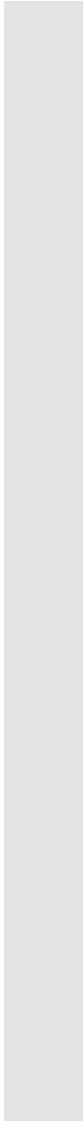


Treatment Outcome of Decompression Illness Patients in Thailand

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Agenda

- I. Background and Rationale
- II. Research Question and Objectives
- III. Methodology
- IV. Results & Discussion
- V. Conclusion
- VI. Benefits and Application



Background and Rationale

Background and Rationale

- Thailand situated in between 2 bodies of water (Gulf of Thailand/Andaman Sea).
- Tourism is Thailand's major source of income and one popular activity amongst tourist is SCUBA diving.
- There are multiple diving practices in Thailand other than Recreational diving consisting of: Military diving, Scientific diving, Traditional diving and etc.



Background and Rationale

- Diving poses risk to injuries and fatalities. One of the most significant diving disease is Decompression Illness. Diver's Alert Network (DAN) conducts annual reports, in the 2020 report a total of 6-10 fatalities per year in Thailand was observed.
- Previous studies in Thailand reported 453 cases of DCI from 2001-2005, and a more recent study reported 97 cases of DCI in one single center in Bangkok.



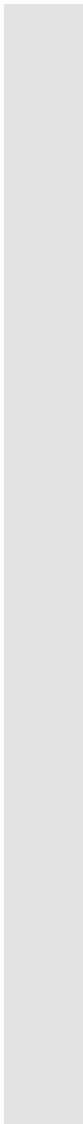
Research Question and Objectives

Research Question

“What are the major contributing factors impacting treatment outcomes of decompression illness patients, who have received recompression treatments in Thailand?”

Objectives

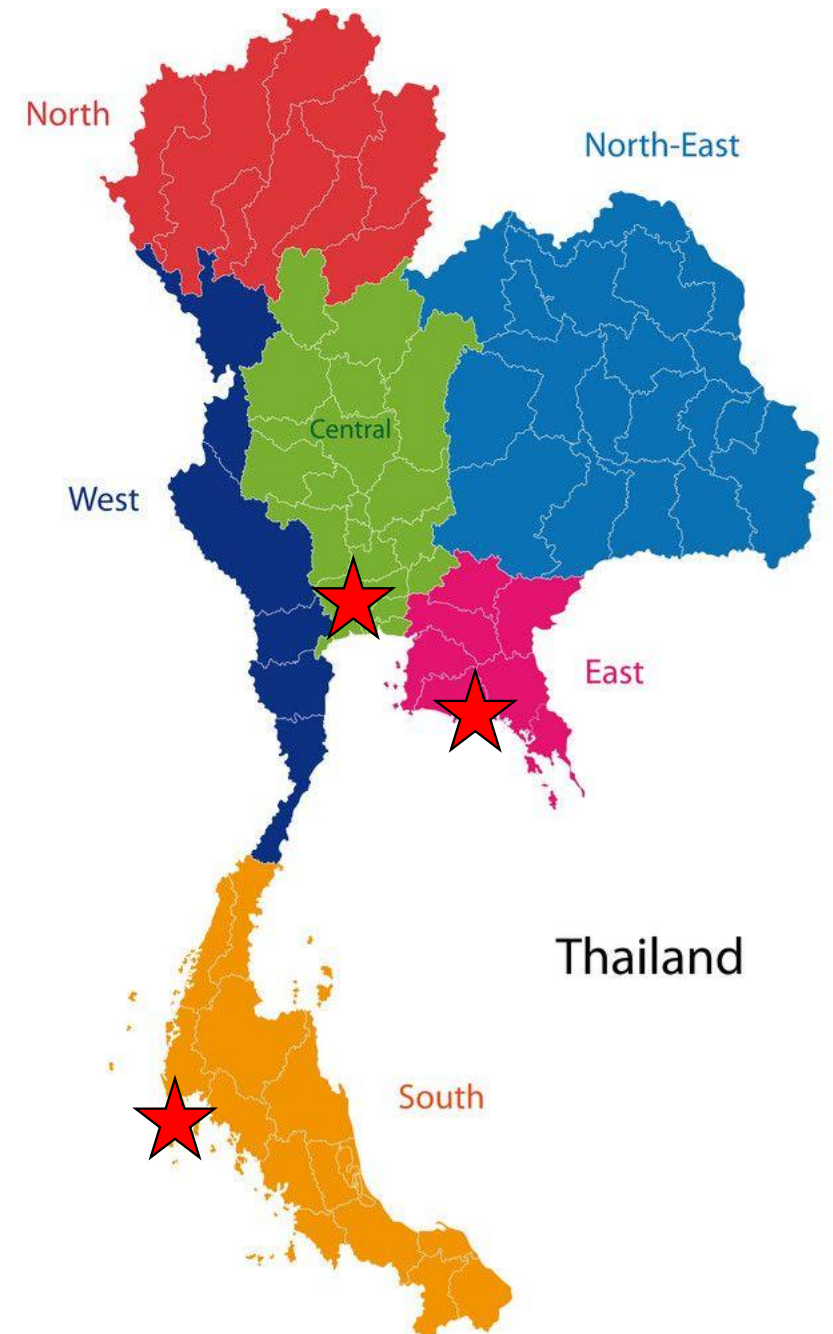
1. To study the presenting symptoms and its association with treatment outcomes
2. To study the importance of first aid oxygen, and its impact on treatment outcomes.
3. To explore the time of onset and time to treatment of patients with DCI



