Factors associated with physical activity in children and adolescents with a physical disability: a systematic review

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ABBREVIATIONS

ASE	Attitude, social influence, and self-efficacy
PAD	Physical Activity for People with a Disability

AIM The aim of this review was to summarize the important factors associated with participation in physical activity in children and adolescents with physical disabilities.
METHOD A systematic mixed-studies review was conducted using the databases Academic Search Elite, CINAHL, The Cochrane Library, EMBASE, PEDro, PsycINFO, PubMed, and SPORTDiscus, searching for studies conducted from January 2000 to May 2013. The studies were identified by two independent researchers following predetermined inclusion and exclusion criteria. The methodological quality was determined using the McMaster University critical review forms for qualitative or quantitative research and was numerically rated according to the criteria developed by Imms.
RESULTS The initial electronic search yielded 10 161 articles, of which six were qualitative and 12 were quantitative studies. These studies showed that a diverse range of positive and negative factors were associated with participation in physical activity, such as self-efficacy, physical fitness, increasing age, and the availability of equipment and local facilities.
INTERPRETATION Future intervention studies could use these results, within the context of an individual child and his or her environment, as the basis for increasing physical activity levels, starting in early childhood and continuing throughout adolescence and into adulthood. An increased awareness of and focus on providing appropriate equipment and adapted sports in the child's own environment by policy makers might increase physical activity levels.

A recent *Lancet* series[1] reported on the importance of being physically active in reducing the development and mortality of non-communicable diseases such as cancer, type II diabetes, and cardiovascular disease.[2] For children in particular, the benefits of physical activity have been consistently documented and it is recognized that encouraging a physically active lifestyle from an early age is important.[3]

Physical activity can increase the physical, emotional, and social well-being of children with physical disabilities, as well as increasing their functional independence, integration, and quality of life and positively impacting their future health.[4–6] Therefore, it is alarming to see a decline in the physical activity of young people.[7] Children with physical disabilities are even less physically active than their peers with typical development.[8–11] A systematic review recently showed that young people with cerebral palsy (CP) participated in habitual physical activity at a rate that was 13% to 53% lower than in those with typical development and 30% lower than the recommended guidelines.[12] A group of 85 Dutch children with several physical disabilities had significantly lower physical activity, with a prevalence of overweight and obesity three and six times higher respectively, than children with typical development.[13] Moreover, a large group of children with disabilities participating in a Fitkids exercise therapy programme showed both reduced aerobic fitness and a high prevalence of overweight and obesity before the programme.[14]

Another systematic review identified a range of personal, social, environmental, and policy- and programme-related factors that influence physical activity in children and adolescents with disabilities.[15] The available literature includes several types of disabilities, including both intellectual and behavioural disabilities, which makes it difficult to understand which factors could be associated with children with a specific physical disability. Recent intervention programmes aiming to improve physical activity in children with physical disability – including an internet-based intervention, counselling, home-based physical therapy, and motivational interviewing – have highlighted the difficulty of improving physical activity in children and adolescents with a physical disability, as no improvements in physical activity were found.[16–18] The improvement of physical

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activity behaviour in this population requires the consideration and comprehension of many factors that play a role in obtaining and maintaining a physically active lifestyle. An overview of these factors can provide information that is useful for health professionals, teachers, policy makers, and sports clubs for developing new interventions to increase participation in physical activity among these children. A complete understanding of why children and adolescents with physical disabilities are or are not physically active is imperative in order to improve their physical activity levels. Therefore, the purpose of this systematic review was to identify the factors that both hinder and facilitate physical activity for children and adolescents with physical disabilities.

What this paper adds

- Positive factors, not only negative factors, might be the basis for individualized interventions for physical activity for children and adolescents with physical disabilities.
- It could be valuable to focus on increasing self-efficacy and to pay extra attention during adolescence.
- Adequately adapted equipment and the availability of local sports seem to be associated with increased physical activity.

METHOD

A protocol regarding this systematic mixed-studies review[19] was developed a priori, including search strategy, inclusion and exclusion criteria, methodological quality assessment, data extraction, and data analysis, and can be accessed by contacting the corresponding author.

Inclusion and exclusion criteria

Studies were included if (1) the primary aim was to examine factors that hinder and/or facilitate physical activity in children with physical disabilities resulting in motor disorders; (2) the study participants included were children with a physical disability (age range 4–18y, mean age <18y) or parents and/or caregivers giving information about their children with physical disabilities; (3) they were full-text reports published after 1 January 2000; and (4) they were written in English or Dutch. Studies in which an intervention was examined or in which physical activity was not the main outcome were excluded from this review. Similarly, studies investigating sedentary leisure activities or functional capacities were excluded, as were studies in which only differences between groups were reported. Finally, studies were excluded if more than 50% of the participating children did not have a physical disability and the results were not presented separately; if the physical disability was of a progressive nature; or if conditions in which exacerbations could occur (such as juvenile idiopathic arthritis) were present. This review included only original, peer-reviewed published articles and dissertations and did not include any 'grey literature', defined as document types produced by all levels of government organizations, academics, business professionals, and other organizations in electronic and print formats in which the process was not controlled by commercial publishing, that is by organizations whose primary activity is not publishing.[20]

Search strategy and screening

A literature search was conducted from January 2000 up to and including May 2013 in the following electronic databases: Academic Search Elite, CINAHL, The Cochrane Library, EMBASE, PEDro, PsycINFO, PubMed, and SPORTDiscus. A comprehensive search strategy was developed in consultation with a medical information specialist with four major themes – children, disability, physical activity, and factors – with individual search terms for each database. The terms for 'children' were derived from the existing search strategy from Riphagen et al.[21] The key terms within the search strategy were mapped to medical subject headings in MEDLINE, and title and abstract search words and phrases were added. The complete search strategy of PubMed can be found in Appendix S1 (available online).

Initial screening of titles was performed by one of the reviewers to exclude obviously non-fitting titles. The titles, abstracts, and full text of these studies were then independently reviewed for eligibility by two reviewers. Any discrepancies in the agreement were discussed with a third reviewer until consensus was reached. Finally, the reference lists of included studies were manually searched to find additional studies.

Methodological quality assessment of the manuscripts

The McMaster Critical Review Forms for qualitative[22,23] or quantitative research[24,25] were used to assess methodological quality, providing a narrative assessment of methodological quality. The wide range of methodologies employed in qualitative studies makes it complex to rate quality numerically. Imms[26] developed criteria for both qualitative research and non-experimental quantitative research, such as that reviewed in this paper. Therefore, the numerical rating criteria developed by Imms[26] were applied to the McMaster Critical Review Forms to interpret methodological quality.

