

Video burns





Aquatic activities for persons with a disability: Competition, Recreation, Therapy

Daniel Daly
with the help of
Karina Rodinova,
Anna Ogonowska-Słodownik, Marlies DeClerck, Baiba
Karklina & Johan Lambeck

There is a Problem (example)

Balneotherapy is a common treatment
for hip/knee OA.

The costs are sometimes reimbursed.

A systematic review found only 7 RCTs.

But methodological quality of the studies was
poor

(J Rheumatology, 2008)



A more important finding is the mismatch between the popularity of aquatic interventions and the paucity of evaluations of their efficacy.

(Hall et al., Arch. Phy. Med. Rehab. 2008)



Purpose 1

Systematically review the literature on the effect of aquatic therapy (exercise) on function, activity and participation in older adults with and without (chronic) Health Problems.

Topics and present participants (Drafting group)

- **Neurology** J. Lambeck (NL)
Active interventions in Stroke, Parkinson and MS
- **Metabolic Syndrome** J. Lambeck: Adults & Children
- **Musculoskeletal orthopedics/rheumatology (Active)**
B. Waller(FIN) ; S. Heywood (Aus):
Musculoskeletal Diseases, Low Back Pain, Osteoarthritis, Hip Replacement, Rheumatoid Arthritis, Fibromyalgia.
- **Balneology** R. Forestier (Fr); T. Bender (Hun):
- **Cardiac rehab / circulation & Pulmonary**
B. Becker (US) (Ben Waller):

Topics and participants (II)

- **Women's health / gynecology** P. Geigle (US):
Include pregnancy, breast cancer but not osteoporosis.
- **Sports injuries** S. Heywood & B. Waller:
- **Geriatrics-Elderly** D. Daly (B) & J. Lambeck:
- **Pediatrics** D. Daly, Javier Gueita (ES)+
- **Immersion** B. Becker
Separate section on immersion. Type of water involved (e.g. mineral content) not considered.
- *NO Mental Health or Dermatology*

Strategy

- Systematic Literature Retrieval in
 - OVID/Medline, **Pubmed**,
Cinahl, Sports discus,
Cochrane, Embase,
ERIC, PEDro,
ScienceDirect, HighWire,
Google Scholar,
Web of Science (citation search) + direct author contact.
- All Types of studies but **if possible at least level 3 evidence**
- Limits:
 - Human above 21 years (- Pediatrics + Metabolic syndrome)
 - Active and Passive therapy (no mud baths).

Search Terms

- E.g. Rheumatoid arthritis or arthritis or RA

And

Hydrotherapy or

Aquatic therapy

Aquatic physi(o)cal therapy

Aquatics

Balneology

Water therapy

Thalassotherapy

Aquatic exercise

Water rehabilitation

Aquatic rehabilitation

Balneotherapy

Spa therapy

Water exercise

Pool Exercise

- Halliwick, Swimming, Adapted Aquatics (Pedi)



Search results Pediatrics: n=511 articles

Exclusion on
title/abstract: n=444

Inclusion: n=67, full-text articles (n=55
electronic search + n=12 from reference
searching)

Exclusion: temporary respiratory
illnesses, policy statements, healthy
children: n=4

Inclusion: n=63 (all study
designs)

Studies with no actual intervention
program, data collection during one
session only, reviews, clinical opinions:
n = 22

Studies with intervention
programs: n = 41

RCTs (for PEDro assessment):
n=9

Other designs:
n = 32

Results Pediatrics: Outcomes/ICF components

Nr	Disability group	Total	Intervention studies	ICF components			
				function	activity	participation	personal factors
1	Diseases and disabilities of the nervous system	17	13	8	9	4	3
2	Internal medicine	8	4	4	0	1	2
3	Diseases and disabilities of the musculoskeletal system	4	3	3	2	2	3
4	Mental and behavioral disorders	20	14	6	12	5	4
5	Endocrine, nutritional, metabolic diseases	4	3	3	1	0	1
6	Sensory system/integration deficits	1	0	0	0	0	0
7	Mixed disabilities group	9	4	3	4	3	0
	TOTAL		41	27	28	15	13

Study Details: Diseases and disabilities nervous system in pediatrics

P - pathology; CP – cerebral palsy; imp. – impairment; ex. - exercise; N/R – not reported; ↑ - increase

7/13	Design	Sample	Age	Intervention	Program details	Duration	Intensity	Temp°
Özer et al., 2007.	RCT PEDro 5/10	N=23; . CP	5-10	swimming training program	Individual 1:1 - 2 wks: static drills, stretching ex., ball games on land. - following wks - drills and ex. in the water. - 4th week-The Aquatics Sports Skills Program. Not eliciting abnormal patterns, self paced swim style.	- 14 wk - 3 x /wk - 30 min	N/R	N/R
Chrysagis et al., 2009.	RCT PEDro 6/10	N=12; . CP	13-20	swimming program	Individual 1:1 - warm up 10 min - 35 min - cool down - walking in shallow pool end, static stretching for the extremities - backstroke, crawl - free swimming, stretching.	- 10 wk, - 2 x /wk - 45 min	N/R	28-31C
Getz, et al. 2007.	non-RCT	N=22 CP	3-6	adapted aquatics vs land	Individual 1:1 - warm up 5 min - 20 min - cool down - structured group activity, songs - individual/in pairs, 10-pt Halliwick method - group activities, songs.	- 16 wk, - 2 x /wk - 30 min	N/R	N/R
Getz, Hutzler, & Vermeer, 2006.	cross section	N=49 neuro-motor impairments	3-7	aquatics program	Individual 1:1 - warm up 5 min – 20 min - cool down - structured group activity with 6 children and their instructors - mental adaptation, songs - individual/in pairs - group activities with songs. - Aim: functional independence in the water	- minimum period of 20 wk - 2 x /wk - 30 min	N/R	31-32C
Aleksandrović et al., 2010	before-After	N=7 neuro muscular imp.	5-13	adapted aquatics	Mainly individual 1:1 - principles of Halliwick method, hydro-therapy, non-swimmers training for healthy population .Adapted to age and disability. - aim: functional independence in the water.	- 8 weeks - 2 x /wk -45 min	N/R	N/R
Aidar et al.,	before-after	N=21 CP	6-12	aquatic activities	N/R	- 16 wk - 2 x /wk	N/R	N/R