Methodology

Study Design

- Retrospective Descriptive Study
- Study period January 2020 to December 2023



Study Population

- Patients that had received hyperbaric oxygen treatment with the diagnosis of “Decompression Illness” in Thailand
- Inclusion Criteria = Patients diagnosed with DCI who received recompression treatments at hyperbaric facilities in Thailand
- Exclusion Criteria = Patients whom received treatments at multiple centers for the same incident, Patients with a change of diagnosis after initial diagnosis, missing data from medical records.



Results & Discussion

Results

	n	%
Gender		
Male	103	57.9
Female	75	42.1
Age		
Mean ± SD	37.46±10.41	
Range	16-64	

	n	%
Ethnicity		
Asian	159	89.3
European	13	7.3
North American	4	2.2
Australasia/Oceania	1	0.6
Middle Eastern	1	0.6
Underlying Condition		
No	151	84.8
Yes	27	15.2
Diving Purpose		
Recreational	117	65.7
Occupational	15	8.4
Traditional	45	25.3
Military	1	0.6
Certification Level		
CMAS 1-2	100	56.2
CMAS 3	22	12.4
Uncertified	56	31.5
High-flow First Aid O2		
Yes	141	81.5
No	32	18.5

Results

	Complete Resolution			Incomplete Resolution			p-value
	Count	Row N %	Column N %	Count	Row N %	Column N %	
<u>Demographic</u>							
Gender							0.535
Male	74	71.8	56.5	29	28.2	61.7	
Female	57	76	43.5	18	24	38.3	
Diving Purpose							0.036*
Recreational	91	77.8	69.5	26	22.2	55.3	
Occupational	13	86.7	9.9	2	13.3	4.3	
Traditional	26	57.8	19.8	19	42.2	40.4	
Military	1	100	0.8	0	0	0	
<u>Diving factors</u>							
Multilevel Diving							0.105
No	71	78.9	54.2	19	21.1	40.4	
Yes	60	68.2	45.8	28	31.8	59.6	
Missed Safety Stop							0.008*
No	85	81	64.9	20	19	42.6	
Yes	46	63	35.1	27	37	57.4	
Flying after diving							0.116
No	115	76.2	87.8	36	23.8	78.3	
Yes	16	61.5	12.2	10	38.5	21.7	
Rapid Ascent							0.218
No	106	75.7	80.9	34	24.3	72.3	
Yes	25	65.8	19.1	13	34.2	27.7	