The qualitative studies were rated by evaluating four common quality procedure criteria: credibility, transferability, dependability, and confirmability.[26] These criteria are derived from more traditional quantitative criteria. The criterion 'credibility' refers to internal validity and contains triangulation, a search for disconfirming evidence, and member checking. The criterion 'transferability' resembles external validity and contains a 'thick' description, such as a detailed description of the study context, the investigator's role in the context, and clear delineation of how the context affects the study's ability to answer the research question. The criterion 'dependability' examines reliability and includes data archiving and the creation of an audit trail (e.g. whether or not there is consistency between the data and the findings). Finally, the criterion 'confirmability' refers to objectivity and contains sceptical peer review or audit, participant audit, and reflective journal keeping.[26,27]

The methodological quality of quantitative studies was rated by evaluating three key criteria: sample, measurement, and analyses.[26] The criterion 'sample' examined whether or not selection bias was reduced, the sample size was appropriate for the design and research question, and the participant characteristics were clearly described. The criterion 'measurement' examined whether or not measurement bias was reduced. The criterion 'analyses' examined whether or not the analyses were appropriate for the research question and outcome measure.[26]

For both research designs, each criterion was scored with one star (no evidence of the study meeting the criterion), two stars (some evidence of the study meeting the criterion or unclear reporting), or three stars (evidence of the study meeting the criterion).[26]

Two reviewers independently performed the methodological quality assessment. Any discrepancies between the two reviewers were discussed until consensus was reached. If consensus could not be reached, agreement was obtained through discussion with a third reviewer. The percentage of agreement between the reviewers was determined afterwards.

Data extraction

Two reviewers independently extracted relevant data, using a standardized form, such as the study design, study inclusion and exclusion criteria, demographic data, setting, methods of data collection, and identified factors associated with physical activity. Any discrepancies were resolved by discussion until consensus was reached.

Data analysis

The Physical Activity for People with a Disability (PAD) model was used to categorize the results during the analysis.[28] This model combines the International Classification of Functioning, Disability and Health, in which personal and environmental factors are defined, with the attitude, social influence, and self-efficacy (ASE) model.[29] This results in a model that defines several levels of both personal and environmental factors. Personal factors include levels such as intention, attitude, self-efficacy, health condition, and barriers and facilitators. 'Intention' is the central factor of physical activity within the PAD model, all other factors influence an individual's intention to become or stay physically active.[28] 'Attitude' is defined as what an individual thinks and expresses about an active lifestyle for him- or herself, whereas 'self-efficacy' is described as the confidence an individual has to engage in physical activity. 'Health condition' refers to aspects related to the diagnosis. Personal 'barriers and facilitators' include additional personal factors related to physical activity. 'Social influence' is defined as what another person thinks about physical activity for that individual and is grouped with environmental 'barriers and facilitators', which contain the additional environmental factors related to physical activity.[28]

RESULTS

Search results

The initial electronic search yielded 10 161 published articles (Fig. 1). After the titles were screened and the residual titles and abstracts were reviewed, full-text copies of 191 articles were retrieved. Following the predefined inclusion and exclusion criteria, 15 full-text articles were included in this systematic review.[10,30–43] A manual search in the reference lists of the articles identified three new studies that met the criteria;[44–46] therefore, a total of 18 studies were included. The studies were published between January 2000 and May 2013, employed either qualitative[30–35] or quantitative[10,36–46] study designs, and varied in the type of physical disability of the participants, sample size, participants' ages, and methods of data collection.

Two studies[39,40] used the same group of participants, but different factors were examined and different measures for physical activity were used, so both studies were included in this review. Two other studies[37,46] also used the same participants, but study results were only partly similar; the results from Matheri et al.[46] were used in this review and only the additional results from Frantz et al.[37] were presented.

Methodological quality assessment of the manuscripts

Agreement in the methodological quality assessment between the two reviewers was high, with agreement percentages ranging from 79 to 100% and a mean agreement of 86.8%. Tables I and II provide the methodological quality rating scores for the qualitative studies and quantitative studies respectively.

Qualitative studies

Six studies used a qualitative research design.[30–35] One study[32] scored the maximum rating of three stars in all four criteria of the methodological quality assessment in accordance with the numerical rating scale of Imms.[26] In this study,[32] the researcher used triangulation, member checking, peer debriefing, and reflective journal keeping and provided a detailed description of the study context and her own role in it. The other five qualitative studies[30,31,33–35] scored the maximum of three stars[26] in at least two of the four criteria. The findings were always discussed with external researchers[30,31,33–35] and were sometimes checked by the participants.[35] However, in general, these studies lacked an adequate description of the study context and the investigator's role in it.[30,31,33–35]

Quantitative studies

A quantitative research design was used by 12 studies.[10,36–46] No study scored the maximum rating of three stars[26] for all three criteria of the methodological quality assessment; however, one study[43] scored three stars[26] in two of the three criteria. The clinical importance of the results was not adequately addressed in all 12 studies[10,36–46] and, therefore, no study scored three stars for 'analyses'. However, the methods used for the analyses seemed appropriate

