The impact of health on professional diver attrition

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Abstract
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Introduction: Approximately 77% of professional divers leave the industry within five years of entry for reasons that are uncertain. One possibility is that attrition is due to ill-health. The health of New Zealand occupational divers is surveyed by a comprehensive medical examination every five years and by a health questionnaire in the intervening years. Divers are thereby confirmed 'fit' annually. The aim of this study was to determine if divers quit the industry due to a health problem not identified by this health surveillance system.
Method: 601 divers who had left the industry within five years of entry medical examination ('quitters') were identified from a computerised database. One hundred and thirty-six who could be contacted were questioned about their principal reason for quitting. Comparison was made between the health data of all those defined as 'quitters' and a group of 436 'stayers' who have remained active in the industry for over 10 years.
Results: Health was the principal reason for abandoning a diving career for only 2.9% of quitters. The overwhelming majority (97.1%) quit because of dissatisfaction with aspects of the work, such as remuneration and reliability of employment. Besides gender, the only significant difference between the health data of quitters and stayers was that smoking was four times more prevalent among quitters.
Conclusions: The key determinant of early attrition from the New Zealand professional diver workforce is industry-related rather than health-related. The current New Zealand diver health surveillance system detects the medical problems that cause divers to quit the industry.

Introduction

The impact of diving on health has been extensively investigated, but not the impact of health on diving. The registered professional diver workforce in New Zealand has remained relatively stable numerically, at approximately one thousand divers, for many years. However, a previous study of this group showed that over a five-year period there was an attrition rate of 77%, suggesting considerable flux, with the number of newly registered divers roughly matching those either retiring or leaving the profession to pursue other employment.[1] There are many possible explanations for such a high rate of attrition, but of primary interest, and the focus of the present study is whether health-related issues play a significant role in a diver's decision to leave the profession.

Diving is undeniably hazardous, with workers at risk of potentially catastrophic accidents, and also the possibility of long-term adverse health effects. Anxiety about such outcomes may be one of the drivers of the reported high attrition rate. However, many studies have reported minimal long-term adverse health effects, even in relation to respiratory and auditory function, both commonly believed to be the most likely targets for damage.[2–7] One of the limitations of such studies is a possible sampling bias caused by the lack of data from divers who are no longer working, and who may have left the industry for health reasons, leading to erroneous conclusions due to a 'healthy worker effect' of unknown magnitude. However, in New Zealand, where occupational diver health is monitored by a comprehensive medical examination every five years and by a health questionnaire in intervening years, very few divers are found to have a health condition that disqualifies them from occupational diving.[1,8] One could conclude that almost all who leave the industry do so for reasons unknown because of a lack of relevant data. However, there remains the possibility that diver attrition may be due to health issues that the health surveillance system is failing to detect.

The current study aims to establish the significance of health issues as a determinant of departure from the professional diver workforce, and to check that the current New Zealand

diver health surveillance system is not failing to detect medical problems that cause divers to quit the industry.

Method

Ethical approval for this study was granted by the Health and Disability Ethics Committee (HDEC), approval number 18/CEN/180. Professional divers were identified from a computerised database and categorised as either 'quitters' (with no derogatory implication intended) or 'stayers'. Quitters were defined as those who had remained registered for fewer than five years and had not re-registered in the last five years, while stayers were defined as current divers who have remained registered for 10 years or longer.

Quitters with a recorded email address were surveyed by asking them to complete a simple questionnaire designed to clarify whether or not they were still working as a diver (perhaps overseas), and if not, what type of diving they had been engaged in when they left, and, most importantly, whether they had quit diving for health reasons. Because of difficulties establishing communication with ex-divers, additional avenues of contact were attempted, namely by telephone and by social media (Facebook®). To give an indication of a desirable sample size, a power analysis based on a notional response distribution of 10% quitting for health reasons (agreed *a priori* based on clinician-author experience) demonstrated that a sample of 113 quitter-divers would be required to complete the survey, with a 5% margin of error, a 95% confidence limit (95% CL) and a total population of quitter-divers of 600. Any who reported that they were now employed as divers registered in another country were excluded from further analysis. The remaining group of respondents was compared with the group of non-respondent quitters to test for group homogeneity with the understanding that the non-respondents would also include an unknown number still working elsewhere as divers.