Results

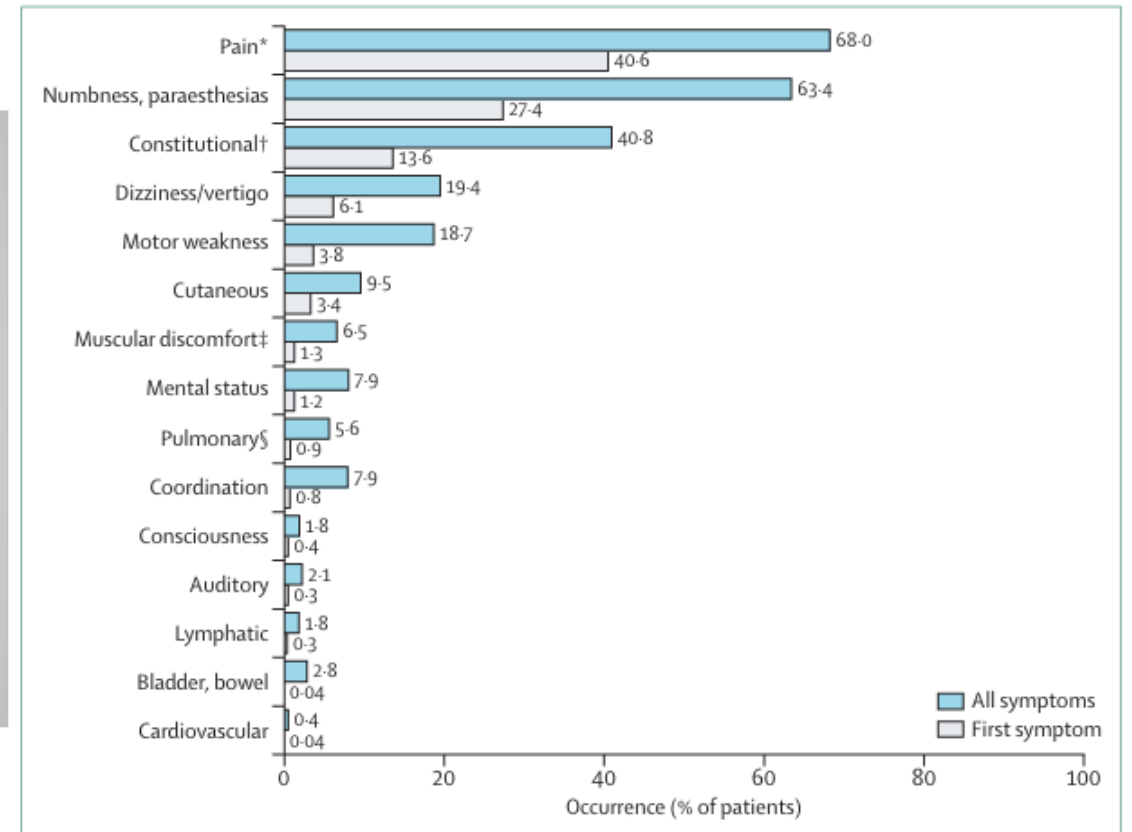
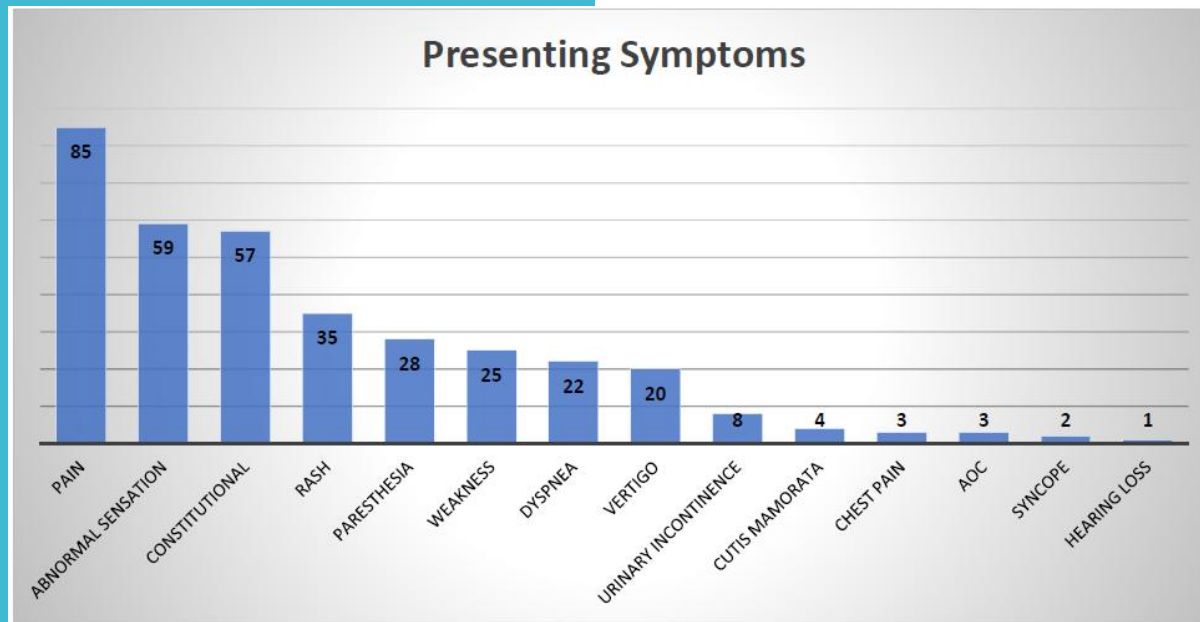
<u>Affected organ</u>							
Inner Ear							0.784
No	129	73.7	98.5	46	26.3	97.9	
Yes	2	66.7	1.5	1	33.3	2.1	
Cardiopulmonary							0.949
No	128	73.6	97.7	46	26.4	97.9	
Yes	3	75	2.3	1	25	2.1	
Spinal Cord							<0.001*
No	126	80.8	96.2	30	19.2	63.8	
Yes	5	22.7	3.8	17	77.3	36.2	
Skin							0.208
No	100	71.4	76.3	40	28.6	85.1	
Yes	31	81.6	23.7	7	18.4	14.9	
CNS							0.035*
No	68	81	51.9	16	19	34	
Yes	63	67	48.1	31	33	66	
Musculoskeletal							0.066
No	80	69.6	61.1	35	30.4	76.1	
Yes	51	82.3	38.9	11	17.7	23.9	

