Adapted Dynamic Cycling for Children and Young People with Cerebral Palsy: A Pilot Study

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Outline

• Background
• Methods
• Results
• Limitations
• Discussion
• Conclusions and Implications
• Acknowledgements
• Questions
Participation: Ethical considerations


Article 12: ‘children have a right to say what they think and have their opinions taken into account’

Article 31: ‘children have a right to relax, play and join in a wide range of activities’

Article 23: ‘children with a disability should have special care and support so they can lead full and independent lives’

Regular moderate intensity physical activity e.g. walking and cycling have significant benefits for health

<table>
<thead>
<tr>
<th>Cycling as Participation</th>
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<td><strong>Cycling: a childhood milestone</strong></td>
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<td><strong>Appropriate cycles and adaptations</strong></td>
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<td><strong>Assessment &amp; on-going evaluation by suitable professional/s</strong></td>
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Medical Model: Disability is inherent in the person
Social Model: Disability is an interaction between individuals and their environment (ICF: WHO, 2001)

Child with Cerebral Palsy (condition)

Sensory deficits, altered muscle activation patterns and muscle weakness

Cycling as an Activity could potentially strengthen, intrinsic as well as augmented feedback

Child in society (social position) Participation

Personal Factors

Environmental Factors
Figure 1: The trajectory of muscle strength with age in a typically developing individual. The dotted line indicates the threshold muscular strength required to perform a particular task (e.g. sit-to-stand).
Figure 3: The trajectory of muscle strength in individuals with cerebral palsy (dash-dot line) and in typically developing individuals (solid line).
Figure 4: The potential impact of an intervention on the trajectory of muscular strength in an individual with cerebral palsy (dashed line). The trajectory of muscular strength without the intervention is also illustrated (dash-dot line), as is the trajectory for a typically developing adult (solid line).
Effects of Adapted Dynamic Cycling

Quantitative Measures: Hamstring length (PA) and Hamstring and Quadriceps Strength

Qualitative: Cycling and Physical Activity participation - interviews and diaries

Phase 1 – included children and young people with CP attending Pedal Power (17 children)

Phase 2- included children and young people with CP not / not yet cycling (18 children)
Methods

• Mixed Methods: Different Subject Experimental Design
• Pre- & Post Intervention assessment
• Ethical Approval: School of Healthcare Studies Research Ethics Committee, Cardiff University, IRAS
Intervention: Cycle Path
Results- Demographics

- Aged 2-17 years
- Cycling Group: n= 17 (7 males, 10 females)
  - 8 Quadriplegia, 8 Diplegia, 1 Hemiplegia
- Non cycling group: n=18 (13 males, 4 females)
  - 7 Quadriplegia, 4 Diplegia, 7 Hemiplegia

<table>
<thead>
<tr>
<th>GMFCS Palisano et al (1997)</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
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<tbody>
<tr>
<td>Cycling Group</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>7</td>
<td>0</td>
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<tr>
<td>Non cycling group</td>
<td>3</td>
<td>8</td>
<td>4</td>
<td>3</td>
<td>0</td>
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</table>
## Results - Quantitative

<table>
<thead>
<tr>
<th>Groups</th>
<th>R Quads</th>
<th>L Quads</th>
<th>R Hams</th>
<th>L Hams</th>
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</thead>
<tbody>
<tr>
<td>Cycling Group</td>
<td>+ 12.4 N ± 6.5</td>
<td>+ 15.56 N ± 13.87</td>
<td>+ 5.19 N ± 3.5</td>
<td>+ 4.23 N ± 5.94</td>
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<tr>
<td>Control Group</td>
<td>-3.62 N ± 4.73</td>
<td>-0.14 N ± 1.4</td>
<td>-1.03 N ± 0.06</td>
<td>-1.05 N ± 3.05</td>
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**Cycling Group – Within Group: Wilcoxon Ranks Sign Test**

Significant Quadriceps changes: (R) p=0.018; (L) p=0.021

Non-significant Hamstring changes: (R) p=0.065; (L) p=0.069
Results: Inferential Comparisons

Repeated Measures ANOVA & ANCOVA
No statistical significance between groups

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<tr>
<td>R Quads</td>
<td>0.76</td>
</tr>
<tr>
<td>L Quads</td>
<td>0.79</td>
</tr>
<tr>
<td>R Hams</td>
<td>0.83</td>
</tr>
<tr>
<td>L Hams</td>
<td>0.83</td>
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Discussion

• Children with CP changing body mass: strength ratio

• Physical activity participation may be an enjoyable way of maintaining or increasing strength- what are the opportunities for CP?

