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Effect of Equine-assisted Activities and Therapies on Cardiorespiratory fitness in children with Cerebral Palsy : A Randomized Controlled Trial

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Cerebral Palsy

- + Cerebral palsy (CP) is defined as a group of permanent disorders of the development of movement and posture, causing activity limitation.
- + The main impairments include reduced muscle strength and cardiorespiratory fitness (CRF), resulting in difficulties performing activities of daily living.



Cardiorespiratory fitness (CRF)

- + Cardiorespiratory fitness (CRF) refers to the ability of the circulatory and respiratory systems to supply oxygen to skeletal muscles during sustained physical activity.

A strong independent predictor of all-cause mortality.

- + Early childhood (0-6 years) is a critical age for children with CP to adopt either an active or sedentary lifestyle.
- + Therefore, an early intervention to increase habitual physical activities and CRF is important to maintain a healthy lifestyle and quality of life in people with CP.

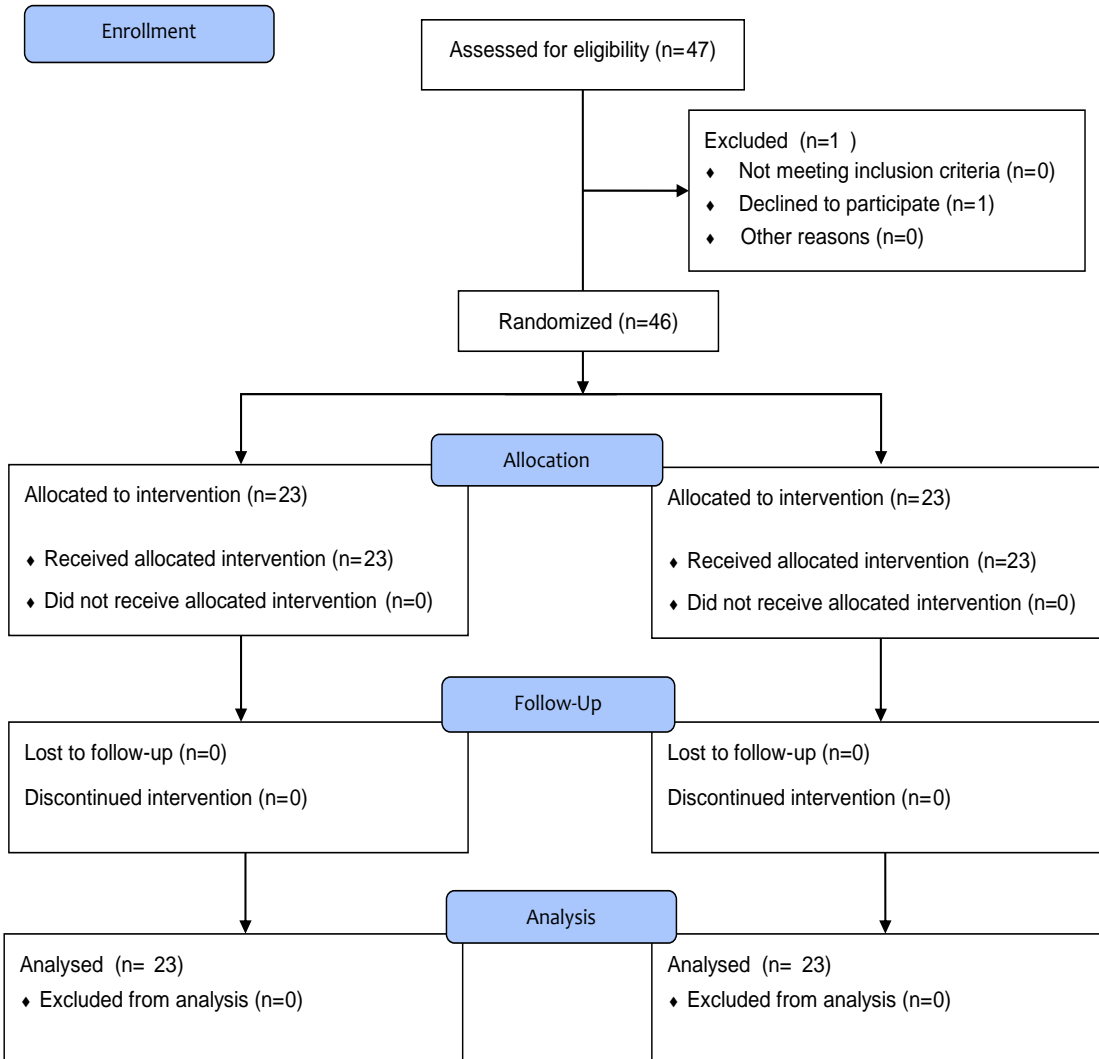
Equine-assisted activities and therapies (EAAT) on CRF

