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INTRODUCTION:

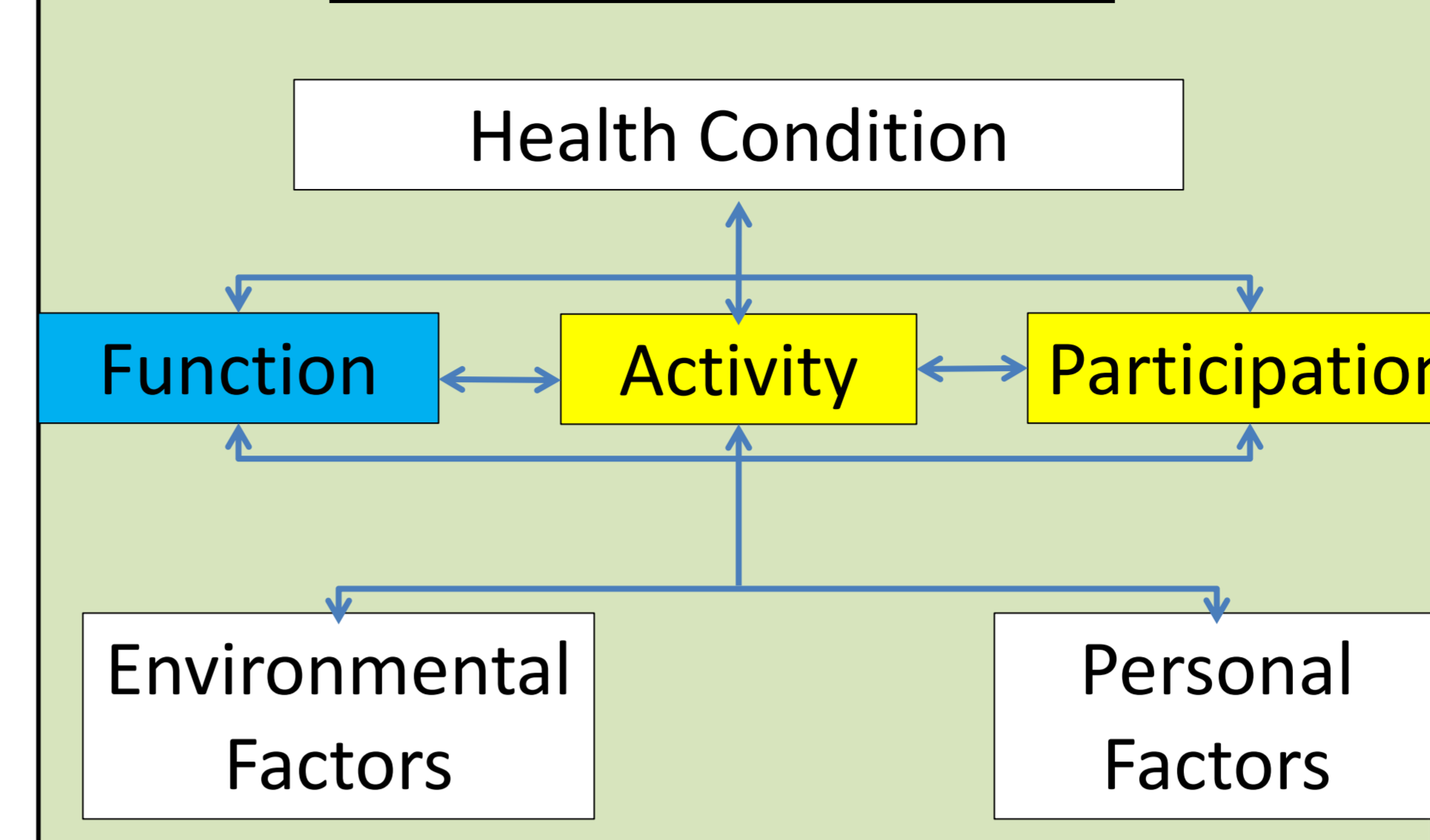
The study of exercise training in adolescents with cerebral palsy (CP) has undergone significant development since 2006. Of interest is the translation of a rehabilitation exercise program into daily activity and participation in an adolescent with CP. This poster updates the findings of Verschuren, *et al.*'s 2008 systematic review (performed in 2006) and examines the results for the possibility of a meta-analysis.