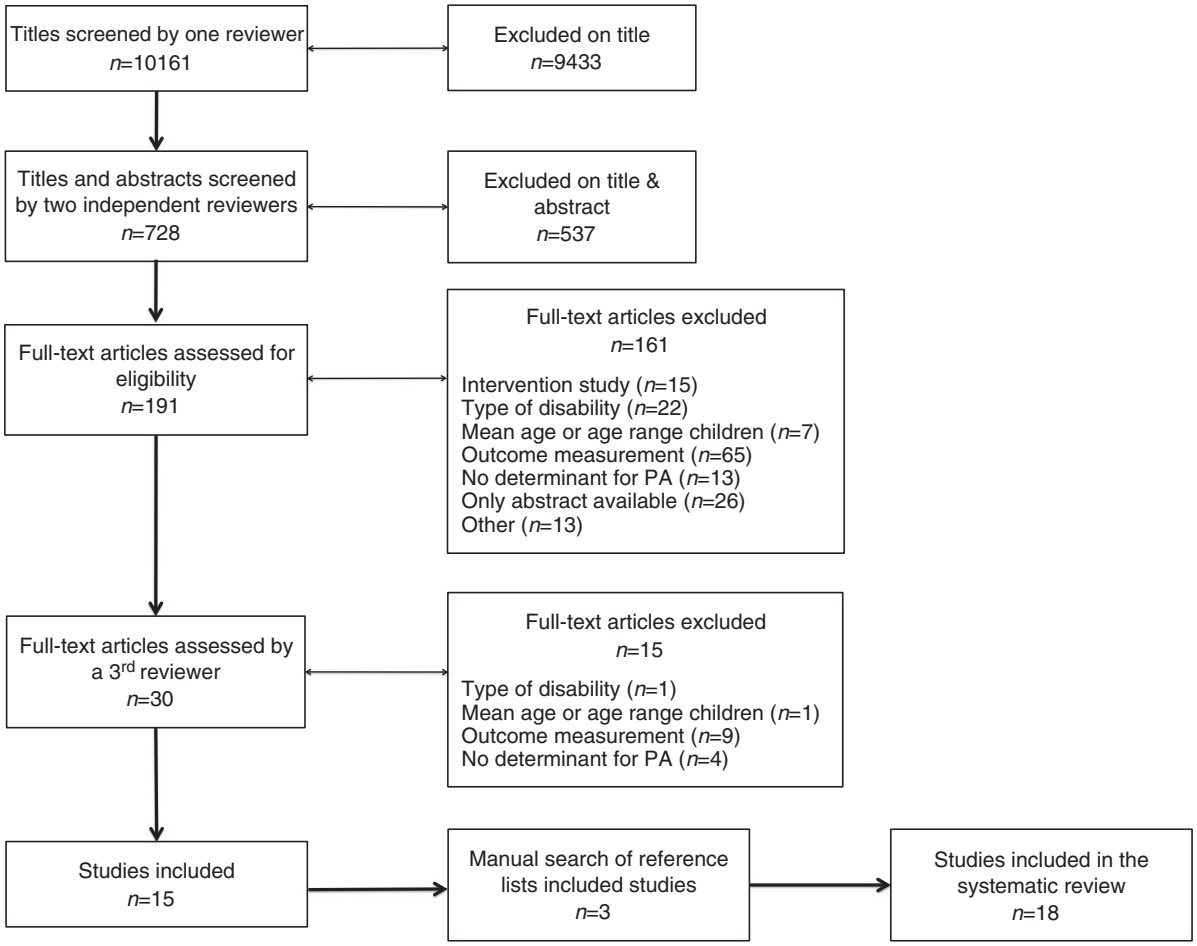

Figure 1: Flow diagram detailing study selection process. PA, physical activity.

and statistical significance was reported in 12 studies.[10,36–46] All these studies[10,36–46] provided no or unclear evidence about their sample; three studies[36,38,42] did not describe their participants in detail and nine studies did not use a justified sample size.[10,37,39–41,43–46] Four studies[37,42,43,46] scored three stars for 'measurement', whereas eight studies scored only one[39,44,45] or two[10,36,38,40,41] stars. These studies did not report on the reliability[36,38–40,44,45] or validity[10,36,39,40,44,45] of all of their outcome measures, or they reported recall bias, since self-reported questionnaires were used.[10,38,41]

Data extraction

The results of the included studies are summarized in detail in Tables I and II.

Qualitative studies

Four of the six qualitative studies used a general qualitative research design[31,33–35] (Table I) and two qualitative studies used a phenomenological design.[30,32] Data were collected using semi-structured interviews[30–34] and focus groups.[35] Three studies included both children and parents,[31,34,35] two studies included only children,[30,33] and one study included only parents (the majority of which were mothers) reporting on their child.[32] The age of the children ranged from 6[34] to 17[32,35] years.

Two studies included children with CP,[33,35] one study included children with spina bifida,[34] one study included children with developmental coordination disorder,[32] and two studies included children with different physical disability diagnoses, such as CP, spina bifida, osteogenesis imperfecta, spinal cord injury, caldar regression, multiple spinal leaks, and other limited mobility.[30,32]

Quantitative studies

All quantitative studies used a cross-sectional design (Table II). Several physical activity monitors[36,39,40,43] were used to collect physical activity data, questionnaires[10,37,38,41–46] were used to collect objective physical activity data and factors related to physical activity, and measurements[36,39,40,44,45] were taken of factors related to physical activity. The age of participants ranged from 5[45] to 21[37,46] years, with the majority of children older than 10 years.

Table I: Summary of included qualitative studies

First author	Design	Measures	Quality criteria	Quality rating	Participants	Participant details				
						n	Mean age (y:mo)	Age range (y)	Sex	Type of disability
Anderson (2005)[30]	Phenomenological	Semi-structured interviews	Credibility Transferability Dependability Confirmability	** * *** ***	Children	14	13:7	10–16	14 Female	Cerebral palsy (*n*=6), spina bifida (*n*=5), osteogenesis imperfecta (*n*=2), other (*n*=1)
Barnett (2012)[31]	General qualitative research	Semi-structured interviews	Credibility Transferability Dependability Confirmability	** * *** ***	8 Children, 8 parents (7 female, 1 male)	8	14:1	13–15	8 Male	Developmental coordination disorder; some also had mild learning difficulties (*n*=4), diabetes (*n*=1), scoliosis (*n*=1), attention-deficit–hyperactivity disorder (*n*=1)
Hunter (2009)[32]	Phenomenological	Semi-structured interviews	Credibility Transferability Dependability Confirmability	*** *** *** ***	22 Parents (18 female, 4 male)	23	13:7	9–17	10 Female, 13 male	Spina bifida (*n*=16), cerebral palsy (*n*=4), spinal cord injury (*n*=1), caldar regression (*n*=1), multiple spinal leaks (*n*=1)
Li (2012)[33]	General qualitative research	Semi-structured interviews	Credibility Transferability Dependability Confirmability	*** * * ***	Children	8	14:4 (SD 1:11)	11–16	5 Female, 3 male	Cerebral palsy
Luther (2010)[34]	General qualitative research	Semi-structured interviews	Credibility Transferability Dependability Confirmability	** * *** ***	12 Children, 12 parents (9 female, 3 male)	12	10:1	6–12	6 Female, 6 male	Spina bifida
Verschuren (2012)[35]	General qualitative research	Focus groups	Credibility Transferability Dependability Confirmability	*** *** * *	33 Children, 33 parents (31 female, 2 male)	33	–	7–17	15 Female, 18 male	Cerebral palsy

*No evidence of study meeting criteria; **Some evidence of study meeting criteria or unclear reporting; ***Evidence of study meeting criteria; –, No data.

Table II: Summary of included quantitative studies

First author	Design	Measures	Quality criteria	Quality rating	Participants	Participant details				
						n	Mean age (y:mo)	Age range (y)	Sex	Type of disability
Capio (2012)[36]	Cross-sectional survey	Accelerometer, log diary, Test of Gross Motor Development – 2nd edition	Sample Methods Analysis	* ** **	Children	31	7:5 (SD 2:6)	–	–	Cerebral palsy
van Eck (2008)[44]	Cross-sectional survey	Questionnaire, Self-Perception Profile for Children	Sample Methods Analysis	** * **	Parents	72	14:5 (SD 1:8)	12–16	26 Female, 46 male	Cerebral palsy
Kang (2007)[38]	Cross-sectional survey	46-item exercise barrier instrument	Sample Methods Analysis	* ** **	Children	145	<18	12–19	28 Female, 117 male	Physical (National Wheelchair Basketball Association classification I, *n*=24; II, *n*=53; III, *n*=57)
Maher (2007)[10]	Cross-sectional survey	Physical Activity Questionnaire for Adolescents	Sample Methods Analysis	** ** **	Children	112	13:11 (SD 1:11)	11–17	36 Female, 76 male	Cerebral palsy
Maltais (2005)[40]	Cross-sectional survey	Accelerometer, Biomechanical Economy Quotient	Sample Methods Analysis	** ** **	Children	11	13:0 (SD 2:2)	10.6–16.3	4 Female, 7 male	Cerebral palsy
Maltais (2005)[39]	Cross-sectional survey	Heart rate monitor, peak oxygen uptake	Sample Methods Analysis	** * **	Children	11	13:0 (SD 2:2)	10.6–16.3	4 Female, 7 male	Cerebral palsy
Matheri (2009)[46]/ Frantz (2011)[37]	Cross-sectional descriptive survey	Physical Activity Scale for Individuals with Physical Disabilities	Sample Methods Analysis	** *** **	Children	234	17:1 (SD 1:11)	14–21	105 Female, 129 male	Paralysed limbs 38%, congenital malformations 15%, spinal injuries 14%, amputated limbs 9%, other 24%
Ortiz-Castillo (2011)[41]	Cross-sectional descriptive survey	Physical Activity Scale for Individuals with Physical Disabilities, Physical Activity Determinants Scale	Sample Methods Analysis	** ** **	Children	93	–	12–18	37 Female, 56 male	Cerebral palsy (*n*=28), spina bifida (*n*=21), muscular dystrophy (*n*=16), spinal cord injury (*n*=9), other (*n*=19)
Shapiro (2010)[42]	Cross-sectional survey	Physical Self-Description Questionnaire	Sample Methods Analysis	* *** **	Children	36	16:0 (SD 2:10)	12–17	9 Female, 27 male	Cerebral palsy (*n*=18), spina bifida (*n*=9), traumatic brain injury (*n*=3), muscular dystrophy (*n*=2), other (*n*=4)
van Wely (2012)[43]	Cross-sectional survey	Step activity monitor, Self-Perception Profile for Children, questionnaire	Sample Methods Analysis	*** *** **	Children	62	10:1 (SD 1:8)	7–13	23 Female, 39 male	Cerebral palsy
Zwier (2010)[45]	Cross-sectional survey	Questionnaire	Sample Methods Analysis	** * **	Parents	97	–	5–7	39 Female, 58 male	Cerebral palsy