- Extremely heterogeneous populations
- Most evidence for: “Disabilities of nervous system” and “Intellectual and behavioral disorders”.
(pre-post studies and single subject design).
- High evidence levels in “musculoskeletal system” (2/3RCTs: PEDro scores 8/10 + 6/10) and “Internal medicine”.
- Function and activity were measured almost 2 * more than participation and personal factors.
- Clinically significant benefits of aquatic interventions on GMFM in children with neuro impairments and potential benefits on pulmonary function (astma).

- The improvement in CHAQ scores approached clinical meaningfulness in children with Juvenile Idiopathic Arthritis.
- 4 studies demonstrated improvements in the PEDI measure.
- Convincing evidence was found for improvements in aquatic and swimming skills for children with intellectual & behavioral disorders.
- BMI changes in obese children were diverse.

Introduction

Exercise is beneficial for older adults (55+) and elderly (70+) and water is an appropriate environment to exercise, nevertheless no recent review has concentrated on this population and the evidence remains unclear.

Why come to the pool ?



*I always went
swimming on
vacation*



*My grandchildren can
swim*



Older adults do not increase activity spontaneously

Current Evidence in Geriatrics:
ECABAT 2013

KU LEUVEN

WHAT and WHO did we look at?

Studies: randomised controlled trials (level 1 evidence)

Population: mean age 55 yrs or older, independent in ADL-and with or without chronic disability.

Interventions: Active Aquatic Therapy (exercise not SPA).

Outcomes: Cardiovascular fitness, flexibility, balance, strength and body composition.

Search Results Elderly 2009 (2 Reviewers)



Potential relevant studies (N=114)

N=84 excluded after reading abstract

- passive intervention in water
- average age ≤ 55 years
- review/no RCT

N=30

N=11 excluded after reading article

- written in Japanese
- not yet published
- did not meet inclusion criteria
- no control group

N=19 (36)

36 studies: Older Adults & Elderly: 20 ≥ 2010

14 studies = Healthy population

6 studies = Arthritis - Rheumatism

5 studies = Hip-knee replacement

4 studies = FALLERS

1 = study Osteoporosis

2 studies = Heart Disease

1 study = COPD

1 study = post cancer

1 study each = Stroke, Parkinson



Delphi score: Methodological quality of RCTs

Author, year	Arnold et al 2010	Chu et al 2003	Folley et al 2003	Hale et al 2012	Arnold et al 2011	Devereux et al 2005	Hall et al 1996	Harmer et al 2009	Liebs et al 2012	Lim et al 2010	Wang et al 2011	Valtonen et al 2010	Avelar et al 2010	Camdus et al 2010	Cox et al 2010	Ide et al 2005	Takeshima et al 2002	Tidhar et al 2010	Tsourlou et al 2006	Simmons et al 1996	Valtonen et al 2011	Abbasi et al 2011	Bento et al 2012	Bocallini et al 2010	Broman et al 2006	Caminiti et al 2011	Giaquinto et al 2010	Graef et al 2010	Lord et al 2006	Sato et al 2009	Vivas et al 2011	Yennan et al 2010	Wadell et al 2004	Cider et al 2003	Katsura et al 2010	
Randomized	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	NR	No	Yes
Randomization Concealed	Yes	Yes	Yes	Yes	NR	Yes	Yes	Yes	Yes	NR	Yes	Yes	NR	NR	Yes	Yes	NR	Yes	NR	NR	Yes	NR	No	NR	NR	NR	NR	NR	NR	Yes	NR	NR	NR	NR	NR	NR
Similarity at baseline	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	
Eligibility criteria specified	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Blinded assessor	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	NR	Yes	No	Yes	No	No	NR	NR	NR	NR	NR	No	Yes	NR	NR	No	No	NR	NR	NR	NR
Blinded care provider	no	No	No	NR	NR	No	No	NR	No	NR	NR	NR	NR	NR	No	No	No	No	No	No	NR	NR	NR	NR	NR	No	NR	NR	NR	No	No	NR	NR	NR	No	No
Blinded subject	No	Yes	No	NR	NR	No	No	No	No	No	NR	NR	No	NR	No	No	No	No	No	No	NR	NR	NR	NR	NR	No	NR	NR	NR	No	No	NR	NR	NR	NR	NR
Point estimates and ITT	Yes	NR	Yes	Yes	Yes	Yes	NR	Yes	Yes	Yes	No	Yes	NR	No	NR	NR	NR	Yes	NR	Yes	No	No	No	No	NR	No	No	No	Yes	No	No	No	No	Yes	No	No
Delphi score	7	7	7	7	6	6	6	6	6	6	6	6	5	5	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	4	3	3	

Results:



