Physiological effects of immersion to consider when referring for Aquatic Physiotherapy.

Research demonstrates clients with stable chronic conditions such as: diabetes, cardiac disease, respiratory disease, renal disease, thermoregulatory disorders and cancers can benefit from exercise in water with appropriate screening and monitoring.

The following table highlights the Physiological effects of Immersion to consider when referring.

	PHYSIOLOGICAL CHANGES WITH IMMERSION	**SCREEN CAREFULLY**	**CLIENTS UNSUITABLE**	**REFs**
CARDIOVASCULAR	• 700ml shift of extracellular fluid central (2/3 to lungs, 1/3 to heart) • Increase in CBV ~ 20-40% • Increase in stroke volume ~ 50% • Increase in cardiac output ~ 34% • 30% increase in heart size (in 6 sec) • Approx. 13mmHg increase of CVP • Increased pulmonary artery pressure • Decreased HR (10-15bpm) • Decreased BP • Decreased Peripheral Resistance • Haemodilution in 1st 30 mins of immersion.	Cardiac disease Postural hypotension Hypertension PVD Haemophiliac ***Stress test prior to aquatic exercise recommended***	Unstable conditions Decompensated heart failure Myocardial infarct < 6weeks Myocarditis < 6 months Unstable ischaemia Uncontrolled arrhythmias Severe and symptomatic aortic stenosis Hypertrophic cardiomyopathy Severe pulmonary hypertension Thrombophlebitis Recent systemic or PE Resting Systolic BP > 200mmHG Resting diastolic BP > 110mmHg Resting heartrate > 100bpm	**Hall, J et al. (1990)** **Becker BE et al. (2009)** **APA (2015)**
RESPIRATORY	• Increased work of breathing • Decreased thoracic expansion • Altered pulmonary pressures • Diaphragm elevation • Decreased lung compliance secondary to central vascular engorgement. • Increased airway resistance ~(58%). • Decreased lung volumes VC (5-10%), TLC, FRC and ERV. • COPD clients (even with FEV_1<35%) have been shown to be safe while exercising submax in water.	COPD COAD Respiratory muscle weakness Asthma Obesity Elderly Anxiety ***Spirometry LFTs recommended to guide immersion safety (VC, FEV_1)***	Clients who are SOB at rest Acute Asthma	**McNamara RJ et al. (2011)** **Anstey KE et al. (2000)** **Perk, J et al. (1996)** **Hall, J et al. (1990)**
DIABETES	• Decreased BGLs with increased metabolic cost of moving in water.	Unstable BGLs Cardiac conditions Hypertension Peripheral neuropathy Cardiovascular autonomic neuropathy Retinopathy PVD Obesity Renal disease	Hypoglycaemia ≤ 4.0 mmol/L Hyperglycaemia ≥ 15 mmol/L and ketones present Unable to self-test BGLs pre, post and during Xs ***Stress test recommended for previously sedentary clients with additional CV risk factors***	**Horden MD et al. (2012)** **APA (2015)**

Pain Management CNS & ANS	• Decrease SNS (fight / flight) • Increased PNS (relaxation) • Meditative effect assists pain reduction • Gate effect of water pressure and temperature on nerve endings • Muscle relaxation • Joint swelling reduction	Anxiety Disorders Epilepsy/seizure		**Becker BE et al. (2009)** **Bender T et al. (2005)**
GENITO-URINARY	• Increased diuresis up to 7 x • Increased sodium and potassium excretion • Decreased BP • Increased renal efficiency – lower renal sympathetic N activity, renal vascular pressure and plasma renin activity. • Regular supervised aquatic exercise arrested Chronic Kidney Disease progression	Renal conditions Clients on fluid restrictions Cardiac conditions Urinary Incontinence		**Hall, J et al (1990)** **Pechter U et al. (2014)**
HEAT SENSITIVE	• Local Public pool at thermoneutral (34-36 degrees) • Exercise increases core temperature	MS Lymphedema Active inflammatory conditions (RA)		**Bender T et al. (2005)**
CANCER Lymphedema	• Hydrostatic pressure provides compression to assist with lymph fluid return to vascular system	Using cytotoxic agents Severe Cachexia Compromised immune function	Neutrophil count < 500m/mm3 Current radiation therapy Current cytotoxic agents and incontinent	**APA (2015)** **Smith SE (2013)**

References:

Anstey KE, Roskell C (2000). Hydrotherapy: Detrimental or beneficial to the respiratory system? *Physiotherapy,* 86 (1): 5-13.

APA (2015). Australian guidelines for aquatic physiotherapists working in and/or managing hydrotherapy pools, 2nd Ed. *Australian Physiotherapy Association*, Aquatic Physiotherapy Group, Camberwell VIC.

Becker BE, Hildenbrand K, Whitcomb RK, Sanders JP (2009). Biophysiologic Effects of Warm Water immersion. *International Journal of Aquatic Research and Education,* (3): 24-37.

Bender T, Karagulle Z, Balint GP, Gutenbrunner C, Baliant PV, Sukenik S (2005). Hydrotherapy, balneotherapy, and spa treatment in pain management. *Rheumatoid Int,* Apr 25(3): 220-4.

Hall J, Bisson D, O'Hare P (1990). The Physiology of Immersion. *Physiotherapy,* 76 (9): 517-521.

Horden MD, Dunstan DW, Prins JB, Baker MK, Fiatarone Singh MA, Coombes JS (2012). Exercise prescription for patients with type 2 diabetes and pre-diabetes: A position statement from Exercise and Sport Science Australia. *Journal of Science and Medicine in Sport,* (15): 25-31.

McNamara RJ, Alison JA, McKeough ZJ (2011). Water-based exercise in chronic obstructive pulmonary disease. *Physical Therapy Reviews*, Vol 16 (1): 25-30.

Perk J, Perk L, Boden C (1996). Cardiorespiratory adaptation of COPD patients to physical training on land and in water. *European Respiratory Journal,* 9: 248-252.

Pechter U, Raag M, Ots-Rosenberg M (2014). Regular aquatic exercise for chronic kidney disease patients: a 10-year follow-up study. *International Journal of Rehabilitation Research*, Vol 37(3): 251-255.

Smith SE (2013). Aquatic Physiotherapy and its application to Cancer Rehabilitation: Informing safe and effective practice. Literature review. APA Aquatic Phyiso Group Level 3 Course Literature Review.