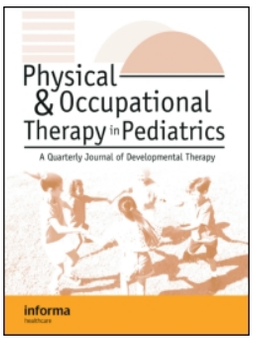

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Interventions to Improve or Maintain Lower-Limb Function Among Ambulatory Adolescents with Cerebral Palsy: A Cross-Sectional Survey of Current Practice in the UK

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ABSTRACT

Objectives: To describe physiotherapy management to improve or maintain lower-limb function among adolescents with cerebral palsy, classified in Gross Motor Function Classification System levels I–III, in the United Kingdom (UK). *Methods*: A list of interventions was identified using a nominal group technique and developed into a survey, which was distributed to approximately 2,100 pediatric physiotherapists in the UK through the Association of Pediatric Chartered Physiotherapists and a private physiotherapy clinic in London between April and June 2015. One-hundred and thirty-five physiotherapists completed the survey. Survey respondents indicated how frequently they used each intervention (i.e., "frequently," "sometimes," "rarely," and "never") in the past year. *Results*: Provision of explanations to the child, liaison with families, liaison with health professionals, provision of advice to schools, and stretching were the most frequently used interventions with 90%, 90%, 86%, 79%, and 76% of respondents, respectively, reporting that they frequently used each. The interventions most commonly reported as "never" used were conductive education (88%), MOVE programme (85%), functional electrical stimulation (82%), body-weight supported treadmill training (80%), and rebound therapy (71%). *Conclusions*: This study suggests that a large number of interventions are used by physiotherapists in the United Kingdom to improve or maintain lower-limb function among adolescents with CP, not all of which are evidence-based.

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Cerebral palsy; adolescents; activity; body structures and functions; physiotherapy interventions

Introduction

Cerebral palsy (CP) is a common cause of childhood disability with a prevalence rate of approximately 2.1 to 2.3 per 1000 live births in the United Kingdom (UK) (SCPE 2002), suggesting that approximately 1500 children born each year are subsequently diagnosed with CP. According to the most recent definition, CP "describes a group of permanent disorders of the development of movement and posture, causing activity limitation, that are attributed to nonprogressive disturbances that occurred in the developing fetal or infant brain" (Rosenbaum et al., 2007). Although the definition acknowledges that CP is accompanied by other disorders such as disturbances of sensation, cognition and communication, and by epilepsy

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and secondary musculoskeletal problems, motor disorders remain the key feature of CP (Rosenbaum et al., 2007).

Even though CP is caused by a nonprogressive disturbance to the brain, a person's functional ability may not remain stable over time. On average, children with CP reach 90% of their motor function by around age 5 years, and development of motor function plateaus by about 7 years (Rosenbaum et al., 2002). In a population of European children with CP, 54% of children were able to walk unaided and a further 16% were able to walk with assistive devices by age 5 years (Beckung et al., 2008). However, 23% of children who can walk and climb stairs at age 10 years will experience a decline in walking ability by age 25 years (Day et al., 2007). Approximately a quarter of 10-year-old children with CP who can walk alone but require some assistance with stair climbing are also likely to experience deterioration in walking by age 25 years (Day et al., 2007). The decline in mobility among people with CP is steeper in adulthood. Around 25% of adults who can walk and climb stairs and 30% of adults who can walk but require a handrail for stairs at age 25 years will experience a decline in function over the following 15 years (Day et al., 2007). This prognosis is supported by the findings of Opheim et al. (2009) who found that 52% of adults with CP aged 18 to 70 years experienced deterioration in their walking ability over a 7-year period. The provision of physiotherapy to people with CP in adolescence and young adulthood may play an important role in preventing this decline in function among young adults with CP.

Physiotherapy is a core part of rehabilitation for people with CP. The evidence to support the effectiveness of physiotherapy remains equivocal however (Franki et al., 2012; Jeglinsky et al., 2010), resulting in variations in the duration, frequency, and content of physiotherapy provided to people with CP. Current research suggests that despite the fluctuation in mobility status across the lifespan of a person with CP, the amount of physiotherapy provided to people with CP does not remain constant throughout their life (Majnemer et al., 2014; McDowell et al., 2015). Between 90% and 94% of parents of preschool children with CP stated that their child received physiotherapy (Myrhaug et al., 2014; Palisano et al., 2012). However, only 63.7% of parents of children with CP aged 6 to 12 years and 51.8% of parents of adolescents with CP aged 12 to 19 years reported that their child received physiotherapy (Majnemer et al., 2014). The same study reported that the vast majority of adolescents with CP who attended mainstream school did not receive rehabilitation services to improve function (Majnemer et al., 2014). Although severity of CP is likely to confound these figures, the proportion of people in the UK with moderate to severe CP who reported having contact with a physiotherapist in the previous 6 months declined from 97% for a person aged 4 to 11 years to 28% for a person aged 19 to 27 years (McDowell et al., 2015).