- Samples = 12 to 249 persons ($M = 71.1$ 66% women)
- M age from 55 to 80 years 80% = 65 - 75yrs.
- Intervention = 4 to 24 weeks ($M = 10.7$) 2 years
- 1 to 5 sessions a week (2 – 3)
- Total treatment = 240 to 4320 min, ($M=1460$ min).
- Water level from waist to deep depending on goal (10 NR).
- Water temperature between 26° and 34° C. (9 NR, 9 < 30°)

Results:



- Intensity = 12 NR
- Qualifications; 50-50 aquatic fitness instructor, PT: 10NR
- Less than 33% did a follow-up study



Outcomes: Body Function/Structure-Elder



study	Total N		Body Function / Structure
Takeshima & al. 2000	30	healthy	VO2 peak, FEV1, trunkROM, muscleF, skinfold
Cider & al. 2003	25	chronic heart failure	VO2max/peak
Chu & al. 2004	12	chronic stroke (mild - moderate)	VO2max, max workload, paretic muscle F
Devereux & al. 2005	50	osteopenia - osteoporosis	Ø
Wang & al. 2006	38	osteoarthritis hip or knee	ROM lower limb(except knee flexion), Muscle of lower limb
Eversden & al. 2007	115	rheumatoid arthritis	Ø
Hinman & al 2007	71	hip/knee osteoarthritis	Visual Analogue Scale, WOMAC pain & function
Sato & al. 2007	30	frail elderly persons	Ø
Foley & al. 2008	105	hip/knee osteoarthritis	QuadricepsF: GYM > HYDRO
Silva & al. 2008	64	knee osteoarthritis	Visual Analogue Scale: Decrease PAIN GYM < HYDRO after 50 feet Walk test

Outcome: Activity/Participation(HrQoL)-Elderly

study	N		Activity / Participation
Takeshima & al. 2000	30	healthy	Vertical jump, Side step test
Cider & al. 2003	25	chronic heart failure	6 min walk test
Chu & al. 2004	12	chronic stroke (mild - moderate)	Gait speed
Devereux & al. 2005	50	osteopenia - osteoporosis	Step test, SF36
Wang & al. 2006	38	osteoarthritis hip or knee	6 min walk test
Eversden & al. 2007	115	rheumatoid arthritis	10 m walk time
Hinman & al 2007	71	hip/knee osteoarthritis	6 min walk test
Sato & al. 2007	30	frail elderly persons	SF36 physical & mental component, HrQoL, FIM for both group after 6 months
Foley & al. 2008	105	hip/knee osteoarthritis	6 min walk test: HYDRO > CONTROL GYM = CONTROL
Silva & al. 2008	64	knee osteoarthritis	Ø

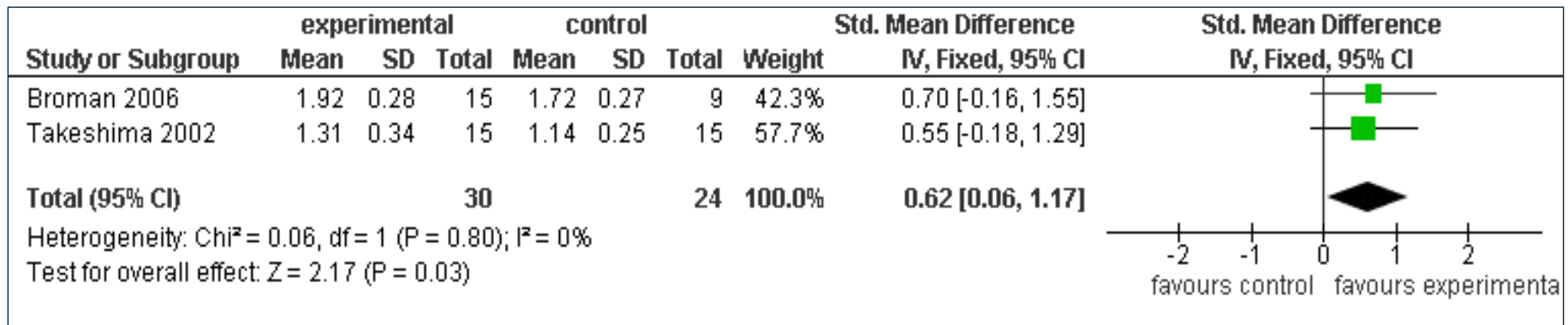
Discussion: Elderly



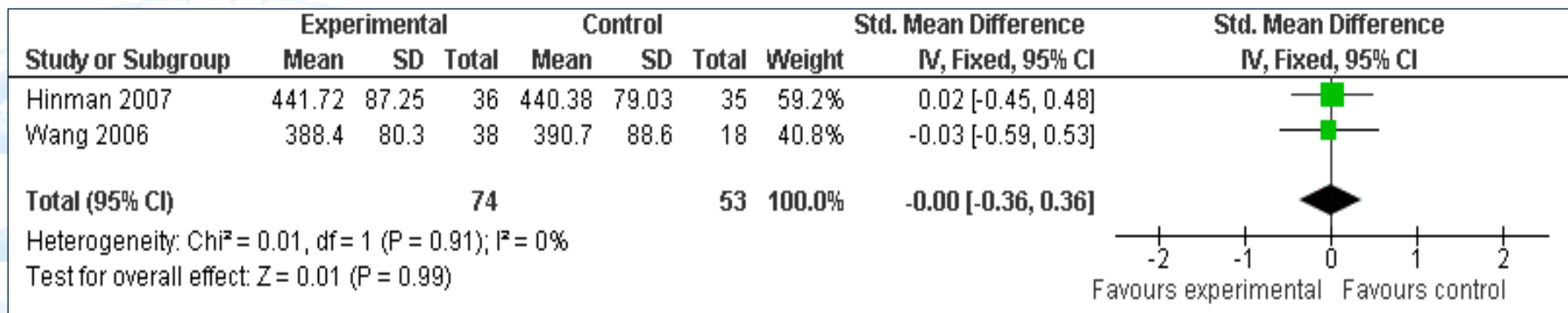
- Aerobic Capacity: improves (does not decrease) if exercise is specific and intervention long enough (12% - 22%)
- For ROM the evidence less consistent ($\pm 11\%$)
- Balance: Only with specific exercises
- Strength: (5% to 30%)
- Body composition: (3.4% increase in lean body mass and 8% decrease in skin-fold thickness).

