

Adult attention-deficit/hyperactivity disorder prevalence among commercial divers in South Africa

Charles H Van Wijk^{1,2}, WA Jack Meintjes²

¹ Institute for Maritime Medicine, Simon's Town, South Africa

² Division of Health Systems and Public Health, Faculty of Medicine and Health Sciences, Stellenbosch University, Cape Town, South Africa

Corresponding author: Dr Charles H Van Wijk, PO Box 494, Simon's Town 7995, South Africa

chvanwijk@gmail.com

Key words

Epidemiology; Fitness to dive; Mental health; Occupational diving; Psychology

Abstract

(Van Wijk CH, Meintjes WAJ. Adult attention-deficit/hyperactivity disorder prevalence among commercial divers in South Africa. *Diving and Hyperbaric Medicine*. 2020 June 30;50(2):164–167. doi: 10.28920/dhm50.2.164-167. PMID: 32557419.)

Introduction: Adult attention-deficit/hyperactivity disorder (ADHD) is associated with increased chance of workplace accidents, psychiatric comorbidities, other risky behaviours and sophisticated psychopharmacological treatment. These factors all contribute to a potentially complex risk profile within the commercial diving context. In order to make informed decisions regarding ADHD and commercial diving, further description of this condition among commercial divers is required. This paper reports on a study that aimed to determine the prevalence of adult ADHD among commercial divers.

Methods: The study used a self-reporting survey-type questionnaire to determine likely diagnosis, based on *Diagnostic and Statistical Manual of Mental Disorders, 5th ed.* criteria, in a group of 245 commercial divers in South Africa.

Results: Fourteen cases (5.7% of the sample) met criteria for ADHD. The majority of the cases presented with combined type, and reflected mild forms of ADHD. Adult ADHD did not appear to occur in significantly different proportions across the biographical variables of age, education or diving qualification.

Conclusion: Based on this small survey, adult ADHD may be over-represented in commercial diving in South Africa, compared to general workplace populations. However, ADHD may not necessarily be a contra-indication to commercial diving.

Introduction

Adult attention-deficit/hyperactivity disorder (ADHD) is a condition characterised by a persistent pattern of inattention and/or hyperactivity-impulsivity that demonstrably interferes with social, academic and/or occupational functioning.¹ Established epidemiological reports for workplace samples suggest a prevalence of around 3.5% (1.2–7.3%, dependent on country) for ADHD among adults.^{2–3}

Prevalence of ADHD within the commercial diving community has not yet been established. Adult ADHD is of concern in the diving medical field as it may contribute to a more complex risk profile within the commercial diving context through a number of mechanisms. Firstly, the core symptoms of ADHD reflect challenges to self-regulation, which may compromise safety performance underwater, for example, through distractibility or impulsivity. Secondly, adult ADHD has been associated with significant functional impairment in the workplace, and with an increased risk of accidents and workplace injuries, with 2.0 relative-odds of workplace accidents-injuries calculated.^{2,4–7} Thirdly, comorbid disorders are common in adults with ADHD, with substance use, mood, and anxiety disorders most prominent, which may all

influence a diver's risk profile. This may require careful consideration of the effect of both the co-morbid conditions, as well as potential psychopharmacological treatment, on safety performance.^{1,8–13} ADHD is further associated with risky behaviours across multiple activity domains.¹⁴

Lastly, medical management of adult ADHD, often in the form of psychostimulants, raises concerns regarding neuropsychological performance under hyperbaric conditions. For example, hyperbaric conditions encountered during deeper diving are associated with central nervous system suppression as a result of hyperbaric nitrogen exposure, and although no direct data exist, it has been hypothesised that these conditions may render stimulant medication less effective. Very deep saturation divers may experience central nervous system stimulation (i.e., high-pressure neurological syndrome), which could also be hypothesised to change the effect of stimulant medication.¹⁵ Further, the use of stimulants may also pose an increased risk for oxygen toxicity when a diver is exposed to elevated partial pressures of oxygen, while drugs that cause sedation may have an increased effect under hyperbaric conditions.¹⁶

Expert opinion guidelines for ADHD in recreational diving have recently been published, and constitute a valuable

resource when considering risk among amateur divers.¹⁷ In order to make informed decisions to guide concerns regarding ADHD and commercial diving, further description of ADHD among commercial divers is required. This paper reports on a study that aimed to determine the prevalence of adult ADHD among commercial divers undertaking their diving medical examination in South Africa over a one-year period from May 2018.

Methods

The study was approved by the Health Research Ethics Committee of Stellenbosch University (#N18/03/039), and all participants provided written informed consent to partake in the study.