Search Strategy:

Databases: MEDLINE, PubMed, EMBASE, CINAHL, Sports Discus, Cochrane, and PEDro

Key words: (1) cerebral palsy AND (2) exercise AND (3) strength, fitness, working capacity, aerobic power, anaerobic power, endurance, cardiorespiratory physical training, cardiorespiratory physical program, OR aquatic.

Table #2: ICF Framework



NOTE:

- Population:**
 - Diagnosis biased to Spastic CP
 - Functional levels biased to GMFCS I-III
- Intervention**
 - Mainly land based
 - Biased toward the strength/ aerobic training
 - Great heterogeneity in components
- Control**
 - Few blinded
 - Most controlled, randomized
- Outcome**
 - Biased to body function and standardized activity (GMFM).
 - Extreme diversity in outcome measures, except GMFM.

Appendix #1: Population, Intervention, Control

Study	Population			Intervention	Control				
	Diagnosis	Age	n		Land/ water				
						Controlled	Randomized	Blinded	CP?
14. Liao (2007)	SD	5-12	24	L	Two Group	Y	Participant	Y	
15. Unnithan (2007)	SD	14-18	13	L	Two Group	Y		Y	
16. Dodd (2007)	AQ,SQ,SD	5-14	14	L	Matched	N		Y	
17. Provost (2007)	H,ASD	6-14	6	L	Multiple Measurements	N		Y	
18. Verschuren (2007)	"CP"	7-12	86	L	Two Group	Y		Y	
19. McNee (2009)	SCP	6-17	13	L	Multiple Measurements	N		Y	
20. Williams (2007)	DQ,SQ,SD	11-15	11	L	ABA design	N		Y	
8. Eek (2008)	BS	10-15	16	L	Multiple Measurements	N		Y	
21. Unger (2006)	D,H CP	13-18	31	L	Two Group	Y	Participant	Y	
22. Engsborg (2006)	SD	?	12	L	Four Group	Y		Y	
23. Salem (2009)	"CP"	4-12	10	L	Two Group	Y	Participant	Y	
24. Cherng (2007)	SD	3-7	8	L	Two Group, ABA/AAB	Y		(within-group)	
25. Crompton (2007)	SD	6-14	15	L	Two Group	Y		Y	
26. Davis (2009)	"CP"	4-12	99	L	Two Group	Y	Participant	Y	
27. Lee (2008)	SD,HCP	4-12	17	L	Two Group	Y	Participant	Y	
28. Gordon (2007)	HCP	3-16	20	L	Two Group	Y	Participant	Y	
29. Getz (2007)	SD	4-8	22	L/W	Two Group	N	Evaluator (TSE)	Y	
30. Zaidat (2007)	H	8-12	8	L/W	Multiple Measurements	N		Y	
31. Chysagis (2009)	ST,DCP	13-20	12	W	Two Group	Y		Y	
COUNT						12	6	18	