Results

	Complete Outcome		Incomplete Outcome		p-value	Unadjusted	95%CI	p-value	Adjusted	95%CI
	Count	Row N %	Count	Row N %		Odds ratio			Odds ratio	
Diving_Purpose										
Recreational	91	77.8	26	22.2	0.434	1.857	0.394-8.760			
Occupational	13	86.7	2	13.3		1				
Traditional	26	57.8	19	42.2	0.057	4.750	0.957-23.572			
Military	1	100	0	0						
Time_of_Onset_gr										
< 8 hr	105	76.6	32	23.4	0.409	0.410	0.049-3.404			
8-19 hr	8	88.9	1	11.1		1				
17-24 hr	12	66.7	6	33.3	0.359	1.641	0.570-4.721			
>24 hr	4	33.3	8	66.7	0.004*	6.563	1.854-23.224			
Multilevel_Diving										
No	71	78.9	19	21.1		1				
Yes	60	68.2	28	31.8	0.107	1.744	0.887-3.430	0.621	1.215	0.561-2.634
Missed_Safety_Stop										
No	85	81	20	19		1				
Yes	46	63	27	37	0.008*	2.495	1.263-4.926	0.062	2.208	0.962-5.069
Rapid_Ascent										
No	106	75.7	34	24.3		1				
Yes	25	65.8	13	34.2	0.221	1.621	0.748-3.514	0.819	1.105	0.469-2.606

Discussion

- During the study period where COVID-19 halted tourism causing a resurgence in traditional diving
- Present symptoms were consistent with multiple previous studies, but affected organs on diagnosis were inconsistent.



Affected Organ

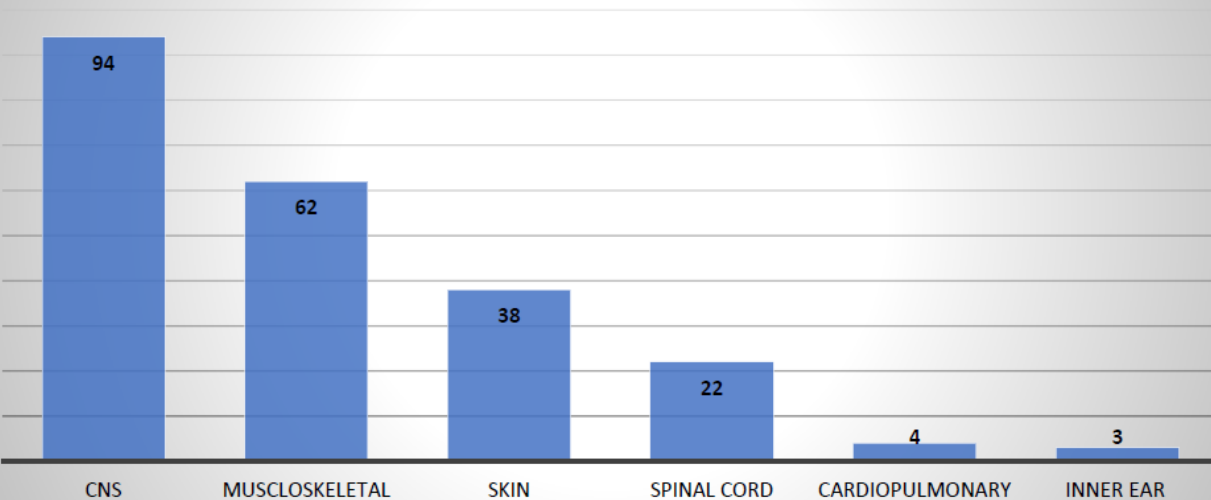


Table 1. Clinical Manifestations of Decompression Sickness (DCS) According to Organ System.*

