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ORIGINAL ARTICLE



# SPORTS STARS: a practitioner-led, peer-group sports intervention for ambulant children with cerebral palsy. Activity and participation outcomes of a randomised controlled trial

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**ABSTRACT**

**Purpose:** To investigate the effectiveness of a practitioner-led, peer-group sports intervention for children with CP at GMFCS Level I–II.

**Method:** Children with CP (GMFCS I–II; 6–12 years) were randomised to *Sports Stars* or waitlist-control groups. *Sports Stars* included eight-weeks (eight hours) of physiotherapist-led, sports-specific gross motor activity training, sports education, teamwork development and confidence building. Sports participation was measured using self-identified participation goals (modified Canadian Occupational Performance Measure (mCOPM)). Physical competence was measured with mCOPM activity goals and high-level gross motor batteries (Test of Gross Motor Development (TGMD-2); GMFM-Challenge) and walking (Timed-Up-and-Go), running (Muscle Power Sprint Test; 10x5m Sprint Test), jumping (Standing Broad Jump; Vertical Jump) and throwing (Seated Throw) items. General participation and quality of life were also measured. Outcomes were measured pre, post and 12-weeks post-intervention. Data were analysed using linear mixed models.

**Results:** Fifty-four children were randomised into *Sports Stars* ($n = 29$; GMFCS $I = 7$, II = 22; male = 19; $8.9 \pm 2$ years) or waitlist-control groups ($n = 25$; GMFCS $I = 10$, II = 15; male = 14; $8.6 \pm 2$ years). The *Sports Stars* group improved sports participation and activity goals (mCOPM $F = 5.49$–$10.29$, $p < 0.001$) and sports-specific physical competence (TGMD-2, $F = 3.45$–$5.19$, $p = 0.001$–$0.009$) compared to the wait-list-control.

**Conclusion:** *Sports Stars* is effective for improving sports-specific participation and physical competence for children with CP.

**➤ IMPLICATIONS FOR REHABILITATION**

1. *Sports Stars* improves performance and satisfaction in sports-specific participation and activity goals for ambulant children with CP.
2. *Sports Stars* improves sports-specific physical activity competence in locomotor and object control skills.
3. Sport-specific interventions should incorporate sport-specific gross motor activity training as well as sports education, confidence building and teamwork.

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## Introduction

Participation in sport is a fundamental human right [1] and a goal for many children with cerebral palsy (CP) and their families [2]. Children with disabilities who participate in sport have been reported to have better quality of life, self-esteem and confidence [3] and better fitness and gross motor skills [4,5]. For children with CP, participation in recreational or competitive community sport has been suggested as an adjunct to long-term physiotherapy due to its potential to maintain the positive effects of therapeutic interventions and its low cost to consumers [6]. Despite this, children with CP participate significantly less in sport than their typically developing peers [7]. Recent participation-focussed research for children with CP at Gross Motor Function Classification System (GMFCS) [8] I–II has shown that individualised physiotherapy can improve activity competence in individual sports (i.e., downhill skiing, ice skating, gymnastics and running) [9–12] and participation in leisure-time physical activity [2]. However, to our knowledge, no studies have investigated whether a practitioner-led, peer-group sports intervention can improve the skills that children with CP need to transition from individual physiotherapy to team-based sports in the community.

Drawing on the "family of Participation Related Constructs" (fPRC) as a model [13], limitations in activity competence are frequently cited as barriers to mainstream sports participation for children with disabilities [14]. This typically refers to children's physical activity competence, including sports-specific skills. For example, children at GMFCS Level I or II are ambulant and typically attend mainstream schools (GMFCS I, 75.6%, GMFCS II 62.6%) [15].

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Supplemental data for this article can be accessed here.

They are often expected to participate in mainstream sports with their typically developing peers. However, mainstream programs are designed for typically developing children with age-appropriate physical activity competence, including the ability to perform high-level locomotor (e.g., running) and object control (e.g., catching) skills, whilst maintaining balance and orientation to teammates and their environment [16]. Children must also have the strength and cardiorespiratory function to perform physical activity at the required intensity and duration needed for training and competition [17]. These expectations are often very challenging for children with CP at GMFCS Level I or II.