*No evidence of study meeting criteria; **Some evidence of study meeting criteria or unclear reporting; ***Evidence of study meeting criteria; –, No data.

Seven studies included children with CP[10,36,39,40,43–45] and four studies included children with different physical disability diagnoses, such as CP, spina bifida, muscular dystrophy, spinal cord injury, traumatic brain injury, paralysed limbs, and other limited mobility.[37,41,42,46] One study did not specify the physical disabilities.[38]

Data incorporated in the Physical Activity for People with a Disability model

The 18 included studies identified several factors associated with physical activity in children with physical disabilities, which were incorporated in the PAD model as shown in Figures 2 to 4. Thirteen studies reported on negative and positive factors,[30–37,40,41,43,44,46] four studies reported on only negative factors,[10,38,39,45] and one study reported on only positive factors.[42]

Personal factors

The personal factors include 'intention', 'attitude', 'self-efficacy', 'health condition', and personal 'barriers and facilitators' (Fig. 2). Only one positive factor was identified at the level of intention.[35] The included studies identified mainly positive factors for attitude.[30,33,35,46] In general, children with physical disabilities think and express positive thoughts about an active lifestyle.[30,33,35,46] Two studies reported that having the opinions 'being active is not good for the body'[35] and 'I need to rest in my spare time'[46] negatively affected children's attitudes towards physical activity, and two studies reported on 'fear of safety, injury or incontinence'.[35,38] For self-efficacy, 'lack of confidence' or 'feeling insecure' were negative factors.[31,35] In contrast, 'feeling confident',[35] 'gaining self-confidence',[46] and 'sport competence'[42,44] were positive factors. Noteworthy positive factors were identified in the study by Luther.[34] Twelve children with spina bifida and their parents reported that 'being able to independently negotiate barriers in the community' and 'engaging others to help them negotiate their physical environment' helped them to participate in the physical activities they wanted to do,[34] which

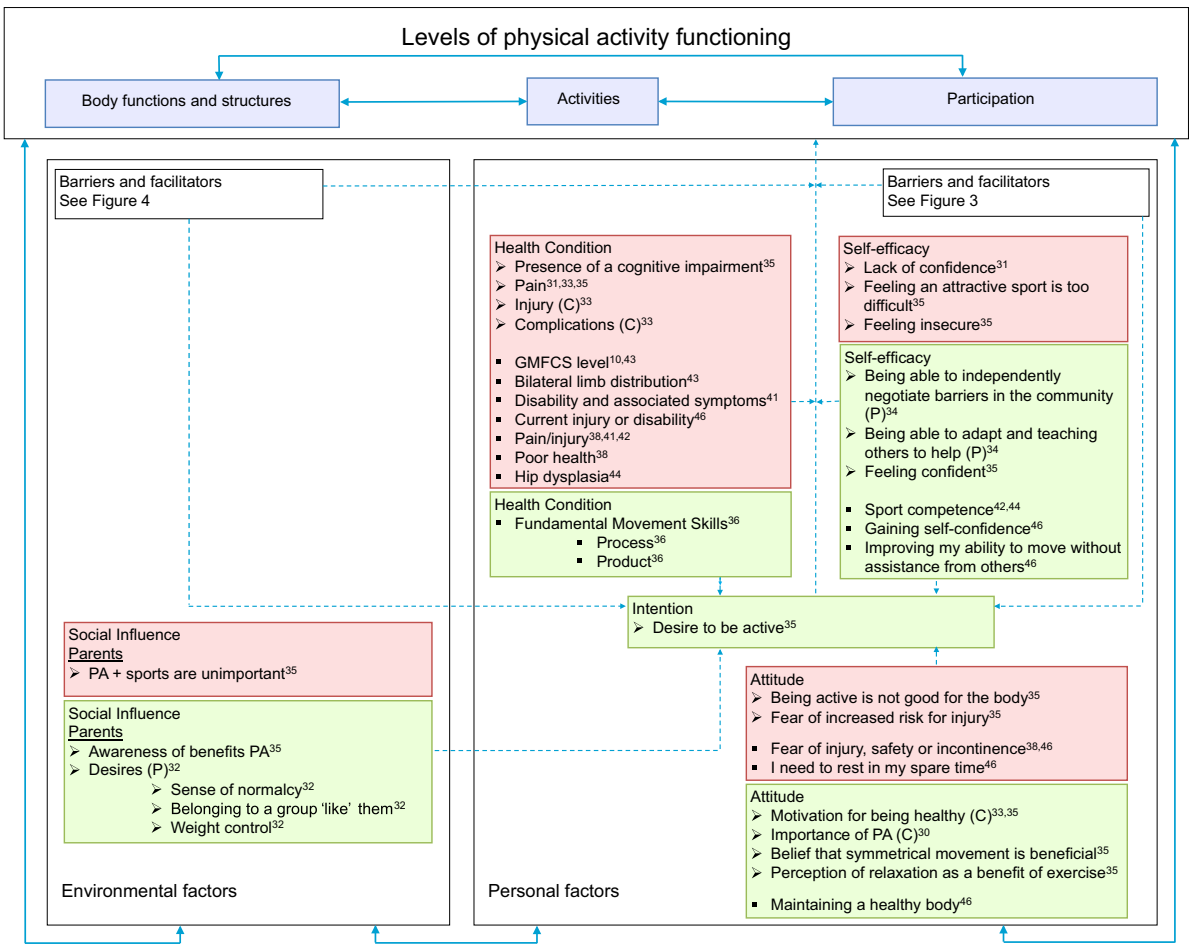

Figure 2: Results of the included studies incorporated in the Physical Activity for People with a Disability (PAD) model. A red box indicates barriers and a green box indicates facilitators. When there is no indicator behind a factor, it means that the factor was mentioned by the parent or child in a qualitative study. C, children and adolescents; P, parents; PA, physical activity; GMFCS, Gross Motor Function Classification System.[28] ➢, Qualitative study result; ▪, Quantitative study result.