While the current literature suggests that adolescents with CP receive less physiotherapy than children with CP, the content of physiotherapy for adolescents has not been described. Improving mobility is often a primary therapeutic goal among people with CP (Vargus-Adams et al., 2011). However, as described above, walking deteriorates for many people with CP from childhood to young adulthood. A wide range of treatments targeted at improving lower-limb function currently exist (Novak et al., 2013), suggesting that the content of physiotherapy for adolescents with CP may vary widely across the UK. A description of current physiotherapy management of adolescents with CP in the UK is required to direct clinical practice, identify areas for further research into the effectiveness of interventions for adolescents with CP, and inform physiotherapy education. The aim of this study was to describe current interventions that are used by physiotherapists in the UK to improve or maintain lower-limb function among adolescents with CP.

Methods

Development of Survey Instrument

A modified nominal group technique (NGT) was used to develop a list of interventions used to improve or maintain lower-limb function in adolescents with CP (aged 12 to 19 years), classified in Gross Motor Function Classification System (GMFCS) levels I–III. Nominal group technique is commonly used to gather the opinion of health professionals and develop consensus among them, although there is some variation in how NGT is described and used in the literature (Foth et al., 2016). A modified NGT was used in this study to collect information on current physiotherapy practices in order to develop a survey rather than achieve consensus. Participants were ten pediatric physiotherapists (all female) from a large National Health Service (NHS) trust in London. The NHS refers to the public health services provided to people in England, Scotland, Wales and Northern Ireland. All members of the pediatric physiotherapy team in this trust were invited to participate, regardless of whether or not they had an adolescent with CP on their current caseload, in order to capture the opinion of therapists with a range of experience. The number of years of experience that participants had as pediatric physiotherapists, the settings in which the participants worked as pediatric physiotherapists, and the proportion of clients on their current caseload who were adolescents with CP are described in Table 1.

Participants were asked to consider the following question and write down all ideas that came to mind: "What interventions do physiotherapists use to improve or maintain lower-limb function among adolescents with cerebral palsy (GMFCS levels I-III)?". Before

Table 1. Description of participants in the nominal group technique.

Participant	Experience as a pediatric physiotherapist (yr)	Settings participant worked in as pediatric physiotherapist	Setting participant currently works in as pediatric physiotherapist	Proportion of clients on current caseload who are adolescents with cerebral palsy (%)
1	5 to 8	Inpatient, acute Inpatient, rehabilitation Community, rehabilitation Outpatient, rehabilitation	Community, rehabilitation	0
2	> 8	Inpatient, acute Community, rehabilitation	Community, rehabilitation	0
3	0 to 2	Community, rehabilitation Outpatient, rehabilitation	Community, rehabilitation	1 to 25
4	> 8	Inpatient, rehabilitation Community, rehabilitation	Community, rehabilitation	26 to 50
5	> 8	Community, rehabilitation	Community, rehabilitation	1 to 25
6	0 to 2	Community, rehabilitation Inpatient, acute Outpatient, rehabilitation	Community, rehabilitation Special needs school	1 to 25
7	0 to 2	Community, rehabilitation Special needs school	Community, rehabilitation Special needs school	1 to 25
8	5 to 8	Community, rehabilitation Outpatient, rehabilitation Special needs school	Outpatient, rehabilitation	0
9	> 8	Community, rehabilitation Inpatient, acute	Community, rehabilitation Special needs school	1 to 25
10	0 to 2	Community, rehabilitation Outpatient, rehabilitation Inpatient, acute	Inpatient, acute Outpatient, rehabilitation	1 to 25

considering the question they were told that an intervention referred to "any intervention provided by a physiotherapist targeted at body structures and functions (e.g., muscle strength, spasticity, flexibility, fitness), activity (e.g., walking, running, jumping, stair-climbing), or a combination of these." No consultation or discussion occurred during this phase. After participants had individually written down answers to this question, each person was asked to give one intervention at a time in a "round robin" format until all interventions had been exhausted. A member of the research team acted as the facilitator to this process. Participants were permitted to write down any new interventions that came to mind during this process and share them on their next turn. Once all ideas were collected, the facilitator led a discussion to clarify and debate the interventions provided, and eliminate any duplications. For example, the group was asked if the title listed for an intervention was clear or if any interventions were essentially the same. A list of the interventions identified during this process was provided to the physiotherapists to comment on prior to the development of the survey. The NGT resulted in thirty-nine interventions being identified. Descriptions of interventions that may not be commonly known are provided in Table 2. An online survey was developed using the results of the NGT and piloted with ten physiotherapists prior to distribution. Following piloting, minor changes were made to the sequence of questions and the structure of the introduction and some questions in order to improve clarity.