There is a legal requirement to capture all commercial diving medical examinations in South Africa within the online Southern African Undersea and Hyperbaric Medical Association (SAUHMA) database. Diving medical practitioners (DMPs) on the SAUHMA database were invited to participate and issue questionnaires to divers. Seven DMPs (of 37 active DMPs) provided questionnaires completed during annual diving medical examinations.

MEASUREMENTS

Adult ADHD was assessed using the self-report Adult ADHD Symptom Scale for DSM-5 (AASS-5). The AASS-5 consists of 21 items in question format which are formulated according to DSM-5 criteria A to D.^{1,3} The scale can be used to calculate a total ADHD score, as well as determine diagnostic cases based on current DSM-5 criteria. The scale is described in detail elsewhere.³ The nature of the questionnaire also allowed comparison to older data reported in terms of the World Health Organisation's (WHO) so-called Set-A criteria for ADHD, which uses a limited-symptom calculation to identify diagnostic cases.^{3,18}

DATA ANALYSIS

Prevalence figures were calculated as cases that met current DSM-5 criteria, expressed as percentage of the total sample. The same was done for cases that met the WHO's Set-A criteria, in order to compare with older population studies. Severity of ADHD could not be directly calculated, but could be indirectly inferred from response feedback analysis, and reported here as estimates. Associations with biographical categories were calculated using Chi-Square analyses.

Results

A total of 263 surveys (from 482 examinations) were returned from seven DMP practices, giving a 55% participant uptake for these practices and representing 11% of medical examinations (namely 2,307) performed in South Africa during this period. Of the 263 surveys returned, 18 were excluded from the final dataset (13 were incomplete, and

five constituted a second entry). The analysis below is based on 245 qualifying participants. The sample had a mean age of 33.1 years (SD 10.3). Twenty-nine participants were qualified as diving supervisors. Further sample composition information can be found in Table 1.

According to current DSM-5 criteria, 14 participants (5.7%; 95% CI 2.9%–8.5%) doing their diving medical examination in South Africa would qualify for a diagnosis of adult ADHD. Using the WHO Set-A criteria, five participants (2.0%; 95% CI 0.4%–3.7%) would qualify for an ADHD diagnosis. Most of the DSM-5 diagnosed cases presented with combined type (eight participants, 3.3%; 95% CI 1.2%–5.4%), with inattentive (four participants, 1.6%; 95% CI 0.1%–3.1%) and hyperactive/impulsive type (two participants, 0.8%; 95% CI 0%–1.9%) representing smaller segments. Severity estimates (according to total score interpretation) suggested that 11 participants (79%) reflected mild and two (14%) moderate forms of ADHD. One completed questionnaire may have reflected a slightly more severe expression of ADHD.

Analysis of the prevalence data showed that age had no significant effect on scores ($r = -0.016$, $P = 0.8$). Neither did ADHD appear to occur in statistically significant different proportions for language, education, or diving qualifications ($P > 0.3$ in all cases).

Discussion

For comparison, a general South African workplace sample recently reported a 3.3% prevalence rate of ADHD using DSM-5 criteria, while a South African Navy diver sample reported a 2.6% prevalence, using comparable methodologies.^{3,19} The reason for the apparent higher prevalence in this sample of 245 commercial divers is unclear. From a methodological perspective, sampling biases and the self-reporting nature of the data may have contributed to an over-representation of diagnostic cases in this sample. From a workplace context perspective it could be hypothesised that individuals with ADHD may be more likely to migrate to and remain in more practical-orientated occupations, such as diving. Alternatively, there may be a bias introduced within the diving industry, where divers are controlled by the supervisor and, therefore, are able to continue to function well, whereas they may not remain in other industries. Further, the positive cases in this sample likely reflected mild ADHD, which may be easier to accommodate in this occupational field.

It is postulated that the impact of ADHD in the commercial diver population may be small, since commercial diving activities are strictly controlled and regulated by the diving supervisor. This view is supported by a preliminary report suggesting that the rate of safety incidents in the highly controlled context of naval diving is not significantly higher among divers with ADHD than among those who do not meet diagnostic criteria.¹⁹ The safety impact may be more

Table 1

Prevalence of ADHD among commercial divers in South Africa, per biographical category, according to the World Health Organisation's Set-A, and Diagnostic and Statistical Manual of Mental Disorders (5th ed.) criteria. Class I = saturation diving; Class II = mixed gas and open bell diving; Class III = surface-supplied diving; Class IV = scuba diving. None = the examination was performed prior to a commercial diving course

Variable	Category	n	Set-A		DSM-5	
			n	%	n	%
Language	Afrikaans	142	4	2.8	8	5.6
	English	69	1	1.4	5	7.2
	Other	34	0	0	1	2.9
Education	< 12 years	75	0	0	2	2.7
	12 years	142	5	3.5	11	7.7
	> 12 years	13	0	0	1	7.7
	Unknown	15	0	0	0	0
Dive qualification	None	50	1	2.0	4	8.0
	Class I	11	1	9.1	1	9.1
	Class II	77	1	1.3	2	2.6
	Class III	99	2	2.0	6	6.1
	Class IV	8	0	0	1	12.5

pronounced in commercial diving supervisors diagnosed with ADHD, and this hypothesis could be explored in future studies. The present study was purely descriptive, and did not examine any possible impact of ADHD symptoms on diving safety performance or rates of accidents/incidents. Further work is required to explore potential associations between ADHD diagnosis and safety incidents while diving or supervising.