Only 1 study reported an adverse effect

Meta analysis: Elderly



Aerobic Capacity



6 min. Walk

Author	WKS	N/WK S	TOT	MIN/SE	TOT		Age	Content	intensity	supervision	Temp	
Takeshima et al., 2002	12	3	36	70	2520	hydro	69.3 (4.5)	20-min warm-up	peak VO2,	trained fitness instructors	30	xiphoid
Healthy								10-min resistance	NR			
								30-min endurance				
								10-min cool-down				
						control	69.3 (3.3)	no intervention				
Broman et al., 2006	8	2	16	48	768	hydro	69.0 (4.0)	aqua jogging:	75% HRmax	PT	27	deep water
								7 min warm-up				
Healthy								30 min interval: 3x10': 2'rest				
								7 min cool-down				
						control	69.8 (3.5)	no intervention				
Chu et al., 2004	8	3	24	60	1440	hydro	61.9 (9.4)	10-min stretching	50% - 70% (wk1-2), 75% (wk3-5),	OT, exercise physiologist	26-28	chest
7 & 5								5-min light aerobic warm-up	80% (wk6-8)			
25% or ES = 1								30-min high - mod aerobic activities at target HR				
								5-min light cool-down				

Author	WKS	N/WK S	TOT	MIN/S ES	TOT	interventio n	Age	Content	intensity	supervisio n	Temp	
Wang et al, 2011	12	3	36	60	2160	hydro	66.7 (5.6)	5 min warm-up	Borge Scale 2-3 for first 4 weeks, 3-4 for next 4 weeks and 4 for the last 4 weeks	trained exercise	30	NR
OA								10 min flexibility		instructor		
								10 min endurance				
								10 min lower body				
								5 min upper body				
								5 min cooldown				
						land	68.3 (6.4)	5 min warm-up	Borge Scale 2-3 for forst 4 weeks, 3-4 for next 4 weeks and 4 for the last 4 weeks	trained exercise		
								10 min upper body		instructor		
								10 min lower body				
								10 min flexibility				
								10 min aerobic				
								5 min cool down				
						control	67.9 (5.9)	no intervention				
Hinman et al 2007(OA)	6	2	12	50	600							
Caminiti et al, 2011	24	3	72	30	2160	hydro and	67 (6)	walking forwards,		PT, nurse	NR	
Heart						Land		,callisthenic exercises	Progressive intensity			
						in different days						
								10 min warm-up,flexibility exercises				
ES = 3								30 min aerobic exercises(cycling or	60-70% VO ₂ max			
								treadmill), cooldown				
				60		land only	69 (8)	30 min of callisthenic exercises		PT, nurse		
						(in same day)		(same as hydro group perform but on land)				

Clinical Message: Older adults



- An aquatic exercise program is moderately to highly effective in elderly for improvement of: body functions and structures, activity and participation.
- There is a need for more high quality trials with sufficient sample size, blinded outcome assessment and follow-up assessment (Multi centered with matching outcomes)