Table 2. Description of interventions identified by focus group.

Intervention	Description	To access further information
Rebound Therapy	Therapeutic use of the trampoline	Rebound Therapy Association of Chartered Physiotherapists (2007) "Safe Practice in Rebound Therapy." Retrieved from http://www.csp.org.uk/sites/files/csp/secure/safe_practice_in_rebound_therapy_01_10_16_0.pdf (Accessed 19 April 2017). Smith, S. and Cook, D. (1990) A Study in the Use of Rebound Therapy for Adults with Special Needs. Physiotherapy, 76 (11), pp. 734–735.
MOVE programme	An activity-based programme combining therapy with an instructional process designed to help the individual acquire motor skills	MOVE International. What is MOVE? Retrieved from http://www.move-international.org/what-is-move/
Postural management	A planned approach to support good posture, usually throughout a 24-hour period, that is tailored specifically to the individual and may include specialist equipment (e.g., special seating, standing frames, orthotics) exercise and therapy.	Enable Ireland. Guide to postural management. Retrieved from http://www.enableireland.ie/sites/default/files/publication/Guide%20to%20Postural%20Management.pdf (Accessed 19 April 2017). NICE (2016) Clinical guideline 145; Spasticity in under 19s: management. Available at: nice.org.uk/guidance/cg145 (Accessed 19 April 2017).
Lycra	Lycra splints or suits consist of sections of lycra stitched together using specific tensions and directions of pull.	Healthcare Improvement Scotland (2005) Dynamic lycra splinting for children with cerebral palsy: evidence note 11. Retrieved from http://www.healthcareimprovementscotland.org/our_work/technologies_and_medicines/earlier_evidence_notes/evidence_note_11.aspx (Accessed 19 April 2017).

Description of Survey Instrument

At the start of the survey participants were informed that the aim of the survey was to get an overview of current interventions that are used by physiotherapists in the UK to improve or maintain lower-limb function in adolescents (aged 12 to 19 years) with CP in GMFCS levels I-III. Participants' gender, age, year of qualification, number of years of experience as a physiotherapist, and number of years of experience as a pediatric physiotherapist in the UK were collected. They were also asked to select the settings that they worked in as pediatric physiotherapists (previous and current), the region of the UK that they worked in, and the current proportion of their clients who were adolescents with CP. Participants were then asked to indicate how frequently they had used a list of interventions in the past year to improve or maintain lower limb function in adolescents with CP. Participants were asked to rate the frequency of use of interventions as "frequently = more than once per month in the past year," "sometimes = once per month in the past year," "rarely = less than once per month in the past year," "never = 0 times in the past year." The final question was an open-ended question that asked participants if they had any additional comments on the topic.

Participants

Participants were physiotherapists who had experience treating adolescents with CP. The survey was distributed to pediatric physiotherapists throughout the UK through the Association of Pediatric Chartered Physiotherapists (APCP) and a private physiotherapy clinic in London between April 2015 and June 2015. The APCP is a Professional Network of the Chartered Society of Physiotherapy in the UK for physiotherapists working in pediatrics. Gatekeepers in the respective organizations sent an email invitation, a participant information leaflet, and a link to the survey to its members/staff. There were approximately 2,100 people on the mailing list for the APCP. Ten physiotherapists in the private physiotherapy clinic received the survey. Ethical approval was granted by Brunel University London, College of Health and Life Sciences Research Ethics Committee (reference 15/04/NEU/15).

One-hundred and thirty-five physiotherapists completed the survey. The majority of respondents were female (99%). Participants received their preregistration qualification allowing them to practice as a physiotherapist between 1968 and 2013. The median (IQR) years of experience as a physiotherapist was 17.5 (17.0) (range, 2 to 43), and the median (IQR) years of experience as a pediatric physiotherapist in the UK was 14.0 (15.0) (range, 0 to 43). Participants reported that adolescents with CP made up 0% (5 participants, 4%), 1 to 20% (75 participants, 56%), 21 to 40% (31 participants, 23%), 41 to 60% (14 participants, 10%), or 61 to 80% (10 participants, 7%) of their current caseload. The age-range of participants, the type of settings that participants worked in, and the regions of the UK that participants worked in are reported in Table 3. Where participants stated that they had previously worked in "other" settings, these settings included a hospice, a specialist rehabilitation center, hydrotherapy, mainstream schools, and a specialist transition service for adolescents.