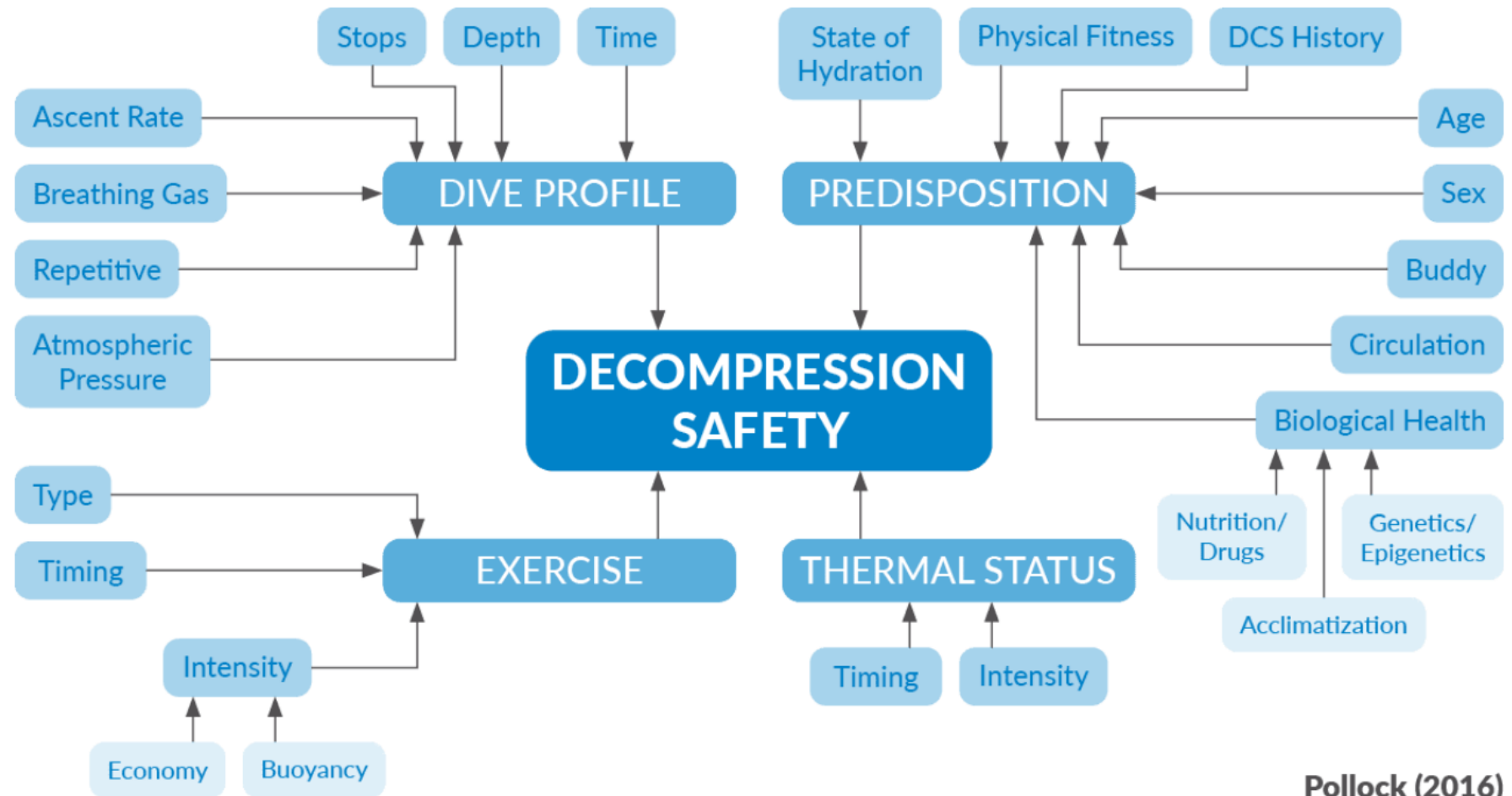
Affected Organ System and Manifestations	% of DCS Cases	Description
Musculoskeletal: pain	50–65	Often described as a deep, boring ache in shoulder, elbow, hip, or knee area, unaffected by joint movement, usually without local tenderness; may be multifocal and poorly localized
Cutaneous		
Rash and itch	5–10	An erythematous, poorly demarcated patch, often itchy, or a more clearly circumscribed, reticular rash with cyanotic discoloration (cutis marmorata or livedo racemosa); usually a truncal or proximal distribution
Patchy paresthesia	40–50	Nondermatomal distribution; often described as tingling
Lymphatic: subcutaneous swelling	1–5	Truncal distribution, similar to that of rash, particularly involving upper chest and shoulders
Spinal cord		
Motor weakness	20–25	Typically, paraplegia or quadriplegia with upper motor neuron signs; severity ranges from subtle to dense
Numbness or dense paresthesia	20–30	Dorsal columns appear to be vulnerable; proprioception may be affected
Bladder and sphincter dystonia	1	Bladder also becomes insensate; urinary retention
Girdle, chest, back, or abdominal pain	1–5	Typically, a premonitory symptom that precedes other spinal symptoms
Inner ear		
Vestibular: vertigo, ataxia	10–20	Usually accompanied by nausea and nystagmus; 75% of inner ear DCS cases have no other symptoms
Cochlear: hearing loss, tinnitus	1–5	Cochlear manifestations are less common than vestibular manifestations in DCS
Brain (cerebral): cognitive impairment, scotomata, visual field changes, focal weakness, ataxia	5–10	Typically, mild executive dysfunction (e.g., impaired concentration or memory); gross focal lesions considered to be less common in DCS than in AGE
Cardiopulmonary: dyspnea, cough, chest pain ("the chokes")	1–5	Typically associated with provocative events such as rapid ascent or omitted decompression after deep dives
Cardiovascular: hemoconcentration, shock, coagulopathy	<1	Rare; typically associated with provocative events such as rapid ascent or omitted decompression after deep dives
Constitutional, including fatigue, malaise, headache	20–40	Often described as similar to a viral infection