Any record of a health-related issue disclosed in initial or subsequent dive medical assessments was noted, and these results together with the category of occupational diving and other demographic data were compared between quitters and stayers.

Statistical analysis was performed using SAS® v9.4 software (SAS Institute Inc., Cary, North Carolina, USA). Frequency and proportion (%) were used for describing categorical variables, such as gender, smoking status and type of diving. Median with minimum and maximum were used to describe the continuous variables, such as years registered and body mass index (BMI), as they did not follow a normal distribution, whilst 95% confidence limits (CL) were estimated for the reported proportions quitting for health reasons and for those with a recorded history of a health condition. Comparisons were made between the quitter group and the stayer group, and between responder and non-responder groups. The Chi-squared test (and Fisher's exact test if suitable) and the Wilcoxon rank-sum test were used for categorical and continuous variables respectively. A P-value of < 0.05 was considered to be statistically significant.

Results

622 divers were identified as 'quitters' and 436 as 'stayers'. Quitters remained registered for a median of one year (range 1–5 years), compared with 14 years (range 10–25 years) for stayers. Record of either an email address or telephone number was available for 364 quitters, but many were either incorrect or no longer active. There were 53 responses to email, a further 67 to telephone calls and 37 to Facebook® contact, giving a total of 157 responses (response rate 25.2%). Twenty-one respondents (13.4%) were still active divers, but were registered and working in countries other than New Zealand. These divers were excluded from our analysis of health reasons for leaving the divers' register, and also from comparison of quitters with stayers, leaving a total of 601 quitters and 136 quitter-responders.

Of the quitter responders, four claimed that they had stopped diving because of a health issue (2.9% of responses, 95% CL = 0.8%, 7.4%). Two were aquaculture workers, one was a construction worker and one was a recreational diving instructor. The specific health reason was described as a sinus problem in all four cases. The most common reason for quitting (97% of responses) was simply to provide a change in job/life direction, usually prompted by dissatisfaction with aspects of professional diving, such as poor remuneration and lack of consistency of employment. A similar proportion of quitters (11.1%, 95% CL = 8.7%, 13.9%) and stayers (11.0%, 95% CL = 8.2%, 14.3%) had a recorded medical condition (most commonly obesity or abnormal hearing or lung function requiring regular surveillance), but none of the four who quit for health reasons had any notable medical condition (including the sinus problems that resulted in quitting) recorded from their health questionnaire or initial medical examination.

For all divers, smoking was almost four times more common in quitters than stayers (18.6% vs 5.3%) (Table 2). The proportion of scientific divers who were current smokers was consistently low in both groups (1.6%), while the proportion of instructors and commercial divers who were current smokers was significantly higher in the quitter than the stayer group (17.7% vs 3.9%, and 31.2% vs 4.7% respectively). This smoking association was particularly pronounced for commercial divers, who represented a similar proportion in both quitter and stayer groups (23.0% vs 19.7%), but the proportion who smoked decreased six-fold in the stayer group.

Quitters were almost twice as likely as stayers to be female (20.6% vs 11.2%) and also more than twice as likely to be an instructor (38.4% vs 17.4%). In fact, 53.2% of females who quit and 26.5% who stayed, were instructors. Quitters were significantly less likely to be a scientific diver. These

Table 1

Comparison of characteristics of New Zealand professional divers who have either quit diving within five years of starting (quitters) or continued diving for > 10 years (stayers); * values were taken from the most recent medical examination and are presented as median (and range) where not expressed as a percentage; percentages are rounded to nearest whole number; *n* (%) for all variables except where stated otherwise; ** 'Reason for leaving' values are not applicable for 'stayers' and not available for 'all quitters' (N/A)