Data Analysis

After assessing the amount of missing data participants were only removed from the analysis for the respective question they failed to answer. Missing data for responses relating to the frequency that each intervention was used ranged from 0.0% to 8.8%. Where applicable, data were checked for a normal distribution using the Kolmogorov–Smirnov test. Descriptive

Table 3. Demographic and professional characteristics of participants (n = 135).

Characteristic		n (%)
Age (yr)	20 to 30	15 (11)
	31 to 40	47 (35)
	41 to 50	32 (24)
	51 to 60	33 (24)
	≥ 61	8 (6)
Settings (previously worked in)	Inpatient, acute	88 (65)
	Inpatient, rehabilitation	68 (50)
	Community, rehabilitation	127 (94)
	Outpatient, rehabilitation	69 (51)
	Special needs school	117 (87)
	Other	23 (17)
Sector (currently working in)	Private	19 (14)
	NHS	96 (71)
	Both private and NHS	11 (8)
	Other	9 (7)
Settings (currently working in)	Inpatient, rehabilitation	88 (65)
	Community, rehabilitation	108 (80)
	Outpatient, rehabilitation	34 (25)
	Special needs school	69 (51)
	Other	15 (11)
Region of the UK (currently working in)	East Anglia	16 (12)
	Kent	6 (4)
	London	21 (16)
	Manchester	2 (2)
	Merseyside	3 (2)
	Northern Ireland	2 (2)
	North Trent	1 (1)
	Oxford	1 (1)
	Scotland	16 (12)
	South West	17 (13)
	Surrey and border	3 (2)
	Sussex	2 (2)
	Wales	2 (2)
	West Midlands	11 (8)
	Yorkshire	12 (9)
	Other	18 (13)

statistics were used to describe the demographic and professional characteristics of the sample. Median, interquartile range (IQR), and range were reported for continuous data that were not normally distributed. Frequencies and percentages were reported for nominal data. The number of physiotherapists who reported using each intervention never, rarely, sometimes or frequently was presented as a percentage of the number of respondents for each question. We conducted separate Kruskal–Wallis tests, as there was suggestion that data did not meet the assumption of a normal distribution, to determine if number of years of experience as a pediatric physiotherapist differed across whether an intervention was used frequently, sometimes, rarely or never, for each intervention. If there was evidence of a difference in years of experience according to how frequently an intervention was used post hoc Mann–Whitney U tests were used to determine where the differences were observed. We only included interventions where there were greater than three counts in each category in these analyses so that it was possible to present summary statistics for years' experience in each category. We also examined if the proportion of therapists who used each intervention frequently, sometimes, rarely or never differed between physiotherapists working in private practice or the NHS by conducting Fisher's exact tests.

Where participants had the option to select "other" the frequency of each "other" response was calculated. Content analysis was used to identify issues raised by participants who

responded to the final open-ended question asking them if they had any additional comments on the topic. This was completed by reading a sub-set of the comments and devising a coding frame to describe the thematic content of the comments. Codes were assigned to each comment and the frequency of each code was calculated. Analyses were conducted using SPSS version 20 (Armonk, NY: IBM Corp).

Results

Of the 39 interventions, 13 were reported to be used frequently by more than 50% of respondents. The percentage of participants who reported using each of these interventions "frequently," "sometimes," "rarely," and "never" is presented in Table 4. The percentage of participants who reported using each intervention at least once is the past year, i.e., the combined percentage of participants who reported using each intervention frequently, sometimes, and rarely, is also presented in Table 4.

The top ten interventions that participants reported using frequently were provision of explanations to child (90% of respondents), liaison with families (90% of respondents), liaison with health professionals (86% of respondents), advice to school (79% of respondents), flexibility exercises/stretching (76% of respondents), core stability exercises (75% of respondents), muscle strengthening exercises (74% of respondents), provision of orthotics or splints (72% of respondents), functional activities (72% of respondents), and self-management strategies (67% of respondents).

Of the 39 interventions, 26 interventions were reported to be used frequently by less than 50% of respondents. The percentage of participants who reported using each of these interventions "frequently," "sometimes," "rarely," and "never" is presented in Table 5. The interventions that participants most commonly reported never using were conductive education (88% of respondents), the MOVE programme (85% of respondents), body-weight supported treadmill training (80% of respondents), functional electrical stimulation (82% of respondents), rebound therapy (71% of respondents), treadmill training (61% of respondents), taping (60% of respondents), disability horse riding (59% of respondents), Pilates (54% of respondents), and resistance training with free weights or resistance bands (40% of respondents).

Table 4. Percentage of participants reporting that they used the following interventions frequently, sometimes, rarely, never, and at least once in the past year (for interventions where more than 50% of participants reported using each intervention frequently).