- + Eight-week hippotherapy (16 sessions) significantly decreased energy expenditure in children with ambulatory spastic CP, aged 9 to 11 years (McGibbon et al).
- + EAAT will less likely improve CRF in children with CP, considering the short duration of maintaining moderate to vigorous exercise activity during the lesson combined with the low training frequency (Bongers and Takken).

Purpose

- + This study aimed to evaluate the effects of a 16-week EAAT program (40 minutes per session, twice a week, 32 sessions) on CRF in children with CP.

CONSORT 2010 Flow Diagram



Study Design

Participants

INCLUSION

- + CP diagnosis
- + Children classified as having Gross Motor Function Classification System (GMFCS) level I, II, or III CP
- + Aged 6-12 years
- + Body weight <35 kg.

EXCLUSION

- + Injection of botulinum toxin within 3 months
- + Selective dorsal rhizotomy or orthopedic surgery within 1 year
- + Poor visual acuity
- + Hearing impairment
- + Severe intellectual disability
- + Uncontrolled seizures
- + hip dislocation
- + Scoliosis Cobb angle >30°
- + Unhealed fracture.

Intervention

- + The lesson was semi-private: the ratio between the instructor and participants was 1:2 or 1:3.
- + Four well-trained ponies (average height, 135 cm; average weight, 294 kg)
- + 32 sessions (40 minutes per session) twice a week for 16 week
- + After the 1 or 2-week adaptation period, repetitions of trot and normal walk were progressively increased to facilitate CRF according to the individual's riding ability

Outcome Measures

- + Motor capacity

 - Gross Motor Function Measure (GMFM), GMFM88 & GMFM66

 - Pediatric Balance Scale (PBS)

 - Timed Up and Go test (TUG)

 - 6-minute walk test (6MWT)

- + Symptom-limited cardiopulmonary exercise test (CPX) using a treadmill (TrueOne 2400, ParvoMedics, Inc., Salt Lake City, UT)


 - Modified Naughton protocol

- + Habitual physical activity

 - Triaxial accelerometer (model GT3X, ActiGraph, LLC, Pensacola, FL)

Statistical analysis

- + The differences in values pre- and post-intervention between the groups
 - : independent t-test or Mann-Whitney test
- + The training effect between each group
 - : The paired t-test or Wilcoxon rank sum test
- + Linear regression analysis was performed to determine the factors affecting the amount of HRrest change



Result

Demographics & clinical Characteristics

	EAAT (N=23)	Control (N=23)	p-value
Age (y)	7.74±1.63	7.22±1.48	0.261
Height (cm)	123.37±8.83	123.91±11.49	0.858
Weight (kg)	24.82±5.04	24.60±5.78	0.893
Sex (male/female)	12/11	12/11	0.429
GMFCS level (I/II/III)	10/9/4	11/10/2	0.882
Bilateral/unilateral cerebral palsy	13/10	14/9	0.470