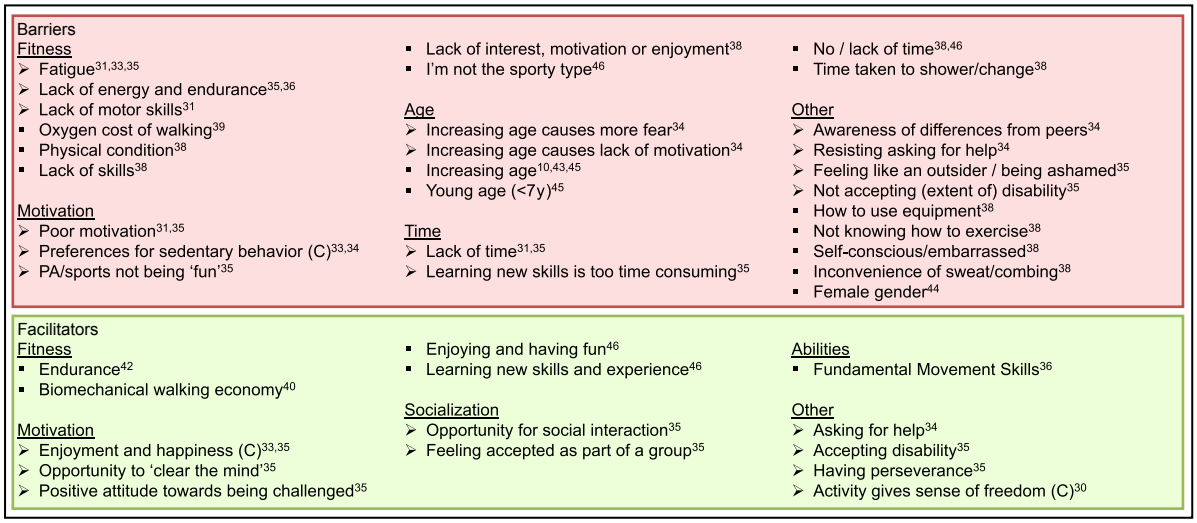

Figure 3: Personal factors, barriers and facilitators of the included studies incorporated in the Physical Activity for People with a Disability (PAD) model. A red box indicates barriers and a green box indicates facilitators. When there is no indicator behind a factor, it means that the factor was mentioned by the parent or child in a qualitative study. C, children and adolescents; P, parents; PA, physical activity.[28] ➢, Qualitative study result; ▪ , Quantitative study result.

conformed with 'improving my ability to move without assistance from others'.[46] Finally, factors regarding health condition were identified. In particular, quantitative studies found several variables, such as the 'Gross Motor Function Classification System (GMFCS) level', that were significantly related to physical activity.[10,43]

At the level of personal 'barriers and facilitators', different factors were identified as related to the child's 'fitness',[31,33–35,38–40,42] 'motivation',[31,33–35,38,46] and 'abilities'[36] (Fig. 3). A striking negative factor was 'increasing age'.[10,34,43,44] Luther noted that, as children with spina bifida grew older, parents reported that 'their children became less active and rejected being involved in disability-adapted programs' and that 'their children were afraid to participate in physical activity'.[34] Maher[10] demonstrated an inverse association (F=4.91, p=0.03) between age and physical activity in children with CP; van Wely et al.[43] demonstrated that 'increasing age' (p<0.001), together with 'GMFCS level' and 'bilateral limb distribution', explained 52% of the variance in ambulatory activity in children with CP; and van Eck et al.[44] showed that older adolescents and females had significantly lower levels of physical activity, explaining 15% of the variance.

Environmental factors

In the PAD model, the environmental factors include 'social influence' and environmental 'barriers and facilitators' (Fig. 2). Social influence always concerned parental influence that was often positive: parents believe that physical activity is important for their child.[31,32,35]

At the level of environmental 'barriers and facilitators', factors were identified for different physical and social environments (Fig. 4). 'Family, teachers, peers, and other people can both hinder and promote physical activity',[30–35,37,38,41,46] 'lack of support from' or 'not being accepted or bullied by peers' were negative factors,[30,31,33–35,37,38] whereas 'getting support',[31,34,35,41] 'making friends',[34,46] or 'positive attitudes towards me by schoolmates, teachers and other people'[33,35,37] were reported as positive factors. The factor of 'teachers and instructors supporting you' seems to be a crucial positive factor associated with physical activity, as it was reported by both parents[31,34] and children.[33] In the study by Ortiz-Castillo,[41] 72% of adolescents with physical disabilities believed that 'having someone who can provide support' facilitates participation in physical activity.

'Adequately adapted activities,[31,33–35,38] programmes,[34,35,38] and equipment',[33,34,38,41,46] and 'access to transport'[31,34,35,38,41,46] were commonly reported as positive factors when they were available, and negative when they were not. It was also notable that the negative factors reported in this area were associated with sport facilities. After examining 33 ambulatory young people with CP and their parents, Verschuren et al.[35] noted a number of constraints in sport facilities, such as 'the teams being too big', 'a long waiting list', the child's 'abilities being underestimated', or the child 'not being allowed to play matches'. Other children with CP reported that 'physical education teachers only select students with better sport skills or performance', which hindered them from being physically active.[33] Another notable negative environmental factor was an 'uneven playground'. In the study by Matheri et al.,[46] 41% of the 234 adolescents with a disability reported that 'uneven playgrounds and compounds make it difficult to do exercise'.

Barriers

Family
- ➢ Reliant on parents for transport and entrance to facilities (C)[31]
- ➢ Lack of parental support (C)[33]
- ➢ Lack of time of parent to assist (P)[34]
- ➢ Parents not accepting extent of disability[35]
- ➢ Parents concern for child's safety[34]
- ➢ Parents feelings:
  - ➢ Dissatisfaction with environment[35]
  - ➢ Fear of child 'not fitting in'[35]
  - ➢ Challenges with managing[35]
  - ➢ Hesitating to ask for help from trainer(s)[35]
- ▪ People at home do not assist me[37]
- ▪ Low maternal level of education[45]

Support from and contact with people
- ➢ Not being accepted or being bullied by peers[31,33,35]
- ➢ Not being accepted by other parents[35]
- ➢ Teachers and instructors giving negative comments[31]
- ➢ Lack of role models (C)[30]
- ➢ Lack of PA partners to play with (C)[33]
- ➢ Lack of professionals who know how to and can teach sport skills (C)[33]
- ➢ Professionals are not assisting child in PA[34]
- ▪ Lack of trained staff/volunteer[38]
- ▪ People's misconception or unfriendly attitude[38]
- ▪ There's no one to do it with[46]

