIS OR PSYCHOSES WITH A SPECIFIC CAUSE

Psychosis often involves recurrent relapses, with up to 80% of first-episode patients relapsing within five years, and each episode heightening the risk of chronicity.^{25,26} When assessing fitness for diving, it is essential to differentiate between chronic psychosis, which typically involves prolonged vulnerability, defined as an increased risk for the development of psychosis later in life,²⁷ and psychoses with an identifiable underlying cause. If the cause of an affective or organic psychosis has been successfully treated and the individual is in complete remission for over one year, diving suitability may be considered. However, chronic psychosis, or psychotic vulnerability, often includes ongoing symptoms and impaired social or

occupational functioning, rendering diving unsuitable in these instances. It refers to an individual's predisposition to developing psychotic symptoms due to a combination of genetic, neurobiological, and environmental factors. Individuals with psychotic vulnerability may not necessarily experience psychosis under normal circumstances but could be at increased risk of an episode when exposed to certain triggers, such as psychological distress, sleep deprivation, substance use, or extreme environmental conditions including those encountered during diving. Given that fitness-to-dive assessments aim to predict and mitigate risks, understanding an individual's psychotic vulnerability is essential in evaluating their ability to safely participate in diving activities.

In the chronic stage, patients have experienced multiple relapses or have developed persistent psychosis. This stage is characterised by prolonged functional decline or severe, enduring illness with chronic symptoms and significant functional disabilities.²⁸

A chronic psychotic condition is a contraindication for diving. Recovery following a first-episode of psychosis, relapse, or recurrence requires a thorough psychiatric evaluation in conjunction with dive medical expertise to ensure safety and suitability for diving activities.

3. COGNITIVE AND PSYCHOMOTOR FUNCTIONING

Approximately 80% of individuals with primary psychotic disorders, including schizophrenia, schizophreniform disorder, schizoaffective disorder, and affective psychoses, experience clinically significant cognitive impairments.¹ These deficits often interfere with their capacity to carry out daily activities, sustain employment, and maintain social relationships. Key domains affected include attention, memory, and executive functioning, which are critical for adaptive functioning in everyday life. Neurocognitive impairments, particularly deficits in attention, processing speed, verbal memory, and executive functioning, may persist in a subset of patients with bipolar disorder.²⁹

Psychomotor slowing affecting up to 50% of individuals with schizophrenia, is characterised by reduced gait speed, decreased activity levels, and slower finger movements.³⁰ The assessment of cognitive and psychomotor functioning is based on observation, patient history, and, if applicable, supplemented by the adult self-report version of the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0),³¹ as well as recent neuropsychological and/or occupational therapy evaluations.

It is important to consider the phenomenon of sensitisation, whereby prior stress experiences may result in enduring psychotic vulnerability and heightened stress reactivity, emphasising the need for careful evaluation of an individual's stress tolerance and coping mechanisms.

Our expert recommendation is that individuals considered fit for diving should have no cognitive or psychomotor impairments, or at most, only mild limitations in these domains. Additionally, given the phenomenon of sensitization where prior stress experiences may lead to enduring psychotic vulnerability and heightened stress reactivity – it is crucial to carefully evaluate an individual's stress tolerance, coping mechanisms, and overall stability to ensure their safety and suitability for diving. As mentioned before in the section regarding daily functioning, adherence to the treatment plan is paramount.

4. COMORBIDITY

There is a high rate of comorbidity between post-traumatic stress disorder (PTSD), substance abuse, depression and psychosis, but also anxiety disorders are also commonly found in individuals with psychosis.^{32,33} The presence of comorbid conditions, such as PTSD, anxiety disorders, depression, or substance use disorders, significantly increases the risk of adverse outcomes in individuals with psychotic vulnerability.^{32,34} These conditions not only heighten baseline stress and arousal levels but also exacerbate the individual's sensitivity to stressors, including those encountered in the challenging underwater environment. Pre-dive training focusing on stress recognition, breathing techniques, and relaxation exercises can improve resilience under pressure and reduce the risk of panic or cognitive overload.

Comorbid conditions should be fully resolved or effectively managed, with no active symptoms or functional impairments. Psychological evaluations should specifically assess the individual's stress tolerance, arousal regulation, and coping capacity under simulated or anticipated diving conditions.