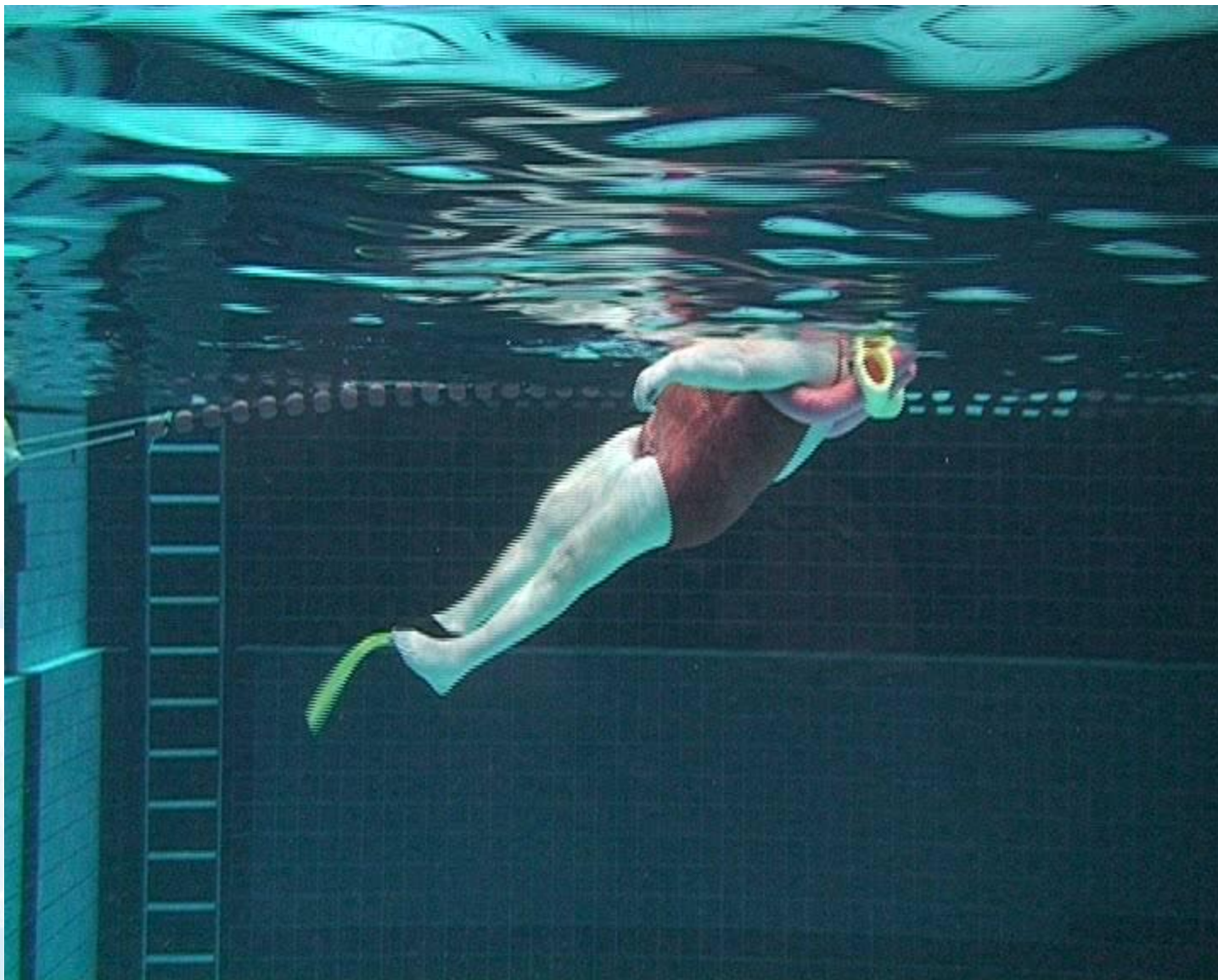
Clinical Message: Older adults



- Few of the beneficial effects have been published in the areas participation, self-efficacy or compliance
- The beneficial health effects of aquatic interventions might have more impact on persons with multiple morbidity, but these persons have most often been excluded from study.
- Aquatic therapy/exercise guidelines need to be developed







One can quite safely advise these general guidelines:

- Aquatic immersion and exercise is both safe and potentially therapeutic for individuals with mild to moderate compensated heart failure and with infarctions older than 6 weeks. Swimming in these populations may be advised judiciously in individuals with good previous swimming skill levels.
- Aquatic immersion beyond xiphoid level and aquatic exercise should not be used in individuals with uncompensated heart failure, very recent myocardial infarctions (less than 6 weeks) or recent myocarditis (within 6 months). Even though the individual may perceive a positive effect of immersion, there is no guarantee of ventricular tolerance.

Aquatic exercise and Cancer

Based on evidence the following can be stated regarding aquatic exercise and individuals experiencing or post cancer treatment.

- Since 60% of cancer survivors are 65 yrs or older, the aquatic environment offers one optimal environment for exercise during or after CA treatment. The hydrodynamic principles of buoyancy buffer gravity's impact on challenged musculoskeletal, cardiovascular and neurological systems for individual during and after CA treatment.
- Precautions to aquatic exercise for individuals during or after CA treatment include medical oversight to monitor 1) immune system reserve especially in regard to potential immune compromise, and 2) energy potential to tolerate moderate exercise.

The background of the entire image is a scenic photograph of a calm blue lake. In the distance, there are forested hills under a clear sky. A small wooden dock with a green platform and a small boat is visible on the left side of the lake. Another dock is visible on the right side. The book cover is centered over this background.

HOW TO LIVE LONGER AND FEEL BETTER

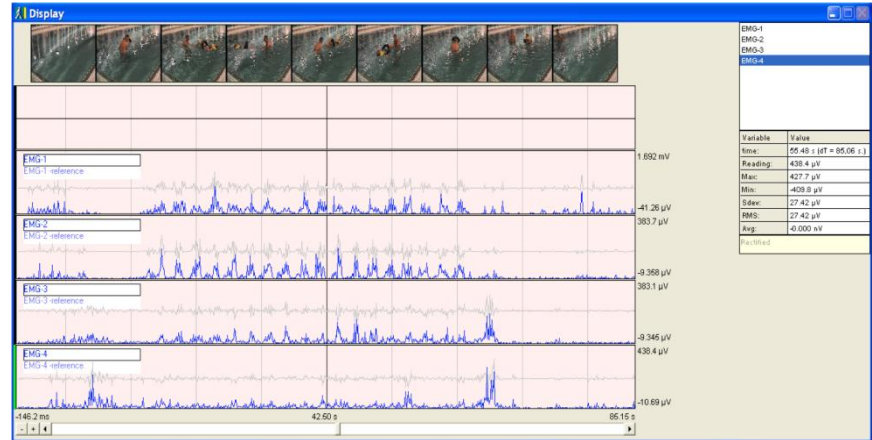
A close-up portrait of Linus Pauling, an elderly man with white hair, smiling. He is wearing a brown jacket over a red and white striped shirt. The portrait is centered on the book cover.