Sports
- ➢ Activity type (competitive sports) (C)[31]
- ➢ Activity not adequately adapted (P)[34,35]
- ➢ Necessary equipment (C)[33]
- ➢ Lack of opportunities (rules, regulation) (C)[30]
- ➢ Sport facility:
  - ➢ Teams too big[35]
  - ➢ Waiting list[35]
  - ➢ Being underestimated[35]
  - ➢ Not allowed to play matches[35]
- ▪ Lack of clothes/(adapted) equipment[38,46]
- ▪ Where to exercise[38]
- ▪ Lack of LTE program[38]
- ▪ No space to exercise (with peers)[38]

Environment
- ➢ Environment not adequately adapted (P)[34]
- ▪ Uneven playgrounds[46]
- ▪ Accessibility of facilities[38]
- ▪ Showering/changing facility[38]
- ▪ No suitable facilities[46]

School
- ➢ Lack of professional training in PE (C)[33]
- ➢ PE teachers only select students with better sport skills or performance (C)[33]
- ▪ No suitable facilities at school[48]
- ▪ Having lot of homework[41]

Transport
- ➢ Lack of (access to) transport[34,35]
- ➢ Transport (living in more rural areas) (P)[31]
- ▪ Lack of transport[38,46]

Financial support
- ➢ Financial restrictions[35]
- ➢ Financial commitment (P)[32]
- ▪ High cost[41]

Other
- ➢ Consequences of stigma of disability (C)[30]
- ➢ Time commitment (P)[32]
- ▪ Inappropriate weather[39,41]
- ▪ Too cold or hot[38]

Facilitators

Family
- ➢ Family resilience (P)[32]
- ➢ Doing PA with parents[35]
- ➢ Parental encouragement and motivation[31]
- ➢ Parental support: [31,34,35]
  - ➢ Getting them to places[31]
  - ➢ Helping with transfers (P)[34]
  - ➢ Perseverance (in exploring options)[35]
  - ➢ Assertiveness (advocating for child)[35]
  - ➢ Having a positive attitude[35]
- ▪ Encouragement to be active[46]

Support from and contact with people
- ➢ Teachers + instructors supporting (P)[31]
- ➢ Skilled helpers (P)[34]
- ➢ Motivation from PE teacher + friends (C)[33]
- ➢ Peer socialization (P)[34]
- ➢ Being accepted by peers + other parents[35]
- ▪ Making friends[46]
- ▪ Positive attitude towards me by schoolmates, teachers and other people[37]
- ▪ Having someone who can provide support[41]
- ▪ Having someone with whom can do PA with[41]

Sports
- ➢ Activity type (sports they enjoy doing)[31]
- ➢ Chances to join competition (C)[33]
- ➢ Opportunities for sport/PA[35]
- ➢ Sport facility: [35]
  - ➢ Having good trainer[35]
  - ➢ Communication between trainers-coaches[35]
  - ➢ Training in small groups[35]
- ➢ Advantages of wheelchair sports (P):[32]
  - ➢ Impact on child (confidence)[32]
  - ➢ Community building[32]
  - ➢ Friendship[32]
  - ➢ Future aspirations[32]
- ▪ Having necessary equipment[41]
- ▪ Sportclub participation (on weekend days)[43]

Environment
- ➢ Adaptive equipment (P)[34]
- ➢ Access to sport/PA in community[31,35]
- ▪ Accessible community recreation facilities[41]
- ▪ Access to suitable facilities[46]

School
- ▪ Participation in PE classes at school[46]

Transport
- ➢ Transport (living close by the city) (P)[31]
- ▪ Having transportation[46]

Other
- ➢ Appropriate group activities (P)[34]
- ➢ Disability-adopted programs (P)[34]
- ➢ Opportunities away from home (C)[30]

Figure 4: Environmental factors, barriers and facilitators of the included studies incorporated in the Physical Activity for People with a Disability (PAD) model. A red box indicates barriers and a green box indicates facilitators. When there is no indicator behind a factor, it means that the factor was mentioned by the parent or child in a qualitative study. C, children and adolescents; P, parents; PA, physical activity; LTE, learn to exercise; PE, physical education.[28] ➢, Qualitative study result; ▪, Quantitative study result.

DISCUSSION

The aim of this systematic review was to identify the factors that hinder or facilitate physical activity in children and adolescents with physical disabilities. A systematic search yielded 18 studies, including both qualitative[30–35] and quantitative[10,36–46] designs, in which a wide variety of factors were identified, with the majority originating from qualitative studies and being reported by children,[30,33] parents,[32] or a combination of the two.[31,34,35] Quantitative studies primarily examined the associations between factors and physical activity[36,38,40,42,46] or predictor variables for physical activity.[10,39,40,42–45] Three studies additionally or only reported descriptive statistics of factors.[37,41,46] The factors were distributed among all levels of the PAD model[28] and many could both hinder and promote physical activity, depending on the presence or absence of a certain factor.

The level of self-efficacy included some distinctive factors. A child's confidence seems to be an important positive factor associated with physical activity,[31,35,46] which may be influenced by factors related to health condition, such as motor skills or lack of them, as shown in the model. For example, if children are able to achieve the self-efficacy factors of 'being able to independently negotiate barriers in the community'[34] and 'teaching others to help',[34] they may overcome common environmental barriers; therefore, self-efficacy is imperative. At the same time, appropriate adaptive equipment for mobility and care[33,34,38,41,46] and appropriate opportunities at school,[46] at sport clubs,[31–33,35] and in the general community[30,31,34,35,38,41] seem to be important environmental requirements, whereas facilitating factors related to 'fitness'[40,42] and 'fundamental movement skills'[36] seem to be important personal requirements. Therefore, policy

makers focusing their attention on appropriate adaptive equipment and opportunities may help to increase physical activity. Health care professionals can assist children in improving fitness and skills, but a focus on self-efficacy may also be beneficial, as it is more likely that children will continue physically active behaviour if they are confident about their own abilities. Conversely, physical activity promotes self-efficacy, as adapted sports programmes were reported to have a positive impact on children's confidence levels.[32]

The results of this review are only partly comparable to results from the recent systematic review on perceived factors associated with physical activity for children with both cognitive and physical disability.[15] Only three of the included studies[30,32,38] in the review from Shields et al.[15] were also included in this review, because they included physical disabilities relevant to both reviews. We also included new studies in this review; the end date of our search was May 2013, compared with September 2010 in Shields et al.[15] Moreover, we included several quantitative studies reporting factors related to physical activity, which were excluded in the review from Shields et al.[15] Although this current review specifically sought factors associated with physical activity in children and adolescents with physical disabilities, we are aware that these children may also have some level of cognitive impairment. It was clear, however, that certain factors were identified more frequently or only for children with physical disabilities. Access to adequate equipment was reported only by children with physical disabilities[34,41] and positive factors related to attitude were more distinct.[30,35,46] In addition, it seems that children with intellectual or mental disabilities are more dependent on social influence to understand the importance of physical activity,[15] whereas children with physical disabilities generally have good personal attitudes towards physical activity.[31,33,35,46]

'Increasing age' was an important barrier specific to children and adolescents with physical disabilities.[10,34,43,44] Bearing in mind the likely long-term negative health consequences of physical inactivity in this population, we need to consider increasing age as a relevant factor associated with physical activity. As children and adolescents with physical disabilities progress into adulthood, they become more independent. Although young adults with physical disabilities still receive support from others, they more frequently reported personal factors as affecting their participation in physical activity, as described by Buffart et al.[47] In particular, the reasons why young adults with childhood-onset physical disabilities engaged in physical activity included motivational factors such as 'feelings of fulfillment and enjoyment', 'having a physical challenge', or 'wanting to achieve a goal', but there were also other factors such as 'maintaining a healthy body', 'functional independence', and 'physical appearance'.[47] Negative factors related to 'limited physical activity sports or facilities' and 'problems with transportation' were consistently reported among children and young adults, but young adults also reported that a 'lack of knowledge about where and how to exercise' and 'expensive equipment' or 'scarce second-hand assistive devices' kept them from being physically active.[47] This information seems to reaffirm the need for the focused attention of policy makers on adequate physical activity opportunities and appropriate adaptive equipment, and that motivation and confidence may be inevitable areas of focus for health professionals.