Intervention	n	Frequently	Sometimes	Rarely	Never	At least once[1]
Provision of explanations to child	134	90%	7%	2%	1%	99%
Liaison with families	135	90%	8%	2%	1%	99%
Liaison with health professionals	134	86%	9%	4%	1%	99%
Advice to school	134	79%	16%	4%	1%	99%
Flexibility exercises/stretching	130	76%	16%	6%	2%	98%
Core stability exercises	134	75%	15%	8%	2%	98%
Muscle strengthening exercises	133	74%	20%	4%	2%	98%
Provision of orthotics or splints	133	72%	22%	5%	1%	99%
Functional activities	134	72%	19%	7%	2%	98%
Self-management strategies	132	67%	21%	9%	3%	97%
Postural management	133	62%	19%	16%	4%	96%
Equipment advice and provision	134	62%	22%	13%	3%	97%
Encourage to use community resources and access sporting activities	134	60%	25%	13%	2%	98%

[1]Calculated as the sum of percentages in frequently, sometimes, and rarely for each intervention.

Table 5. Percentage of participants reporting that they used the following interventions frequently, sometimes, rarely, never, and at least once in the past year (for interventions where less than 50% of participants reported using each intervention frequently).

Intervention	n	Frequently	Sometimes	Rarely	Never	At least once[1]
Gait training	133	47%	31%	17%	5%	95%
School assessments	130	43%	31%	20%	6%	94%
Provision of mobility aids	132	42%	30%	23%	5%	95%
Night time positioning	131	39%	24%	23%	14%	86%
Neurodevelopmental therapy	131	39%	21%	21%	19%	81%
Specialist seating	131	36%	26%	21%	17%	83%
Resistance training with body weight	128	31%	31%	17%	22%	78%
Physical education adaptations	127	29%	42%	17%	12%	88%
Hydrotherapy	129	27%	19%	28%	25%	75%
Cardiovascular exercise with gym equipment	129	25%	19%	32%	24%	76%
Muscle endurance exercise with gym equipment	130	18%	19%	29%	34%	66%
Muscle strengthening exercise with gym equipment	128	18%	23%	29%	30%	70%
Lycra	132	17%	32%	29%	22%	78%
Resistance training with free weights or resistance bands	127	14%	22%	24%	40%	60%
Botulinum toxin	131	12%	35%	34%	19%	81%
Serial casting	132	12%	22%	42%	24%	76%
Advice on weight management	131	10%	30%	44%	16%	84%
Rebound therapy	123	10%	9%	10%	71%	29%
Pilates	125	10%	16%	20%	54%	46%
Treadmill training	127	8%	11%	20%	61%	39%
Disability horse riding	128	8%	13%	20%	59%	41%
Taping	130	4%	12%	24%	60%	40%
MOVE programme	124	4%	5%	6%	85%	15%
Functional electrical stimulation	124	2%	2%	13%	82%	18%
Conductive education	125	2%	5%	5%	88%	12%
Body-weight supported treadmill training	125	2%	7%	11%	80%	20%

[1]Calculated as the sum of percentages in frequently, sometimes, and rarely for each intervention.

There was evidence that the number of years of experience as a pediatric physiotherapist differed according to the frequency at which neurodevelopmental therapy was used (X^2 (3, $N = 131$) $= 9.37$, $p = 0.025$). The median (IQR) years' experience of physiotherapists who reported using neurodevelopmental therapy frequently, sometimes, rarely and never were 16.0 (17.0) yr, 9.0 (16.0) yr, 14.5 (13.0) yr and 11.0 (18.0) yr, respectively. Post hoc pairwise comparisons indicated that physiotherapists who reported using neurodevelopmental therapy sometimes had fewer years of experience than people who used it frequently ($U = 221$, $p = 0.008$) and rarely ($U = 437.5$, $p = 0.008$). There was no evidence that the number of years of experience differed according to the frequency at which any other intervention was used. There was some evidence that the frequency at which the following interventions were used differed depending on whether the physiotherapist worked in private practice or the NHS: cardiovascular exercise with gym equipment ($p = 0.005$), muscle strengthening exercises with gym equipment ($p = 0.015$), resistance training with free weight or resistance bands ($p = 0.005$), treadmill training ($p = 0.003$), conductive education ($p = 0.023$), serial casting ($p = 0.003$), taping ($p < 0.001$), and advice about weight management ($p = 0.004$). In general, more physiotherapists working in private practice used cardiovascular exercise with gym equipment, muscle strengthening exercises with gym equipment, resistance training with free weights or resistance bands, Pilates, treadmill training, conductive education, taping, and advice about weight management frequently or sometimes compared to physiotherapists

Table 6. Percentage of participants, working in private practice and the NHS respectively, reporting that they used the following interventions frequently, sometimes, rarely, and never in the past year.