Characteristics	**All quitters** (*n* = 601)		**Quitter responders** (*n* = 136)		**Stayers** (*n* = 436)	
Male/female ratio (%)	477/124	(79/21)	108/28	(79/21)	387/49	(89/11)
Height [cm (range)]*	177	(152–200)	178	(152–200)	178	(154–204)
Weight [kg (range)]*	81	(47–153)	83	(52–145)	85	(48–150)
BMI [$kg \cdot m^{-2}$ (range)]*	26	(18–51)	26	(18–41)	27	(19–42)
Age at last medical [years (range)]*	29	(16–62)	28	(16–56)	43	(23–72)
Years registered [years (range)]	1	(1–5)	1	(1–5)	14	(10–25)
Non-smoker	326	(54)	83	(61)	317	(73)
Ex-smoker	163	(27)	35	(26)	96	(22)
Current smoker	112	(19)	18	(13)	23	(5)
Medical issue on record	67	(11)	17	(12)	48	(11)
Type of diving						
Instructor	231	(39)	54	(40)	76	(17)
Commercial	138	(23)	15	(11)	86	(20)
Scientific	65	(11)	16	(12)	126	(29)
Aquaculture	49	(8)	16	(12)	24	(6)
Military/Police/Customs	53	(9)	26	(19)	56	(13)
Construction	41	(7)	3	(2)	55	(13)
HBU attendant	12	(2)	5	(4)	4	(1)
Film	12	(2)	1	(< 1)	9	(2)
Medical issue on record	67	(11)	17	(12)	48	(11)
Reason for leaving**						
Dissatisfaction	N/A		132	(97)	N/A	
Health	N/A		4	(3)	N/A	

results are summarised in Tables 1 and 2. Comparison of the responder and non-responder groups showed no significant differences apart from the proportions of the various diver sub-groups.

Discussion

The impact of health status on the attrition rate of professional divers was investigated by identifying and surveying a group of divers who left the industry within five years of joining.

Table 2
Prevalence of smoking amongst the principal categories of New Zealand professional divers who have either quit diving within five years of starting (quitters) or continued diving for > 10 years (stayers); number (%) are shown; * $P < 0.0001$

Diver Category	**Quitters** (n = 601)		**Stayers** (n = 436)	
Scientific	1 (1.6)	(n = 65)	2 (1.6)	(n = 126)
Instructor	41 (17.7)	(n = 231)	3 (3.9)	(n = 76)
Commercial	43 (31.2)	(n = 138)	4 (4.7)	(n = 86)
Aquaculture	15 (30.6)	(n = 49)	3 (12.5)	(n = 24)
Military/Police/Customs	4 (7.5)	(n = 53)	5 (8.9)	(n = 56)
Construction	7 (17.1)	(n = 41)	6 (10.9)	(n = 55)
All*	112 (18.6)		23 (5.3)	

The reasons given for leaving were almost entirely related to the diving work environment, such as dissatisfaction with aspects of the job or just wanting a change in career, rather than anything to do with health. This finding will not surprise clinicians who have experience working with professional divers, but the purpose of the study was to quantify the impact of health on diver attrition, and we are not aware of any previous studies that address this issue.

The finding that only 2.9% of responding professional divers leave the industry for health reasons undetected during formal health surveillance provides strong support for the integrity of the current system of health surveillance for this group of workers. This is particularly so since in every case the undetected medical problem responsible for the divers' decisions to leave the industry was highly unlikely to result in a life or limb-threatening event. In contrast, a high percentage quitting for undetected health reasons, particularly health problems with significant implications for diver safety, would have suggested an inadequate surveillance process and an unacceptably high false negative rate (if we define 'negative' as absence of health-related findings that would preclude safe diving).