The current review used the PAD model to categorize and present the identified factors associated with physical activity.[28] The ASE model[29] incorporated herein is based on the theory of planned behaviour,[48] which suggests that it is more likely that people will engage in physical activity when they have a positive attitude, perceive that there is social support, and believe in their own ability to engage in physical activity.[28,48] The findings of this review seem to be consistent with this theory. By presenting the factors on different levels, it should be possible to develop interventions that may promote physical activity involving all these levels. However, a critical note has to be made when applying the PAD model. This model was originally developed for adults with a disability, and using this model for children and adolescents led to discussions about, for example, the factors of social influence. In young children, social influence mainly originates from the direct family,[31,32,35] whereas, as children get older, other people and the community seem to play a more important role.[47] Moreover, the results of this review demonstrated that, as age increases,[10,43,44] new negative factors such as 'more fear' and 'lack of motivation' are experienced.[34] As children progress into adulthood, the environment places greater demands that cannot always be fulfilled. Unfortunately, development in children and adolescents is difficult to categorize in the PAD model. In the future, the PAD model may be adjusted, or a new model may be developed, specifically for children and adolescents, with special emphasis on the developmental issues in paediatric research and care.

Future interventional research should aim to establish a practical guide based on these factors, which would help health care professionals realise individual approaches. It is obvious that no 'one-size-fits-all' concept is suitable for this population, but children with physical disabilities would experience greater benefit from individual approaches. As the reviewed literature originated from different countries, the factors and their strengths may differ; therefore, possible cultural differences should be taken into account when establishing such a guide.

The strengths of this review were that a sensitive search strategy was used, which produced an extensive yield of relevant literature, and 18 studies were located that met the selection criteria. Furthermore, every step in the study selection procedure, methodological quality assessment, data extraction, and data analysis was independently performed by at least two reviewers. The findings in the included studies were consistent with and applicable to the PAD model,[28] the use of which was also considered as a strength, since different levels could be addressed.

Some limitations should also be considered when interpreting the results of this review. Language and publication bias may be present because studies that were not written in English or Dutch were excluded, as were studies published before January 2000 and 'grey literature' (defined above). Only one[32] of the 18 included studies scored the maximum rating of three stars in the methodological quality assessment, which may have influenced the quality of the results of the studies. Although the McMaster Critical Review Forms[22–25] and the numerical rating criteria developed by Imms[26] are used in the literature, no information is available about their validity or reliability.[49] The relative importance of each factor should be considered, as the strength of the factors is mostly unclear and, therefore, it is uncertain which factors will be most important. Finally, there might be variability between the studies regarding the definition of physical activity, leading to different results.

CONCLUSION

The participation of children and adolescents with physical disabilities in physical activity is complex; a cluster of many factors exist that hinder or promote physical activity. An individualized approach in children and adolescents with physical disabilities, using the opportunities available to the child as a basis for increasing physical activity, may be an important element in future interventions. Increasing self-efficacy may also be of value, as it seems to support children in increasing physical activity behaviour that may persevere throughout their life. Additional focus may be necessary during adolescence, as increasing age is an important negative factor that affects physical activity. Policy makers in schools, sport clubs, and the general community need to be aware of the importance of adequately adapted environments, and the availability of appropriate adaptive equipment and adapted sports in the child's own environment.

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SUPPORTING INFORMATION

The following additional material may be found online:

Appendix SI: Search strategy PubMed.

REFERENCES

1. Physical activity, global health series. *Lancet*. http://www.thelancet.com/series/physical-activity (accessed 18 July 2012).
2. Lee IM, Shiroma EJ, Lobelo F, et al. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet* 2012; **380**: 219–29.
3. Biddle SJ, Gorely T, Stensel DJ. Health-enhancing physical activity and sedentary behaviour in children and adolescents. *J Sports Sci* 2004; **22**: 679–701.
4. Murphy NA, Carbone PS; American Academy of Pediatrics Council on Children With Disabilities. Promoting the participation of children with disabilities in sports, recreation, and physical activities. *Pediatrics* 2008; **121**: 1057–61.
5. Wilson PE, Clayton GH. Sports and disability. *PM R* 2010; **2**: S46–54; quiz S55–6.
6. King G, Law M, King S, et al. A conceptual model of the factors affecting the recreation and leisure participation of children with disabilities. *Phys Occup Ther Pediatr* 2003; **23**: 63–90.
7. Hills AP, King NA, Armstrong TP. The contribution of physical activity and sedentary behaviours to the growth and development of children and adolescents: implications for overweight and obesity. *Sports Med* 2007; **37**: 533–45.
8. Rimmer JA, Rowland JL. Physical activity for youth with disabilities: a critical need in an underserved population. *Dev Neurorehabil* 2008; **11**: 141–8.
9. Schoenmakers MA, de Groot JF, Gorter JW, et al. Muscle strength, aerobic capacity and physical activity in independent ambulating children with lumbosacral spina bifida. *Disabil Rehabil* 2009; **31**: 259–66.
10. Maher CA, Williams MT, Olds T, et al. Physical and sedentary activity in adolescents with cerebral palsy. *Dev Med Child Neurol* 2007; **49**: 450–7.
11. Buffart LM, Roebroeck ME, Rol M, et al. Triad of physical activity, aerobic fitness and obesity in adolescents and young adults with myelomeningocele. *J Rehabil Med* 2008; **40**: 70–5.
12. Carlon SL, Taylor NF, Dodd KJ, et al. Differences in habitual physical activity levels of young people with cerebral palsy and their typically developing peers: a systematic review. *Disabil Rehabil* 2013; **35**: 647–55.
13. Neter JE, Schokker DF, de Jong E, et al. The prevalence of overweight and obesity and its determinants in children with and without disabilities. *J Pediatr* 2011; **158**: 735–9.
14. Kotte EM, Winkler AM, Takken T. Fitkids exercise therapy program in the Netherlands. *Pediatr Phys Ther* 2013; **25**: 7–13.
15. Shields N, Synnot AJ, Barr M. Perceived barriers and facilitators to physical activity for children with disability: a systematic review. *Br J Sports Med* 2012; **46**: 989–97.
16. Maher CA, Williams MT, Olds T, et al. An internet-based physical activity intervention for adolescents with cerebral palsy: a randomized controlled trial. *Dev Med Child Neurol* 2010; **52**: 448–55.
17. Van Wely L, Balemans AC, Becher JG, et al. The effectiveness of a physical activity stimulation programme for children with cerebral palsy on social participation, self-perception and quality of life: a randomized controlled trial. *Clin Rehabil* 2014; **28**: 972–82.
18. Van Wely L, Balemans A, Becher J, et al. Physical activity stimulation program for children with spastic cerebral palsy did not improve physical activity: a randomised controlled trial. *J Physiother* 2014; **60**: 40–9.
19. Grant MJ, Booth A. A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Info Libr J* 2009; **26**: 91–108.
20. GreyNet International. Grey Literature Network Service. http://www.greynet.org/ (accessed 9 July 2014).
21. Ket H, Riphagen I. Pediatrics for PubMed, 2006. Revised Ket H, 2009. http://www.medischebibliotheekznb.nl/Filters%20PubMed.htm (accessed 16 April 2014).
22. Letts L, Wilkins S, Law M, et al. Guidelines for Critical Review Form – Qualitative Studies. Version 2.0. McMaster University, 2007. http://www.srs-mcmaster.ca/Portals/20/pdf/ebp/qualguidelines_version2.0.pdf (accessed 9 July 2014).
23. Letts L, Wilkins S, Law M, et al. Critical Review Form – Qualitative Studies. Version 2.0. McMaster University, 2007. http://www.srs-mcmaster.ca/Portals/20/pdf/ebp/qualreview_version2.0.pdf (accessed 9 July 2014).
24. Law M, Stewart D, Pollock N, et al. Guidelines for Critical Review Form – Quantitative Studies. McMaster University, 1998. http://www.srs-mcmaster.ca/Portals/20/pdf/ebp/quanguidelines.pdf (accessed 9 July 2014).
25. Law M, Stewart D, Pollock N, et al. Critical Review Form – Quantative Studies. McMaster University, 1998. http://www.google.nl/url?sa=t&rct=j&q=&esrc=s&frm=1