Chart #1: Functional Distribution

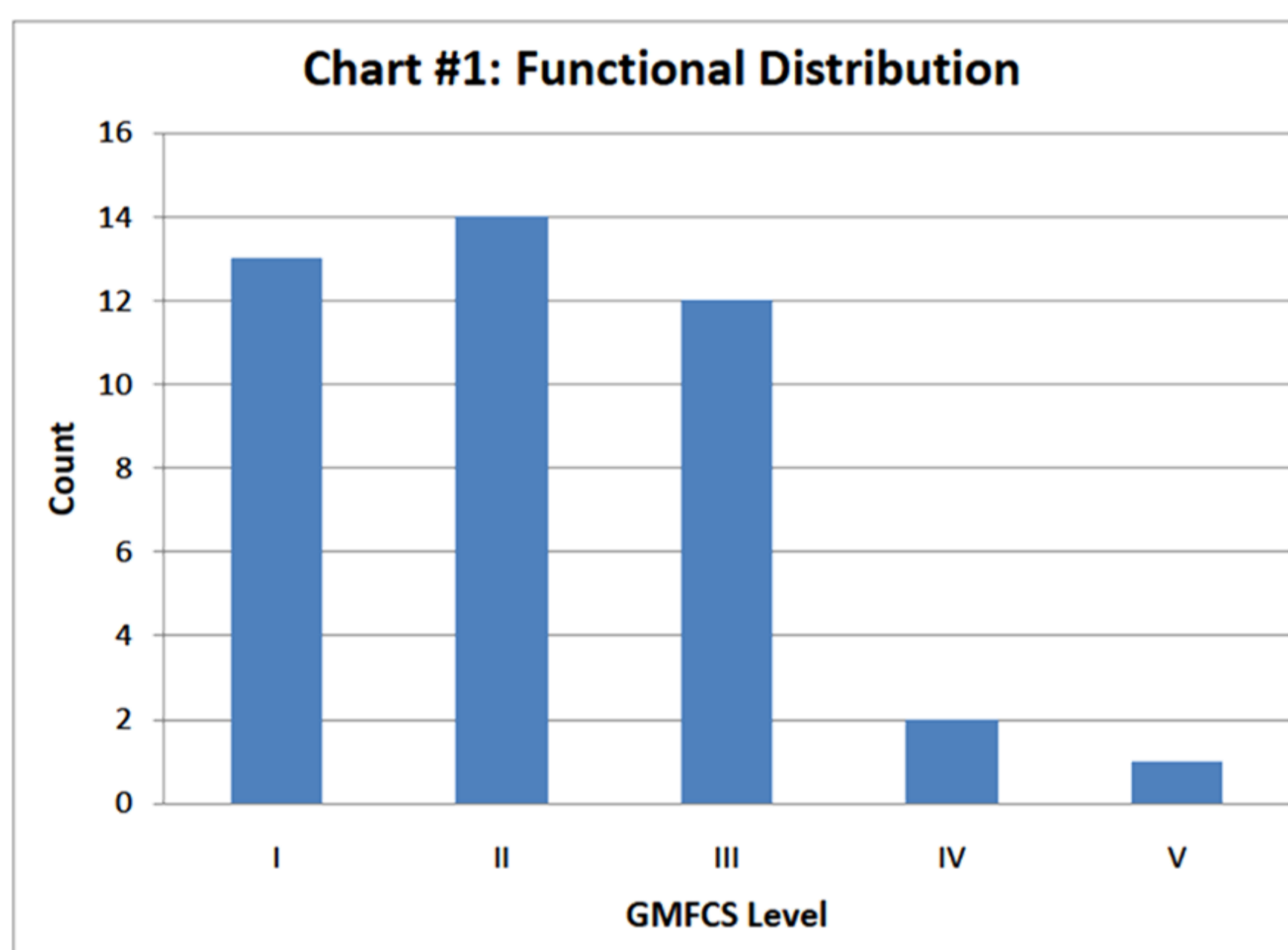