Adult ADHD continues to be of particular interest to DMPs in terms of assessing risk to diving safety. Theoretically at least, ADHD remains a risk factor for safe diving through mechanisms such as distractibility, impulsivity, or the effects of medical treatment. The established literature suggests a greater risk for workplace accidents associated with the diagnosis of ADHD.⁵ No such data are available yet from the commercial diving field. In this regard, the higher expression of ADHD in the current sample (relative to comparable general worker samples), as well as the suggestion of no significant increased risk for adverse safety events in naval diving, both discussed above, could be hypothesised to suggest small impact on diving performance, at least in cases of mild ADHD.

The study has a number of limitations. ADHD is always a clinical diagnosis, and the symptoms were self-reported. Although the rating scale has demonstrated positive predictive validity, caution needs to be exercised when interpreting subjective scale responses. From a methodological perspective, sampling biases and the self-reporting nature of the data may have contributed to an over-representation of diagnostic cases in this sample. Therefore, the extent to which results might be confidently extrapolated to the total commercial diving industry in South Africa, let

alone internationally, is unclear. Similar studies in other countries would be valuable.

Conclusions

Based on this small survey, adult ADHD may be over-represented in commercial diving in South Africa, compared to general workplace populations. However, ADHD is not necessarily a contra-indication to commercial diving. Diving medical practitioners may thus need to carefully consider the potential impact of ADHD – whether the initial condition, or its treatment – on safety performance when called to make fitness-to-dive determinations.

References

- 1 American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 5th ed. Arlington (VA): American Psychiatric Association; 2013.
- 2 de Graaf R, Kessler RC, Fayyad J, ten Have M, Alonso J, Angermeyer M, et al. The prevalence and effects of adult attention-deficit/hyperactivity disorder (ADHD) on the performance of workers: Results from the WHO world mental health survey initiative. *Occup Environ Med.* 2008;65:835–42. doi: 10.1136/oem.2007.038448. PMID: 18505771. PMCID: PMC2665789.
- 3 Van Wijk CH. Adult ADHD in the South African workplace: the usefulness of a self-report screening measure and preliminary prevalence estimates. *S Afr J Psychol.* 2019; Epub 2019 Aug 15. doi: 10.1177/0081246319870780.
- 4 Biederman J, Faraone SV, Spencer TJ, Mick E, Monuteaux MC, Aleardi M. Functional impairments in adults with self-reports of diagnosed ADHD: A controlled study of 1001 adults in the community. *J Clin Psychiatry.* 2006;67:524–40. doi: 10.4088/jcp.v67n0403. PMID: 16669717.
- 5 Kessler RC, Lane M, Stang PE, Van Brunt DL. The prevalence