&source=web&cd=2&ved=0CDAQFjAB&url=http%3A%2F%2Fwww.srs-mcmaster.ca%2FPortals%2F20%2Fpdf%2Febp%2Fquanreview_form1.doc&ei=0kO-U6yhJsuAPf_lgdgJ&usg=AFQjCNEwMex4T1xGtlVxbwj0Tn7Het2zUA (accessed 9 July 2014).

26. Imms C. Children with cerebral palsy participate: a review of the literature. *Disabil Rehabil* 2008; **30**: 1867–84.

27. Netwerk Kwalitatief Onderzoek AMC – UvA. Richtlijnen voor Kwaliteitsborging in Gezondheids(Zorg)Onderzoek: Kwalitatief Onderzoek. Amsterdam: Netwerk Kwalitatief Onderzoek AMC – UvA, 2002.

28. van der Ploeg HP, van der Beek AJ, van der Woude LH, et al. Physical activity for people with a disability: a conceptual model. *Sports Med* 2004; **34**: 639–49.

29. de Vries H, Dijkstra M, Kuhlman P. Self-efficacy: the third factor besides attitude and subjective norm as a predictor of behavioural intentions. *Health Educ Res* 1988; **3**: 273–82.

30. Anderson DM, Bedini LA, Moreland L. Getting all girls into the game: physically active recreation for girls with disabilities. *J Park Recreat Admi* 2005; **23**: 78–103.

31. Barnett AL, Dawes H, Wilmut K. Constraints and facilitators to participation in physical activity in teenagers with developmental co-ordination disorder: an exploratory interview study. *Child Care Health Dev* 2013; **39**: 393–403.

32. Hunter DE. A phenomenological approach: the impact on families of sports participation for a child with a physical disability. (UMI Dissertations). Ann Arbor, MI: ProQuest, 2010.

33. Li C, Chen S. Exploring experiences of physical activity in special school students with cerebral palsy: a qualitative perspective. *Eur J Adapt Phys Activ* 2012; **5**: 7–17.

34. Luther BL. Food and physical activity choices to prevent overweight in children with spina bifida. (UMI Dissertations). Ann Arbor, MI: ProQuest, 2010.

35. Verschuren O, Wiart L, Hermans D, et al. Identification of facilitators and barriers to physical activity in children and adolescents with cerebral palsy. *J Pediatr* 2012; **161**: 488–94.

36. Capio CM, Sit CHP, Abernethy B, et al. Fundamental movement skills and physical activity among children with and without cerebral palsy. *Res Dev Disabil* 2012; **33**: 1235–41.

37. Frantz J, Phillips JS, Matheri JM, et al. Physical activity and sport as a tool to include disabled children in Kenyan schools. *Sport Soc* 2011; **14**: 1227–36.

38. Kang M, Ragan BG, Zhu W, et al. Exercise barrier severity and perseverance of active youth with physical disabilities. *Rehabil Psychol* 2007; **52**: 170–6.

39. Maltais DB, Pierrynowski MR, Galea VA, et al. Physical activity level is associated with the O_2 cost of walking in cerebral palsy. *Med Sci Sports Exerc* 2005; **37**: 347–53.

40. Maltais DB, Pierrynowski MR, Galea VA, et al. Habitual physical activity levels are associated with biomechanical walking economy in children with cerebral palsy. *Am J Phys Med Rehabil* 2005; **84**: 36–45.

41. Ortiz-Castillo E. Physical activity patterns and factors influencing physical activity participation among adolescents with physical disabilities in urban communities. (UMI Dissertations). Ann Arbor, MI, USA: ProQuest, 2012.

42. Shapiro DR, Martin JJ. Multidimensional physical self-concept of athletes with physical disabilities. *Adapt Phys Activ Q* 2010; **27**: 294–307.

43. van Wely L, Becher JG, Balemans AC, et al. Ambulatory activity of children with cerebral palsy: which characteristics are important? *Dev Med Child Neurol* 2012; **54**: 436–42.

44. van Eck M, Dallmeijer AJ, Beckerman H, et al. Physical activity level and related factors in adolescents with cerebral palsy. *Pediatr Exerc Sci* 2008; **20**: 95–106.

45. Zwier JN, van Schie PE, Becher JG, et al. Physical activity in young children with cerebral palsy. *Disabil Rehabil* 2010; **32**: 1501–8.

46. Matheri JM, Frantz JM. Physical activity levels among young people with physical disabilities in selected high schools in Kenya and their perceived barriers and facilitators to participation. *J Commun Health Sci* 2009; **4**: 21–6.

47. Buffart LM, Westendorp T, van der Berg-Emons RJ, et al. Perceived barriers to and facilitators of physical activity in young adults with childhood-onset physical disabilities. *J Rehabil Med* 2009; **41**: 881–5.

48. Ajzen I. The theory of planned behavior. *Organ Behav Hum Dec* 1991; **50**: 179–211.

49. Crowe M, Sheppard L. A review of critical appraisal tools show they lack rigor: alternative tool structure is proposed. *J Clin Epidemiol* 2011; **64**: 79–89.