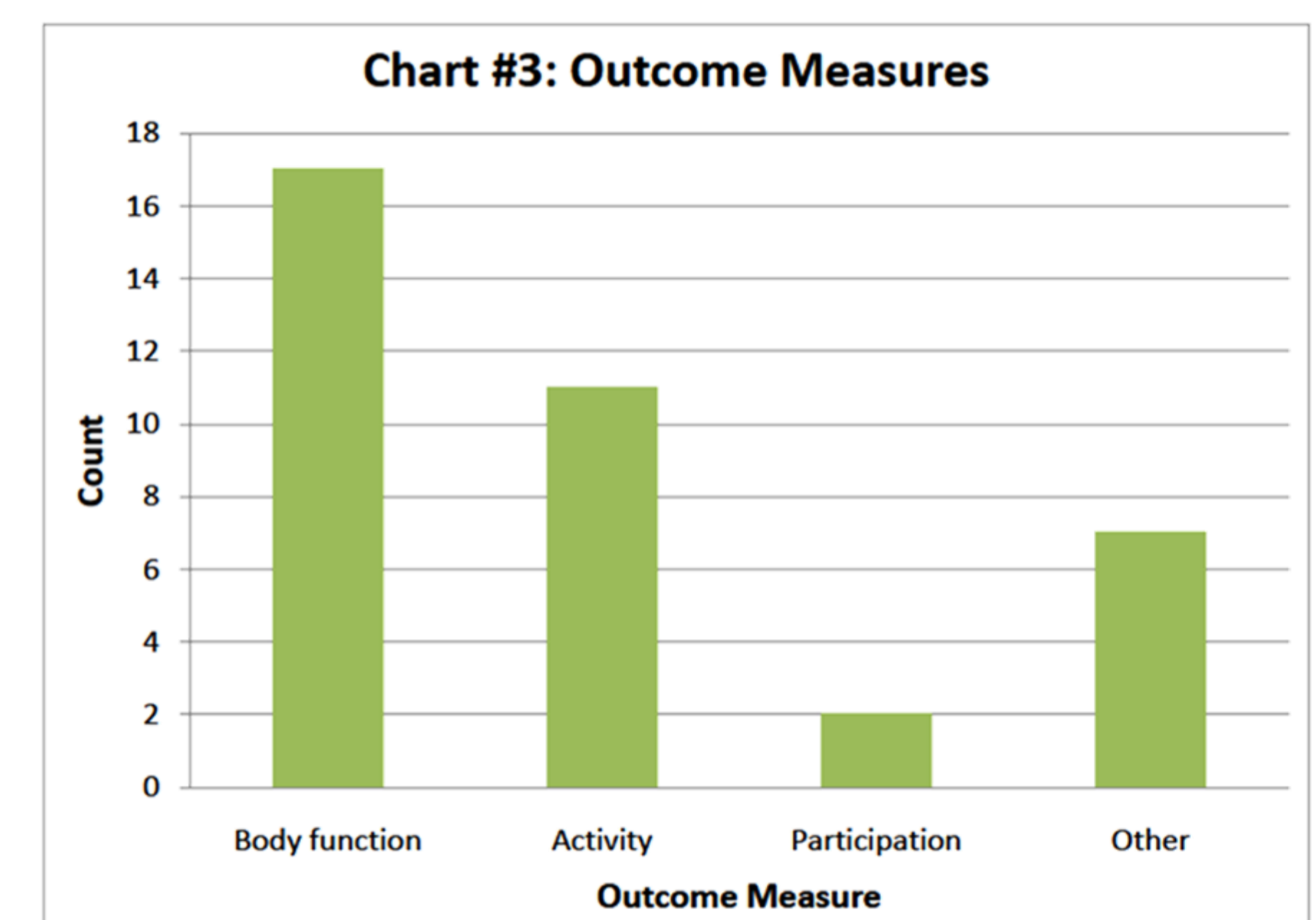