• Strength gains through neural changes via internal feedback, augmented by external feedback and goal directed strategies
Thematic analysis

Pickering et al, 2012

Figure 2 Themes

Key:
Clear boxes are topics being explored
Shaded boxes show emerging themes

Child with CP

Measurement data

Interview and diary data

IMPACT ON CHILD AND FAMILY

Cycling skills
Developments over time
Social Participation
Health Benefits
Other skills

Enriched environments
Other physical activities

Aspirations
Parents/Carers/School staff

Pedal Power Cardiff

Facilitators
Barriers

Staff + volunteers
Environment

Adapted Dynamic Cycling
Technical setup of bike

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Aspirations

Peter’s Mum: “Gabriela put him on the Tom Cat trike, strapped his feet in and it was the first time ever he pedalled and he couldn’t stop it. Everybody got so emotional, fantastic. It just shows if you’ve got the tools for the job, the right equipment, you can do it…This year we cycled from Bristol towards Windsor because we could hire the special trike….I think completely independently he cycled not far off 40 miles…”

Peter aged 7 years Diplegia, High tone, GMFCS I
Social Participation Publication pending, 2013

• Interview

“...at the caravan park it was much easier than walking ...I cycled quickly with my friend and we chased each other on bikes and went To buy sweets at the village shop...we cycled on our own without Mum and Dad to the ‘lagoon’[see drawing]...when I don’t have my bike I tag along with others for a while...ponder my thoughts... get bored... In the city there aren’t enough safe places to cycle but at the caravan its easier to get around- it’s a clever ,clever invention whoever invented it I want to thank them.....”

• Diary drawing

Diane was 10, GMFCS II and has Diplegia
Andrew’s cycling skills

Recumbent Trike steered from side

Andrew was able to describe his cycling experiences: ‘…when I pedal it’s like I’m there and I am enjoying it…we cycle in the park and I go down the slope…and then I change it…. you know… I put into 3 (gears) and it makes me fast…’

Dad describes his progress ‘…he loves biking, obviously it gives him that independence…they’ve taken the footplates away..’

Andrew progressed to going cycling with a carer (Bethan)

Dad: ‘…Bethan actually cycles with Andrew and they now do four circuits rather than the one or two he did before….’

Andrew 17 years and GMFCS level II with diplegia, athetosis and autism
Non cycling group analysis - physical activities + cycling

Wheel of Participation
May’s Cycling Ambitions

May’s own Diary entry (aged 10 years)

Today I had a 20 mins bike ride with my sister and brother to RK secondary school car park there are loads of bends, curbs, bays and car spaces. I have come on really well considering me and my family all thought I wouldn’t be able to achieve such a brilliant opportunity, we also thought I am going to be doing a bike prefishsniy test after easter so we have been practising weving in and out and signalling left and right the right is really easy for me but the left is what I find tricky. and I am also learning that I have to ride on the left on the road.

May

Interview:

Int: … So assuming you pass your cycling proficiency test, what do you hope to do with your cycling?
M: …to get better and better at it.
Int: Where would you like to go with your bike?
M: H Forest
Int: Have you been there already?
M: Yeah but I had to go on a ‘stupid tandem’ because my teacher kind of forced me…another Dad pedalled..
Mum: …It was sort of an ice cream basket on the back..
Int: So you didn’t do any pedalling at all?
M: No which was really, really, really disappointing…cos all my other friends were like riding a bike and I was lonely….
Ghost’s interview (GMFCS III)

‘I walk most of the time but its just like those Few days when I’m not very active and I need the wheelchair..the kids in school say ‘why Are you in a pram’?’

‘We tried to go on the bumper cars… I’ve been on them before…but the man asked my mum if I was disabled and he said we don’t really have people with disabilities on here….’
Change in cycling activity ‘Ghost’

“Didn’t think he would ever be able to ride a bike”
Lack of physical activity
‘Murray’ aged 4 years, Diplegia GMFCS III
Fatigue

Rugby 11 years
GMFCS IV: “After trying the trike my legs feel aching”

Ghost 10 years
GMFCS III
“My legs was killing me after 15 minutes of lazer tag”

Wayne 7 years
GMFCS II
“Legs get too tired after riding a bike so don’t do it very often”

Suarez 8 years
GMFCS III
“My legs hurt for 3 days after riding the trike”
Change in behaviour

- 11 of the 18 children started cycling during or after the study was completed
Limitations:

- Small sample size
- Convenience volunteer sample
- Wide age ranges and GMFCS abilities
- Insufficient intervention period (6/52) & intervention frequency (x1 per week)
- Difficult to standardise and monitor intervention – participant specific
- Availability for hiring adapted bikes limited
- Weather
Conclusions and Implications

- Adapted dynamic cycling has potential social and physical health benefits

- Observed improvements in cycling skills and strength trends deserve further investigation with larger sample sizes

- Therapists, educators and policy makers should consider adapted dynamic cycling opportunities for children and young people with disabilities
Acknowledgements

- Nancie Finnie Charitable Trust
- Children, families and carers who took part
- Pedal Power Trustees
- Bike-shed staff and volunteers
- BBC Children in Need
- Jenx Ltd
- Polar
- NHS physiotherapists in England and Wales who helped us recruit to control group, as well as Contact a Family, Cerebra and Scope.
THANK YOU FOR LISTENING

ANY QUESTIONS?