Change of motor capacity after the intervention

	EAAT (N=23)			Control (N=23)			p-value
	Pre-intervention	Post-intervention	Difference	Pre-intervention	Post-intervention	Difference	
GMFM66	77.91±11.96	80.15±12.68	2.24±2.32 ^a	83.57±13.01	84.38±12.61	0.81±0.97 ^a	0.023
PBS	46.61±13.00	49.09±11.80	2.48±2.00 ^a	51.96±5.41	52.26±4.93	0.30±0.88	0.000
TUG (sec)	8.82±3.52	7.26±2.59	-1.55±1.19 ^a	12.61±16.82	11.27±15.10	-1.33±3.64	0.024
6MWT (m)	349.83±92.78	387.04±110.75	37.22±49.52 ^a	351.52±103.72	364.96±95.05	13.43±37.47	0.014

The PBS, TUG, and 11 6MWT results improved only in the EAAT group, and the difference between the two groups was statistically significant (p<.05)

Change of cardiorespiratory fitness after the intervention

	EAAT (N=20)			CONTROL (N=21)			P-VALUE
	Pre-intervention (N=20)	Post-intervention (N=20)	Difference (N=20)	Pre-intervention (N=21)	Post-intervention (N=21)	Difference (n=21)	
Exercise time (min)	11.49±2.21	12.94±2.20	1.45±1.42 ^a	11.17±4.35	12.15±4.95	1.25±1.83 ^a	0.341
VO ₂ peak (mL/kg/min)	24.74±2.66	26.58±3.91	1.84±4.33	26.31±4.19	26.18±4.23	-0.09±3.57	0.066
VE(L/min)	21.79±6.22	23.69±7.51	1.90±4.99	21.38±6.97	21.20±5.16	0.18±4.11	0.236
RER	.98±.04	1.01±.06	0.04±0.05 ^a	.98±.05	.98±.06	0.01±0.05	0.106
HR _{rest} (beat/min)	92.20±14.65	79.80±7.45	-12.40±11.980 ^a	92.00±15.36	90.95±12.93	-0.62±8.41	0.008
HR _{max} (beat/min)	169.10±13.99	170.05±12.61	0.95±13.15	168.62±16.30	167.64±15.27	-0.90±9.17	0.605
SBP rest (mmHg)	102.80±8.63	101.50±6.55	-1.30±7.03	102.45±11.07	101.50±9.34	0.05±6.29	0.521
DBP rest (mmHg)	69.65±8.04	68.10±7.64	-1.55±8.22	66.40±8.56	66.18±8.55	0.52±7.73	0.410

Change of physical activity after the intervention

	EAAT (N=23)			Control (N=23)			p-value
	Pre-intervention	Post-intervention	Difference	Pre-intervention	Post-intervention	Difference	
%SPA	73.13±6.30	74.99±6.66	1.86±5.07	70.75±5.21	70.13±8.24	-0.61±4.86	0.098
%LPA	22.41±5.18	20.84±5.49	-1.58±4.41	23.64±4.21	23.88±6.13	0.24±3.74	0.139
%MPA	3.10±1.19	2.81±1.01	-0.28±0.67	3.65±1.24	3.78±1.40	0.13±1.00	0.109
%VPA	1.34±1.08	1.35±0.95	0.00±0.53	1.95±0.99	2.20±1.33	0.25±0.75	0.307
Activity (counts/min)	809.58±253.82	771.61±250.36	-37.97±147.50	946.89±236.51	967.83±319.92	20.94±180.53	0.223

Outcome of linear regression analysis

Parameter	Reference	Estimate	Standard Error	t-value	p-value
Intercept		746.75	128.90	5.79	<0.0001
Group	2 (1)	194.09	42.84	4.53	<0.0001
GMFM66 score		12.88	9.66	1.33	0.1914
PBS score		12.24	13.08	0.94	0.3561
TUG result		-9.28	6.60	-1.41	0.1689
HRrest		-5.82	1.24	-4.71	<0.0001

Conclusion

EAAT Effect on HRrest

- HRrest was decreased at the end of the 16-week EAAT program in children with CP.
- This decrease was not explained by the improvement of motor capacity (GMFM, PBS, and TUG results) but by the intervention (EAAT or control).

Effort to CRF improvement

- The increased risk of cardiometabolic diseases in people with CP is associated with low CRF
EAAT may be among the endurance training programs that can be provided to children with CP to improve their CRF.

**Thank you,
Any
questions?**