	Private practice (n = 19)					NHS (n = 96)				
	n	Frequently	Sometimes	Rarely	Never	n	Frequently	Sometimes	Rarely	Never
Cardiovascular exercise with gym equipment	19	42.1%	31.6%	5.3%	21.1%	90	17.8%	17.8%	38.9%	25.6%
Muscle strengthening exercises with gym equipment	17	35.3%	29.4%	5.9%	29.4%	91	12.1%	20.9%	36.3%	30.8%
Resistance training with free weights or resistance bands	17	29.4%	41.2%	5.9%	23.5%	91	8.8%	18.7%	28.6%	44.0%
Pilates	16	12.5%	43.8%	18.8%	25.0%	90	7.8%	11.1%	21.1%	60.0%
Treadmill training	17	17.6%	29.4%	23.5%	29.4%	90	3.3%	8.9%	21.1%	66.7%
Conductive education	17	5.9%	5.9%	11.8%	76.5%	89	0%	1.1%	3.4%	95.5%
Serial casting	19	0%	0%	57.9%	42.1%	93	15.1%	25.8%	37.6%	21.5%
Taping	18	22.2%	16.7%	33.3%	27.8%	93	1.1%	10.8%	19.4%	68.8%
Advice on weight management	17	35.3%	23.5%	41.2%	0%	95	6.3%	27.4%	46.3%	20.0%

working in the NHS (Table 6). Fewer physiotherapists working in private practice used serial casting frequently or sometimes compared to physiotherapists working in the NHS (Table 6).

Of the other health professionals that physiotherapists reported that they liaised with, the most commonly reported professions were occupational therapists (reported by 95% of participants), orthopedic surgeons (90%), speech and language therapists (63%), and neurologists (61%).

Twenty-nine participants (21%) responded to the final open-ended question asking participants if they had additional comments on the topic. The main themes identified were barriers to implementation of interventions, modes of delivery used with adolescents with CP, and specific issues with delivering physiotherapy to adolescents. Seven people provided comments relating to barriers to implementation of interventions, which included lack of facilities (e.g., gym equipment, trampoline), lack of time, high workload, funding issues, and unfilled vacancies within departments. Two people provided comments on barriers to implementation of evidence-based practice, which included patients receiving conflicting advice from independent practitioners and willingness to follow traditional approaches. Seven people provided comments on how physiotherapy was delivered to adolescents in their experience, which included referring children to activities and sports that they engaged with, offering blocks of treatment, and using a team approach that involved health professionals as well as school staff and sports coaches in the community. Three people commented that obtaining "compliance" with physiotherapy was challenging during adolescence and one person commented on the importance to continue delivering physiotherapy to adolescents in GMFCS levels I and II who are often discharged. The remaining comments related to other professionals that respondents liaised with (two comments), clarification on why they provided the responses they did (six comments), and ideas for future research (one comment).

Discussion

The results of this study indicate that a wide range of interventions are used by physiotherapists in the UK to improve or maintain lower limb function among adolescents with CP. In addition to liaising with the young person, family, and other health professionals, stretching, core stability exercises, muscle strengthening and functional activities were frequently

used by a large proportion of respondents. The most frequently used interventions targeted all levels of the WHO's International Classification of Functioning, Disability and Health (ICF) Framework, i.e., body structures and functions, activity and participation (WHO, 2001). For example, stretching, core stability exercises, and muscle strengthening were frequently used interventions that address impairments, while encouragement to use community resources and sporting activities addresses participation. Further, the frequent use of interventions to address both environmental and personal factors, such as self-management strategies and liaison with schools, highlights that physiotherapists acknowledge that functioning results from an interaction between the young person's condition and contextual factors (WHO, 2001).

The high percentage of physiotherapists who reported frequently providing explanations to the child, and liaising with families, health professionals, and schools is in line with previous research that suggests adolescents receive more indirect services or consults only than children with CP (Kaminker et al., 2004; Majnemer et al., 2014). In this study 98% of therapists reported that they encouraged adolescents to use community resources and access sporting activities at least once in the past year. This is slightly higher than the proportion of therapists (73.8%) who stated that they would recommend a community recreation programme for a 12-year-old child with CP (Kaminker et al., 2004). While this finding suggests that therapists are encouraging adolescents to become more independent as they transition to adulthood, whether these attempts to promote independence and self-management are effective is unclear. Adults with CP report feeling that rehabilitation in childhood did not support the maintenance of their independence and well-being throughout their lives (Moll & Cott, 2013). Although they worked hard to improve their function in childhood with the assistance of rehabilitative services, these services were no longer accessible when they experienced declines in function in adulthood (Moll & Cott, 2013).