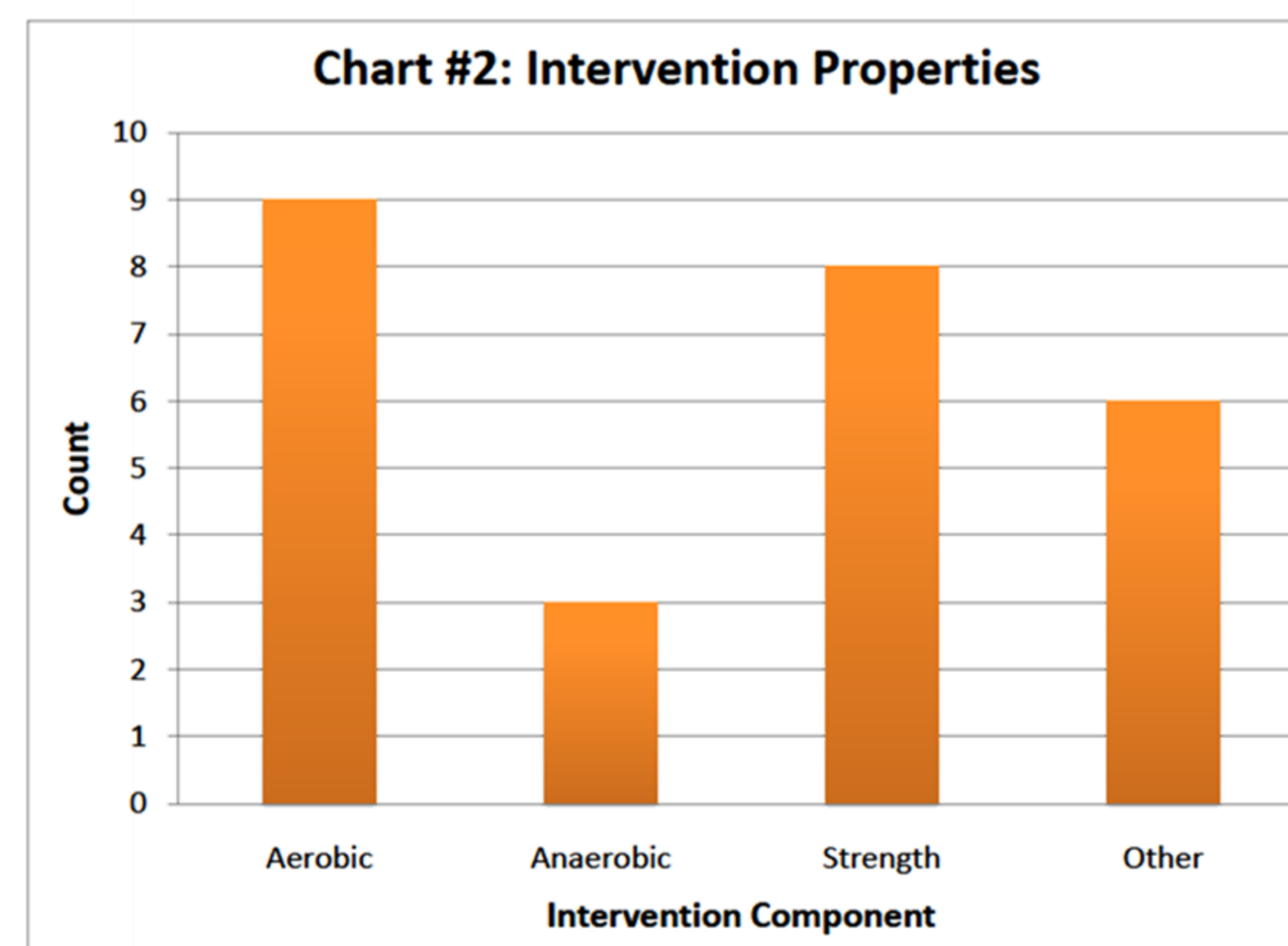
Chart #3: Outcome Measures



Appendix #2: Intervention Component Expanded

Study	Component			
	Aerobic	Anaerobic	Strength	Other
14		Loaded Sit to Stand	Loaded Sit to Stand	
15	Individualized Program		Individualized Program	
16	Partial Body Weight Supported Treadmill			
17	Body Weight Supported Treadmill			
18	Functional Circuit Aerobic Training	Anaerobic Circuit Training	Strength Circuit Training	
19	Static Bicycling	Static Bicycling	Heel Raises (Loaded)	
8	Bicycle Warmup		Resistance Training (Easy, Med, Heavy Load)	
21			Circuit Strength Training	
22			Progressive Resistance/ Specificity	
23				Task-oriented training
24	Body Weight Supported Treadmill			
25				Lower limb training vs upper limb dexterity
26				Hippotherapy
27			Squat-stand, lateral step-up, stair walk, isometric exercise of the lower limbs, isokinetic exercise using a bicycle	
28				Fine motor and manipulative gross motor activities
29				Individualized motor skills in water vs fundamental skills on land (control)
30				Sport training (included aquatic exercise)
31	Backstroke and Crawl			
COUNT	8	3	8	6