These results are relevant to the many previous studies investigating the converse issue, the impact of diving on health, which could be criticised for sampling bias due to the omission of data from ex-divers. Our findings suggest that a 'healthy worker effect' is unlikely to have a significant impact on the validity of such studies of working divers, especially in relation to the possibility that serious diving-induced health problems might be significantly over-represented among divers who have left the industry. Although there might be potential for diving to have exacerbated the condition in the four divers we found who ceased diving because of sinus problems, it is more likely that diving unmasked a chronic predisposition to such problems.

The reasons for recreational diving instructors being more likely to quit than any other category of diver are speculative, but we suggest that instructors may, in general, be a more itinerant group, perhaps comprising those who consider instructing as a short-term, interim or secondary occupation. Work as an instructor may also be less consistent and more seasonal than some of the more 'stable' diving careers such as scientific, construction or military diving. We also noted a correlation between smoking and quitting diving, such that smokers were more likely to quit diving, and, as a corollary, non-smokers were far more common amongst stayers than quitters (72.7% vs 54.2% respectively). The proportion of instructors in the quitter group was more than twice that in the stayer group, and the proportion of instructors who smoked in the quitter group was more than four times that in the stayer group.

The six-fold decrease in the proportion of commercial divers who smoked in the stayer group compared to the quitters might be explained simply on the basis of age. The median age of the stayer group was 15 years older than the quitter group, but although smoking prevalence rates in the general population decrease with age, the large difference we found between quitters and stayers emphasised a stayers' smoking prevalence rate significantly lower than the age-related New Zealand and international population norms.[9,10] The quitters who responded to this survey were not asked their current smoking status, but further research could resolve the question of whether diving may act as a motivation to quit smoking, or conversely, that smoking possibly contributes to a departure from diving. If the former were true, however, we would have expected to find a higher proportion of ex-smokers in the stayers group.

LIMITATIONS

Firstly, the study surveyed only those divers who quit early in their career, whereas there are likely to be some who leave for health reasons after a career spanning longer than five

years. We agree that research including the more experienced group would be worthwhile, but note that a high rate of attrition has been reported in the first five years of the divers' careers. In addition, the results of many previous studies of the long-term health effects of diving suggest that clinically evident diving-related health reasons for quitting are very unlikely.[2–7] That said, one must accept that lack of a diving-related health reason for quitting diving does not necessarily exclude the possibility of delayed development of a diving-related clinical condition (e.g., dysbaric osteonecrosis).

Secondly, these results are not necessarily generalisable to populations of professional divers in other countries. The characteristics, including health status, of professional divers may vary depending on local certification and health surveillance protocols. Therefore, it is conceded that early career attrition rates probably vary internationally.

Thirdly, we found that 13% of the group of quitter-responders were, in fact, working as divers, but registered in other countries. Therefore, it is possible that a similar proportion of the quitter-non-responders were also still active divers. Our inability to determine this number reduces the accuracy of our comparison of quitter-responder and non-responder groups. Nevertheless, this had no effect on the primary outcome of the study, the influence of health status on the decision to quit diving.

Finally, as there was a relatively low quitter response rate, despite our employment of three methods to contact the ex-divers, we accept the possibility of a non-response bias. It could be argued that there might be a higher rate of leaving for health reasons among the non-responders. On the other hand, our reported response rate of 25.2% should be considered conservative, as the majority of non-responders were unable to be contacted and so had no opportunity to respond. However, the fact that there was not a single report of a diver quitting because of a clearly diving-related health condition suggests that health status is a minimal contributor to the professional diver attrition rate.

Conclusions

Diving-related health reasons are of minimal significance in determining attrition rates of professional divers. The low rate of health-related attrition from the professional diver workforce supports the integrity of the current diver health surveillance system. Conclusions drawn from studies of the health effects of diving on working divers are unlikely to be significantly affected by the absence of those who have left the industry.

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Conflicts of interest

Simon Mitchell is the Editor of *Diving and Hyperbaric Medicine*. He had absolutely no involvement in the peer-review and decision-making processes for this paper, which were managed entirely by the Associate Editor, Associate Professor F Michael Davis.

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