LINUS PAULING

General Conclusions

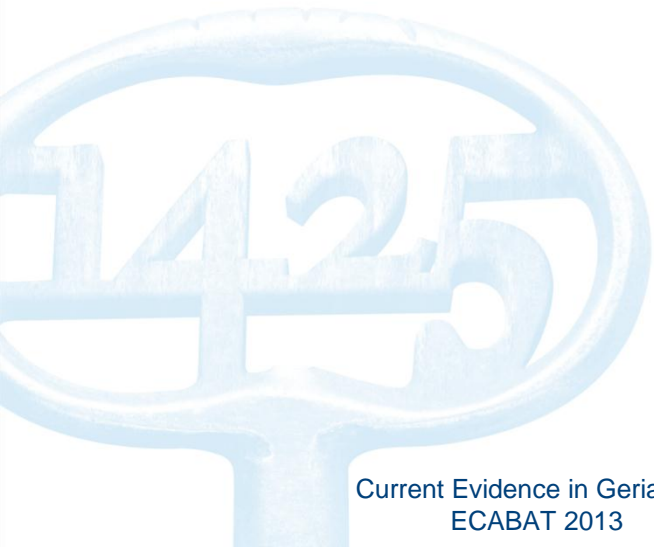
- The WHO wants to include a narrative review in the updated guideline based on systematic findings.
- The drafting group is performing a systematic review and together with previous reviews and existing recommendations / position statements, can conclude preliminarily that
 - Aquatic interventions do have beneficial effects on certain domains of impaired health
 - Few of the beneficial effects have been published in the areas participation, self-efficacy or compliance
 - The beneficial health effects of aquatic interventions might have more impact on persons with multiple morbidity, but these persons have most often been excluded from study.

MUSCLE RECRUITMENT PATTERNS IN THE BAD RAGAZ RING METHOD: A PRELIMINARY STUDY



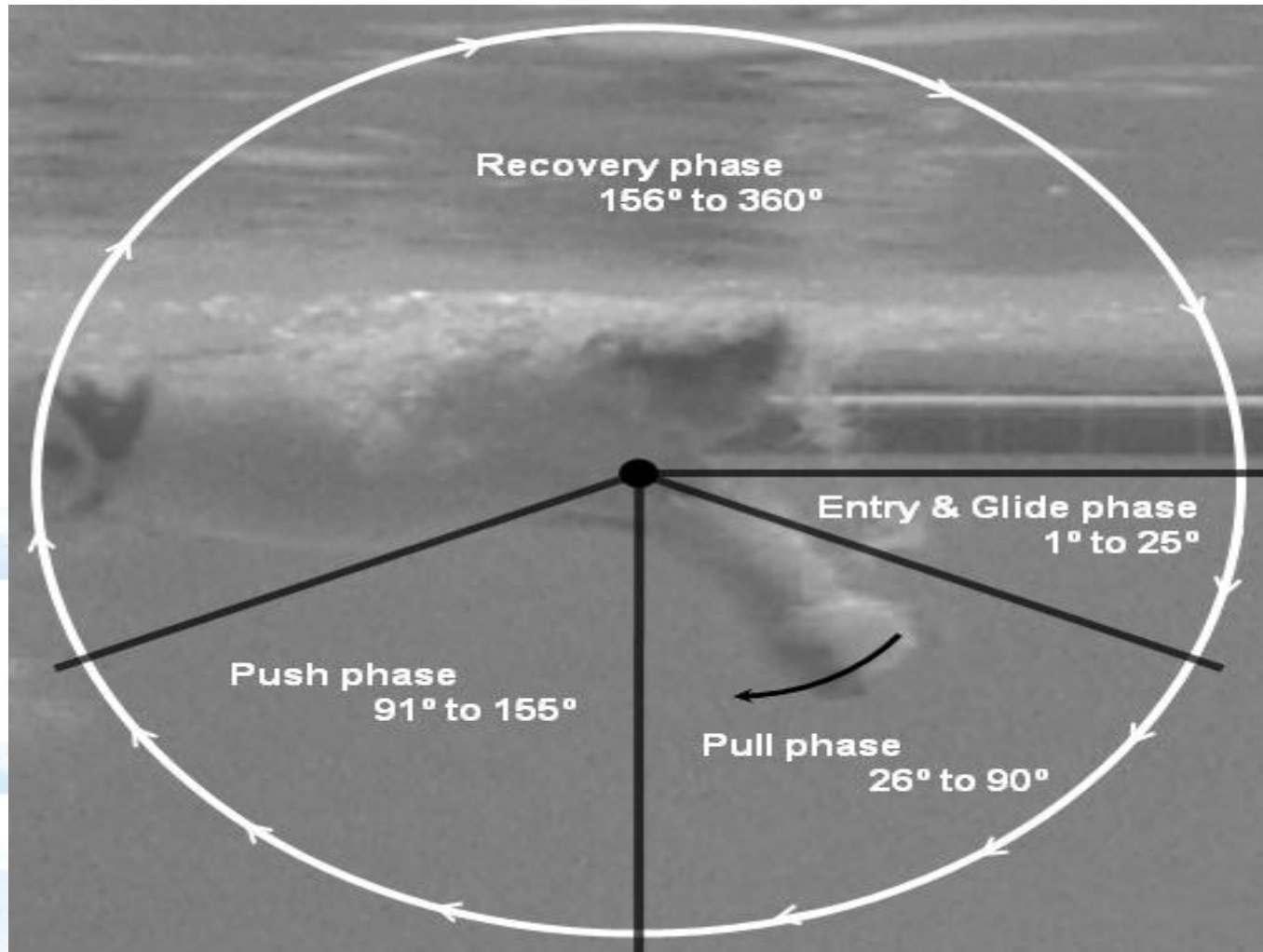
Therapists performed the pattern consistently. No difference was found between the first 5 and last 5 repetitions of a trial for mean total cycle time, contraction time and rest time of TA. There is however a significant decrease in activity of TA between the first 5 and last 5 repetitions of a trial, while the appearance of fatigue would lead to an increase in activity during contraction. In addition there was a significant decrease in activation time and activity of TA over repeated trials during both contraction and rest in water and on land.