* Approximate proportions of divers affected are based on data from various sources^{44,46,47} and the experience of the authors. AGE denotes arterial gas embolism.

Discussion

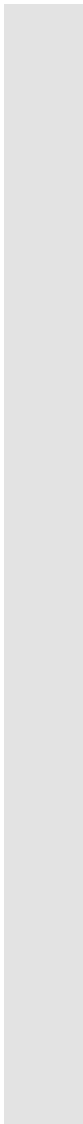
- Cross tabulation of collected data to find associations with incomplete outcomes revealed traditional diving, Missed safety stops, and CNS and Spinal cord symptoms to be statistically significant.
- Further analysis was done looking into diving factors using logistic regression to find odds ratio, this showed missing safety stops to be a significant factor but once adjusted multivariate loss its significance.
- First-aid high flow oxygen, was given to 19% of all patients, but wasn't associated with incomplete treatment outcomes, but despite this finding oxygen still remains to be the most important treatment in first-aid especially in severe cases.

Emphasis on Decompression Safety



Decompression safety is influenced by a multitude of factors, variably related to the dive and the diver.

Pollock (2016)



Conclusion

Conclusion

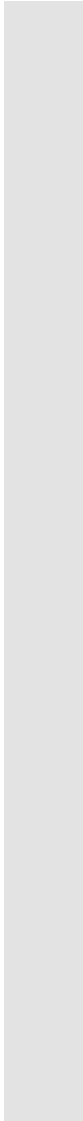
- This was the first multi-centered study to examine associations between various factors and treatment outcomes
- Traditional divers were found to be at a higher risk of poor treatment outcomes. Often involving deep dives, prolonged dive, and Improper equipment.
- The recreational group, this study only "explores the tip of the iceberg." Prior survey indicated an additional 50-100 DCI cases treated in the private sector, where access to data is challenging



Limitations

Limitations

1. Encountering missing data due to collection of secondary data from medical records
2. There can be an under-report of cases of DCI in Thailand due to the study focusing on DCI cases that received recompression illness, but doesn't take into account untreated cases of DCI
3. The nature of descriptive study might not lead to definitive conclusion of causal relationships between variables
4. Prevalence and Incidence rate isn't able to be determined, due to lack of data of the diving population.



Benefit and Application

Benefit and application

1. Findings of the study can lead to better knowledge and understanding of DCI
2. Multi-center data collection better represents the problem of DCI in Thailand compared to previous studies
3. Raise awareness of DCI in divers, and doctors whom are not familiar with DCI
4. Improved pre-hospital care and time to definite treatment of divers with DCI
5. Betterment of preventive measures of DCI, and possibility of standardized implementation of diving safety conventions

Thank you
for your attention,
Any questions?