It may be argued that interventions such as liaison with families and encouragement to use community resources are used in combination with direct interventions such as stretching or muscle strengthening. Indeed co-ordinated rehabilitation services are likely important for successful transition to adulthood. However, as separate interventions were identified during the NGT and remained as such in the survey, this study does not provide any insight into the model of care provided to young people.

Many interventions that a large proportion of participants reported never using are interventions that require equipment (e.g., body-weight supported treadmill training, disability horse riding, rebound therapy, muscle strengthening and endurance exercises with gym equipment), suggesting that lack of resources may be a barrier to implementation of certain interventions. This was supported by qualitative comments from a small number of respondents. Additionally, a higher proportion of physiotherapists working in private practice reported using interventions that require equipment, such as cardiovascular exercise with gym equipment, muscle strengthening exercises with gym equipment and taping, suggesting that physiotherapists' choice of intervention is influenced by the resources available at their organization. At present the lack of empirical evidence to support the use of many interventions that require equipment may act as a barrier to physiotherapists justifying requests for equipment, particularly among those working in the public sector.

Interestingly, although muscle strengthening was one of the most frequently used interventions only 18% of respondents reported frequently using muscle endurance or strengthening exercises with gym equipment. It may be argued that although muscle strengthening, muscle strengthening with gym equipment, resistance training with body weight, and resistance training with free weights or resistance bands were included in the survey as separate interventions they are essentially the same intervention. As these were identified as separate

interventions during the NGT however, they remained as such in the survey. We believe that this highlights an inconsistency among physiotherapists regarding the terminology they use to describe strength training and also the components that they believe constitute strength training.

Few studies to date have reported on the content of physiotherapy for people with CP. A study conducted in South Korea found that, unlike the findings of this study, neurodevelopmental therapy was the most frequently used intervention for adolescents with CP during rehabilitation (Kim, Hong, Lee, Lee, & Kang, 2014). This highlights that the content of rehabilitation provided to adolescents with CP is not consistent across the world. This may be due to differences between countries in preregistration education, the types of interventions promoted to physiotherapists through professional organizations or postregistration courses, or the availability of country-specific evidence. However, similar to the findings of this study, a survey of physiotherapists in Canada in 2008 indicated that the most frequently recommended interventions for a 4-year-old child with spastic unilateral CP classified in GMFCS level II were stretching (66% of therapists), strengthening exercises (53.8% of therapists), treatments based on neuro-facilitation approaches (i.e., neurodevelopmental therapy, PNF and inhibition/facilitation techniques) (11.5% of therapists), and task specific training and functional exercises (7.7% of therapists) (Saleh et al., 2008).

Of the interventions identified in this study, a systematic review of interventions for CP found strong evidence that casting improved passive range of motion of the lower limb, botulinum toxin injections reduced lower-limb spasticity, and aerobic exercise improved aerobic fitness (Novak et al., 2013). This study found that 76% of therapists reported using serial casting, 81% reported using botulinum toxin, and 76% reported using cardiovascular exercise with gym equipment at least once in the past year. Although these interventions were recommended by Novak et al. (2013) to be included in standard care for children with CP, there was insufficient evidence to support the use of casting or aerobic exercise to improve gross motor function and only moderate quality evidence to support the use of botulinum toxin in combination with physiotherapy for improving walking function among children with CP (Novak et al., 2013). Novak et al. (2013), also recommended that neurodevelopmental therapy be discontinued from CP care as there was low quality evidence that it did not improve normalized movement, prevent contracture development, improve function, or enhance social emotional and cognitive skills. Despite this recommendation this study indicates that 81% of physiotherapists used neurodevelopmental therapy at least once in the past year. There was no consistent pattern of recently graduated physiotherapists using neurodevelopmental therapy less frequently than more experienced physiotherapists; while physiotherapists who used neurodevelopmental therapy frequently had more years of experience than those who used it sometimes, physiotherapists who used it rarely also had more experience than those who used it sometimes. There was no evidence that people with more years of experience used neurodevelopmental therapy more frequently than those with fewer years of experience.

Of the thirty-nine interventions identified in this study only fifteen were included in the review by Novak et al. (2013) as there was insufficient research on the effectiveness of the remaining interventions to include them. Of the interventions that were included in the review there was low quality evidence that hydrotherapy, treadmill training, functional training, and strength training using resistance within functional tasks improves gross motor function, moderate quality evidence that hippotherapy improves gross motor function, insufficient evidence to support the use of electrical stimulation, strength training via progressive resistance training or orthotics to improve lower-limb function, and low quality evidence that conductive education does not improve performance of functional activities. There was

no evidence regarding the use of assistive technology, stretching or splinting/positioning on gross motor function, although there was low quality evidence that assistive technology improves independence in activities of daily living, moderate quality evidence that stretching is ineffective at preventing contractures, and insufficient evidence that splinting/positioning prevents contractures (Novak et al., 2013).