Paralympic video



Current Evidence in Geriatrics:
ECABAT 2013

Arm co-ordination in Arm Amputees



Current Evidence in Geriatrics.
ECABAT 2013

1. IdCadapt did not change with an increase in swimming speed up to max. (catch-up model).
2. All swimmers showed significantly more catch-up before their affected-arm pull compared to their unaffected-arm pull.
3. At SSmax, the fastest swimmers used higher SF and less catch-up before their affected-arm pull, compared to the slower swimmers.

Lower trunk muscle activity during crawl swimming in a single leg amputee

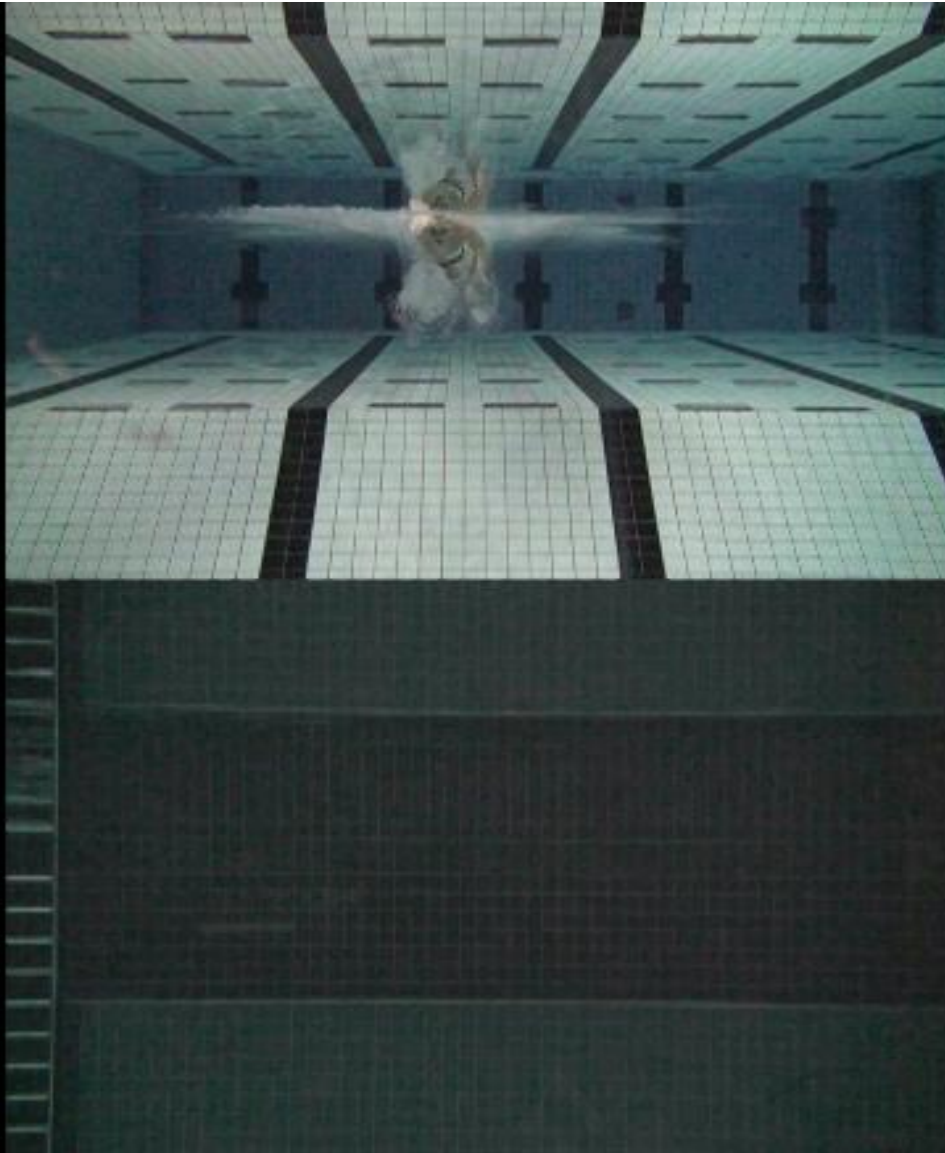
Successful crawl swimming depends on body roll along the longitudinal axe.

Sufficient core trunk stability is needed to balance out the forces generated by the upper and lower extremities.