- and workplace costs of adult attention deficit hyperactivity disorder in a large manufacturing firm. *Psychol Med.* 2009;39:137–47. doi: [10.1017/S0033291708003309](https://doi.org/10.1017/S0033291708003309). PMID: [18423074](https://pubmed.ncbi.nlm.nih.gov/18423074/).
- 6 Chang Z, Lichtenstein P, D’Onofrio BM, Sjölander A, Larsson H. Serious transport accidents in adults with attention-deficit/hyperactivity disorder and the effect of medication: A population-based study. *JAMA Psychiatry.* 2014;71:319–25. doi: [10.1001/jamapsychiatry.2013.4174](https://doi.org/10.1001/jamapsychiatry.2013.4174). PMID: [24477798](https://pubmed.ncbi.nlm.nih.gov/24477798/). PMCID: [PMC3949159](https://pubmed.ncbi.nlm.nih.gov/PMC3949159/).
 - 7 Küpper T, Haavik J, Drexler H, Ramos-Quiroga JA, Wermelskirchen D, Prutz C, et al. The negative impact of attention-deficit/hyperactivity disorder on occupational health in adults and adolescents. *Int Arch Occup Environ Health.* 2012;85:837–47. doi: [10.1007/s00420-012-0794-0](https://doi.org/10.1007/s00420-012-0794-0). PMID: [22752312](https://pubmed.ncbi.nlm.nih.gov/22752312/).
 - 8 Friedrichs B, Igl W, Larsson H, Larsson J-O. Coexisting psychiatric problems and stressful life events in adults with symptoms of ADHD – a large Swedish population-based study of twins. *J Atten Disord.* 2012;16:13–22. doi: [10.1177/1087054710376909](https://doi.org/10.1177/1087054710376909). PMID: [20686099](https://pubmed.ncbi.nlm.nih.gov/20686099/).
 - 9 Hesson J, Fowler K. Prevalence and correlates of self-reported ADD/ADHD in a large national sample of Canadian adults. *J Atten Disord.* 2018;22:191–200. doi: [10.1177/1087054715573992](https://doi.org/10.1177/1087054715573992). PMID: [25749874](https://pubmed.ncbi.nlm.nih.gov/25749874/).
 - 10 Fayyad J, de Graaf R, Kessler R, Alonso J, Angermeyer M, Demyttenaere K, et al. Cross-national prevalence and correlates of adult attention-deficit hyperactivity disorder. *Br J Psychiatry.* 2007;190:402–9. doi: [10.1192/bjp.bp.106.034389](https://doi.org/10.1192/bjp.bp.106.034389). PMID: [17470954](https://pubmed.ncbi.nlm.nih.gov/17470954/).
 - 11 Gjervan B, Torgersen T, Nordahl HM, Rasmussen K. Functional impairment and occupational outcome in adults with ADHD. *J Atten Disord.* 2012;16:544–52. doi: [10.1177/1087054711413074](https://doi.org/10.1177/1087054711413074). PMID: [21725028](https://pubmed.ncbi.nlm.nih.gov/21725028/).
 - 12 Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Arch Gen Psychiatry.* 2005;62:593–602. doi: [10.1001/archpsyc.62.6.593](https://doi.org/10.1001/archpsyc.62.6.593). PMID: [15939837](https://pubmed.ncbi.nlm.nih.gov/15939837/).
 - 13 McGough JJ, Smalley SL, McCracken JT, Yang M, Del’Homme M, Lynn DE, et al. Psychiatric comorbidity in adult attention deficit hyperactivity disorder: Findings from multiplex families. *Am J Psychiatry.* 2005;162:1621–7. doi: [10.1176/appi.ajp.162.9.1621](https://doi.org/10.1176/appi.ajp.162.9.1621). PMID: [16135620](https://pubmed.ncbi.nlm.nih.gov/16135620/).
 - 14 Shoham R, Sonuga-Barke E, Yaniv I, Pollak Y. ADHD is associated with a widespread pattern of risky behavior across activity domains. *J Atten Disord.* 2019;1087054719875786. doi: [10.1177/1087054719875786](https://doi.org/10.1177/1087054719875786). PMID: [31583930](https://pubmed.ncbi.nlm.nih.gov/31583930/).
 - 15 Lowry C. High-pressure neurological syndrome. In: Edmonds C, Lowry C, Pennefather J, Walker R, editors. *Diving and subaquatic medicine*, 4th ed. London: Hodder Arnold; 2005. p. 243–8.
 - 16 Manning EP. Central nervous system oxygen toxicity and hyperbaric oxygen seizures. *Aerospace Med Hum Perform.* 2016;87:477–86. doi: [10.3357/AMHP.4463.2016](https://doi.org/10.3357/AMHP.4463.2016). PMID: [27099087](https://pubmed.ncbi.nlm.nih.gov/27099087/).
 - 17 Querido AL, van Hulst RA. Diving and attention deficit hyperactivity disorder. *Diving Hyperb Med.* 2019;49:41–7. doi: [10.28920/dhm49.1.41-47](https://doi.org/10.28920/dhm49.1.41-47). PMID: [30856666](https://pubmed.ncbi.nlm.nih.gov/30856666/). PMCID: [PMC6526049](https://pubmed.ncbi.nlm.nih.gov/PMC6526049/).
 - 18 Kessler RC, Adler L, Ames M, Demler O, Faraone S, Hiripi E et al. The World Health Organization Adult ADHD Self-Report Scale (ASRS): A short screening scale for use in the general population. *Psychol Med.* 2005;35:245–56. doi: [10.1017/s0033291704002892](https://doi.org/10.1017/s0033291704002892). PMID: [15841682](https://pubmed.ncbi.nlm.nih.gov/15841682/).
 - 19 Van Wijk CH, Meintjes WAJ. Associations between adverse underwater events and ADHD diagnosis among military divers. *J Atten Disord.* 2019;1087054719864654. doi: [10.1177/1087054719864654](https://doi.org/10.1177/1087054719864654). PMID: [31319735](https://pubmed.ncbi.nlm.nih.gov/31319735/).

Conflicts of interest and funding: nil

Submitted: 05 November 2019

Accepted after revision: 24 February 2020

Copyright: This article is the copyright of the authors who grant *Diving and Hyperbaric Medicine* a non-exclusive licence to publish the article in electronic and other forms.