In Sackett, Rosenberg, Gray, Haynes, and Richardson (1996) defined evidence-based medicine as the practice of integrating clinical expertise, the best available evidence and patients' choice. In this study therapists' reports of the interventions they used may have been influenced by the type of patients they saw in the previous year; therapists may not have used an intervention in the past year because based on their clinical expertise and/or the patient's choice it was not appropriate. However, it is widely reported that a research-practice gap exists across all areas of healthcare (Grohl et al., 2003; McGlynn et al., 2003; Schuster, McGlynn, & Brook, 1998). This study indicates that a research-practice gap also exists in physiotherapy practice for adolescents with CP and that evidence-based guidance for service delivery is required.

Physiotherapists report that time constraints and child/parent adherence are barriers to evidence-based practice when providing services to children with CP (Saleh et al., 2008). Other barriers to implementation of evidence-based practice that have been reported by health professionals include the influence of the opinions of leaders that may go against research evidence, obsolete knowledge of practitioners, the belief that health professionals lack authority to change clinical practice, policies that promote unproven interventions, lack of incentives to participate in effective educational activities, and patient demands for care that is ineffective (Haines et al., 2004; Sitzia et al., 2002). The finding that the frequency at which interventions were used did not differ according to years of experience suggests that recently graduated physiotherapists are influenced by more experienced physiotherapists in terms of their choice of intervention, physiotherapy education has not largely changed over time, or experienced physiotherapists change their practice based on ongoing education. Many pre-registration physiotherapy courses in the UK contain only a short module on pediatric physiotherapy, of which management of CP is only one of several topics. With such limited time, educators need to prioritize the interventions that are taught to students. We believe that, as exercise (in several forms) is a commonly used interventions for children with CP, it is important that students receive training in delivering exercise according to evidence-based guidelines. Further, the high frequency at which physiotherapists liaise with families, schools and other health professionals suggests that physiotherapy students should receive training in these specific skills. This is consistent with the current recommendation that physiotherapy students are provided with opportunities for interprofessional learning (CSP, 2015).

Although there is an apparent research-practice gap in physiotherapy practice, there is also undoubtedly a lack of research into many of the interventions used by physiotherapists to treat adolescents with CP. The lack of an evidence base makes it difficult to justify the choice of one intervention over another. However, the evidence base is stronger for some interventions than others. Physiotherapists should consider if introducing new interventions to practice, for which no research has been conducted to determine their effectiveness, is beneficial to patients. Further, physiotherapists worldwide need to develop consensus on the most important research questions to address regarding the effectiveness of interventions for adolescents with CP in order to systematically build the evidence base and provide more cohesion between physiotherapy management of adolescents with CP worldwide.

It is acknowledged that the results of this study may be subject to recall bias. In particular, therapists may have had difficulty accurately reporting how frequently they used an intervention in the past year. However, the use of a survey allowed us to collect a large amount of data on current practices from therapists throughout the UK. Future studies should attempt to describe the duration, frequency, and content of therapy received by adolescents with CP across the UK using clinical records. More information about the content of physiotherapy provided to children and adolescents with CP in other developed countries is also required to compare standards of physiotherapy provision internationally. The barriers to implementation of evidence-based practice should also be further explored among physiotherapists who treat adolescents with CP and research priorities should be determined for this field.

Although the response rate to the survey is seemingly low, not all physiotherapists who were contacted may not have been eligible to participate. The large age-range of participants, the range of settings that participants worked in, and the wide range of regions of the UK that participants worked in, however, suggests that the sample is representative of the population of physiotherapists who work with adolescents with CP in the UK. The number of respondents is also similar to that in previous studies that assessed current rehabilitation practices for children with CP using a survey (Anaby et al., 2016; Saleh et al., 2008).

Conclusion

This study provides an overview of current physiotherapy interventions that are used by physiotherapists in the UK to improve or maintain lower-limb function among adolescents with CP. The results demonstrate that a large number of interventions are used for this population, not all of which are evidence-based. Advice and liaison with the young person, their family, other health professionals and schools, were frequently used as were stretching, core-stability exercises, muscle strengthening, and functional activities. A lack of guidelines and high quality research regarding the effectiveness of interventions for adolescents with CP, as well as workplace, practitioner, and patient barriers may contribute to a research-practice gap that exists in this field.

Declaration of Interest

The authors report no conflicts of interest. No funding was received for this study.

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