5. MEDICATION

Medication for psychosis, primarily antipsychotics, are designed to manage symptoms such as hallucinations, delusions, and disorganised thinking. While severe adverse effects are possible, most individuals tolerate these medications well and experience only mild side effects, such as drowsiness, dry mouth, or weight gain.³⁵ Commonly reported side effects include weight gain, sedation, drowsiness, and dry mouth; however, movement disorders, seizures, orthostatic hypotension, and disrupted blood glucose levels may also occur. Because psychotropic medications may heighten the risk of nitrogen narcosis or oxygen toxicity, limiting diving depth such as to 18 metres (60 ft) – is recommended to help prevent these effects.^{36,37} While narcosis symptoms typically become more pronounced at greater depths, Clarke notes that cognitive impairment can occur as shallow as 10–20 m (33–66 ft), with more severe symptoms emerging beyond 30m (99ft).³⁷ Given that narcosis symptoms may develop insidiously and compromise self-control at greater depths, a depth limit of 18 m (60 ft) serves as a precautionary measure to mitigate potential risks in individuals with psychotic vulnerability.

Diving on a low dose of antipsychotic medication, provided there are no side effects or additional cardiovascular risk factors, is generally considered safe.³⁸ While most individuals tolerate antipsychotics well, certain medications carry a higher risk of seizures, which can be fatal underwater. Clozapine, in particular, is incompatible with diving due to its significant seizure risk, and older antipsychotics such as chlorpromazine, promazine, thioridazine, and haloperidol may also increase seizure susceptibility.³⁸

Patients with affective psychosis may require mood stabilisers, particularly lithium, which is commonly prescribed for bipolar disorder. Diving while taking lithium requires careful consideration due to its potential risks.³⁸ However, other mood stabilisers are generally well-tolerated and not contraindicated for diving, provided general factors such as potential side effects are carefully evaluated.

Although diving on a low dose of antipsychotic medication, in the absence of significant side effects or additional cardiovascular risk factors, is generally considered safe, we recommend complete remission for over one year, no polypharmacy, and stable medication use for a period of at least one year.

6. DAILY FUNCTIONING

To prevent a psychotic relapse, early recognition and intervention are crucial, these are achievable only with consistent adherence to medication and commitment to therapy, insight and awareness of the condition. Prognosis is closely tied to these factors, with individuals demonstrating better adherence and self-awareness typically achieving greater stability. There are essential factors that impact recovery in individuals with long-term psychosis across three areas: clinical recovery, societal recovery, and personal recovery.^{39,40} Clinical recovery is linked to fewer negative symptoms, improved daily functioning, and enhanced societal and personal recovery. Societal recovery is supported by employment, a life partner, and better clinical outcomes, while personal recovery is associated with higher life satisfaction, fewer depressive symptoms, and clinical improvement.

Given the importance of adequate daily functioning, it is essential to consider that there should be no more than mild limitations in daily activities.

7. DEEP DIVING

Although the altered states caused by nitrogen narcosis and HPNS may mimic psychotic symptoms, narcosis is typically restricted to depths exceeding 30 metres (100 ft). For divers who avoid these depths, the likelihood of encountering such effects is minimal. Importantly, there's no evidence to suggest that a history of psychosis increases susceptibility to nitrogen narcosis. Narcosis results from physiological responses to high-pressure gases, independent of one's

psychological history, underscoring that while the effects may appear similar, the underlying causes are distinct.

Limitations and future research directions

While this article provides a comprehensive overview of psychosis and its implications for diving, it is important to acknowledge certain limitations:

- Many of the recommendations and assessments presented here are based on clinical expertise and professional judgment, rather than extensive empirical studies. This reflects the limited availability of robust data on psychosis in the context of diving medicine. Although expert guidelines offer valuable insights, they underscore the need for more evidence-based research to validate and refine these recommendations.
- While hyperbaric environments are known to influence cognition and mood, little research has explored whether repeated or prolonged exposure to high-pressure conditions could exacerbate psychotic vulnerability or trigger psychosis in predisposed individuals. Future longitudinal studies could investigate these potential risks.
- Modern antipsychotics and mood stabilisers are generally well-tolerated, but their interaction with hyperbaric conditions such as heightened risk of narcosis or oxygen toxicity remains under-researched. Investigating the pharmacological profiles of these medications in hyperbaric environments could refine guidelines for divers with psychiatric histories.
- Current assessments for diving fitness often generalise risk based on broad categories of psychotic disorders and medication use. However, individual factors such as genetic predisposition, stress resilience, and cognitive functioning may significantly influence outcomes. Research exploring these individualised risks could improve the precision of fitness evaluations.
- The rarity of documented cases linking psychosis and diving incidents limits the ability to draw definitive conclusions. Retrospective analyses and detailed case reports could shed light on patterns or triggers, helping to enhance safety protocols.

Conclusions

This article examines the relationship between psychosis and diving, providing an in-depth exploration of psychotic disorders, their implications under hyperbaric conditions, and guidelines for assessing diving fitness. This article serves as a guide for medical professionals to assess diving suitability in individuals with psychosis while highlighting the need for further research to refine and validate these recommendations.

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