Chart #2: Intervention Properties



Appendix #4: Expanded Outcome Measures

Study	Outcome			
	Body function	Activity	Participation	Other
14	1-Rep Max of STS, Gait Speed, Isometric strength of knee extensor, Physiological Cost Index	GMFM-66 (Dimension D&E)		
15	Oxygen cost of arm cranking, aerobic capacity, VO2 max	GMFM-66 (Dimension D&E)		
16	Self-selected 10m walking speed, 10-minute walk test	GMFM-66 (Dimension E)		
17	Six minute walk test, energy expenditure measurement, 10 metre walking velocity, single leg balance test	GMFM-66 (Dimension D&E)		
18	10m Shuttle Run, Muscle Power Sprint Test, BML agility, muscle strength	GMFM-66 (Dimension D&E)	Children's Assessment of Participation & Enjoyment (CAPE)	Self-Perception Profile for Children, Health-Related Quality of Life (TAQOOL)
19	Ankle dorsiflexion ROM, Timed-Up and Go (TUG), Functional Mobility Scale, Gillette Functional Assessment Questionnaire, # Heel Raises, 3-D Gait Pattern	GMFM-66 (Posture and Ability) & GMFM-66 (Dimensions D&E)		
20	Muscle strength measurement, 3D gait analysis, joint ROM, grading of spasticity	GMFM-66 (Dimensions D & E) - converted to GMFM-66		
8	3-D Gait Analysis			Self-perception of body image & functional competence
21	Ankle strength/ plantarflexor spasticity, gait, end-range dorsiflexion	GMFM-66 (Dimension E), GMFM-66		Quality of life (PedQL 4.0)
22	TUG	GMFM-66 (Dimension D&E)		
23	Gait velocity, stride length, cadence, double-limb support time, muscle tone, motor control	GMFM-66		
24	TUG, Uptime, 10-minute walk test, Isometric strength of knee extensors, Upper limb speed and dexterity (BOTMP, Box & Blocks Test, Handwriting Speed Test, NK Dexterity Board)	GMFM-66 (Dimension D&E) - converted to GMFM-66		
25		GMFM-66		Cerebral Palsy Quality of Life Questionnaire for Children, KIDSCREEN, Child Health Questionnaire
26	Muscle tone (Modified Ashworth Scale)/ strength (Manual Muscle Test), # squat-stand/ lateral step-ups (30min), 3D gait analysis	GMFM-66 (Dimension D&E)		Caregiver survey for extremity use
27	Assisting hand assessment, Accelerometry, Bruininks-Oseretsky Test of Motor Proficiency, Jebsen-Taylor Test of Hand Function, Kinematics of a Drawer opening test			
28	Pediatric Evaluation of Disability Inventory (PEDI), Aquatic Independence Measure (AIM)		PEDI (social function)	Pictorial scale of perceived competence and social acceptance for children with CP
29	Motor skills - gross (throw & catch, stretching, zigzag running, protraction, side/ forward walking on a balance board, flexibility, dynamic flexibility) and fine (cube building, stringing beads)			
30				
31	Spasticity (R/L hip adductors, knee flexors), ROM (R/L Shoulder, hip and knee)	GMFM-66 (Dimension D&E)		
COUNT	17	13	2	6

CONCLUSION

- This literature search shows that the focus and compatibility of research since the Verschuren (2008) article has not improved.
- These results call for the implementation of studies that use a common validated outcome measure.

Acknowledgements:

*Stay-FIT Study Group Includes: Dr. J.W. Gorter, Dr. B. Timmons, Dr. P. Rosenbaum, Dr. B. Palisano, Dr. V. Wright.