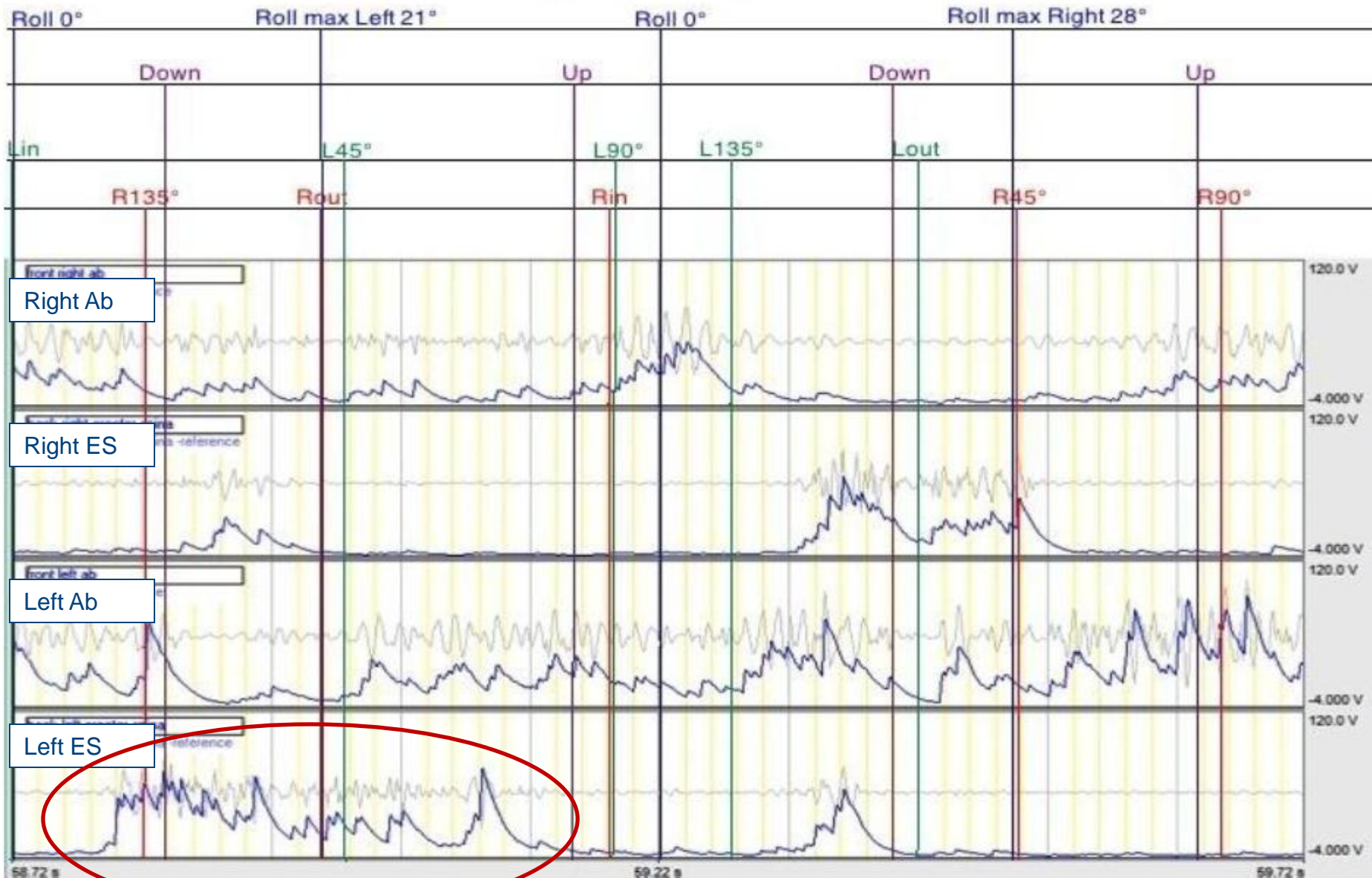
Various theories on how a swimmer generates and controls the body roll.

From those theories it can be expected that a single leg amputee will show different result from a swimmer using both legs

Core stability in single leg amputees



Results - body roll and muscle activity RL Amp



Results – body roll and muscle activity

- Both swimmers roll less at higher speed
 - S9 swimmer rolls more to the right side (amputated side)^o
- Clear muscle pattern is observed in ES for both swimmers but not so clearly in RA
 - More roll = more muscle activity in ES4

Is Competition: therapeutic? = Are swimmers with disabilities (e.g. ID) as fit as swimmers of the same level
= swimming speed?



Thank You for Your attention!!



Thank You for Your attention!!



Cardiac Rehab / Conditioning / Circulation

References

1. Arborelius jr M, Balldin UI, Lilja B, Lundgren CE (1972). Hemodynamic changes in man during immersion with the head above water. *Aerosp Med*, 43, 592-598.
2. Becker BE (2009). Aquatic Therapy: Scientific Foundations and Clinical Rehabilitation Applications. *PM&R*, 1, 859-872.
3. Cider Å, Grüner Sveälv B, Scharin Täng M, Schaufelberger M, Andersson B (2006). Immersion in warm water induces improvement in cardiac function in patients with chronic heart failure. *Eur J Heart Fail*, 8, 308-313.
4. Gabrielsen A, Sørensen VB, Pump B, Galatius S, Videbaek R, Bie P, Warberg J, Christensen NJ, Wroblewski H, Kastrup J. Norsk P (2000). Cardiovascular and neuroendocrine responses to water immersion in compensated heart failure. *Am J Physiol Heart Circ Physiol*, 279, H1931-1940.
5. Magder S, Linnarsson D, Gulstrand L (1981). The effect of swimming on patients with ischemic heart disease. *Circulation*, 63, 979-986.
6. Meyer K, Bücking J (2004). Exercise in heart failure: should aqua therapy and swimming be allowed? *Med Sci Sports Exerc*, 36, 2017-2023.
7. Meyer K, Leblanc MC (2008). Aquatic therapies in patients with compromised left ventricular function and heart failure. *Clin Invest Med*, 31, E90-97.
8. Yamaguchi H, Tanaka H, Obara S, Tanabe S, Utsuyama N, Takahashi A, Nakahira J, Yamamoto Y, Jiang ZL, He J, Bando E, Miyamoto H (1993). Changes in cardiac rhythm in man during underwater submersion and swimming studied by ECG telemetry. *Eur J Appl Physiol Occup Physiol*, 66, 43-48.