Leaders in the field of physical activity have indicated that helping children with CP to improve their physical activity competence may contribute to improved participation, confidence, sense of self, motivation and enjoyment of physical activity, and improve their quality of life [2,9,14]. Gross motor activity training is effective for improving activity competence in gross motor function [18], postural control [16] and fitness [19,20] in school-aged children with CP. However, interventions that focus solely on physical activity competence do not necessarily translate to improved participation for children with disability [21]. Early evidence suggests that to improve participation, interventions must also address aspects such as children's psychological, cognitive and social competencies [22]. Along with physical skills, these are the four core components of the "*Physical Literacy Framework*" used by coaches and physical education teachers to teach children about sport [23]. Alongside physical competence, essential cognitive competence might include knowing game rules; psychological competence might include having enough persistence and confidence; and social competence might involve peer relationships and working as a team. Group-based therapy interventions may offer these multiple benefits for children [24], in order to facilitate their transition to community sports.

Despite the benefits of sports participation, research shows there is a gap in intervention programs that aim to support children with disabilities such as CP to transition from individual physiotherapy into team-based recreational or competitive sports. To address this gap, we developed *Sports Stars,* a practitioner-led, peer-group sports intervention which includes popular land-based team sports, and has been detailed in the published protocol for this trial [25]. This intervention is participation-focussed and includes physiotherapist-led activity competence training across physical (sports-specific gross motor activity training), cognitive (sports education), psychological (confidence building) and social (teamwork skills) elements, in a community setting (local park) to prepare children to transition to community team sports participation. It was hypothesised that compared to children in the waitlist-control group, children in the *Sports Stars* group would demonstrate greater improvement in their (1) sports participation, (2) physical activity competence (sports-specific gross motor function), and (3) quality of life.

## Materials and methods

### Design

This was a randomised, waitlist-controlled, assessor blinded trial of the *Sports Stars* intervention for school-aged children with CP at GMFCS Level I-II. The trial was registered with the Australian New Zealand Clinical Trials Registry (ACTRN12617000313336) and approved by ethics committees of the CPL-Choice, Passion, Life (formerly the Cerebral Palsy League) and The University of Queensland. The published protocol reports detailed methods for this study including sample size calculations, the randomisation process, validity and reliability of outcome measures and intervention content [25]. In brief, participants were grouped into subgroups of 4–6 children based on their geographic location. These subgroups were randomised into either the immediate *Sports Stars* or waitlist-control groups using a concealed random sequence. Recruitment was ceased when no subgroups of at least four participants could be recruited in a common geographical area. The required sample size of 50 was met. Participant flow and study dates are reported in the CONSORT flowchart (Figure 1).

### Participants

Children were recruited through a state-wide CP service and CP register between March 2016 and September 2018. Participants were children (i) aged 6–12 years, (ii) with a diagnosis of CP, (iii) who were ambulant, with a GMFCS Level I or II. Children had not had orthopaedic or neurological surgery within six months, or Botulinum Toxin injections within three months prior to intervention. Participants had appropriate physical, behavioural and intellectual ability to complete baseline assessments and participate in intervention protocols and did not have medical co-morbidities impacting safe exercise as reported by their parents. Parents provided written consent, and children provided written assent for study participation and result publication. To maintain assessor blinding, parents were instructed to direct questions regarding the intervention to the treating therapist.

### Intervention

The *Sports Stars* intervention is provided in detail in the published protocol, including a sample session plan [25]. In brief, *Sports Stars* included eight, weekly, one-hour sessions (eight hours) of intervention, which combined sports-specific gross motor activity training, sports education, teamwork development and confidence building for four sports: soccer, netball, T-ball and cricket. The variety of sports activities provided aimed to provide opportunities for children to develop a wider range of (i) physical sports skills, (ii) knowledge and understanding of different sports, (iii) confidence in trying new sports and (iv) sports preferences. Sessions were led by a physiotherapist who had received *Sports Stars* training and detailed session plans from the chief investigator (GC). *Sports Stars* groups were conducted in community parks between April 2016 and October 2018 and included two sessions of each sport. Participants in the *Sports Stars* group did not receive any other physiotherapy during the 8-week intervention, however, were permitted to continue recreational activities such as sport. Parents were asked to record these activities in a daily log, however, poor adherence to reporting recreational activities meant that accurate amounts could not be reported.

Participants in the waitlist-control group received standard care. Parents of participating children in the control group reported that their children received a mean of 1.3 h (range 0–4 h) of physiotherapy during the 8-week intervention period. Waitlist-control groups were invited to participate in a *Sports Stars* intervention following their 12-week follow-up assessment.

### Outcome measures

Outcome measures were collected pre-intervention (0 weeks), immediately post-intervention (8 weeks), and at 12-weeks post-intervention (20 weeks). Assessments were performed in each child's local community therapy centre by the chief investigator (GC), who was

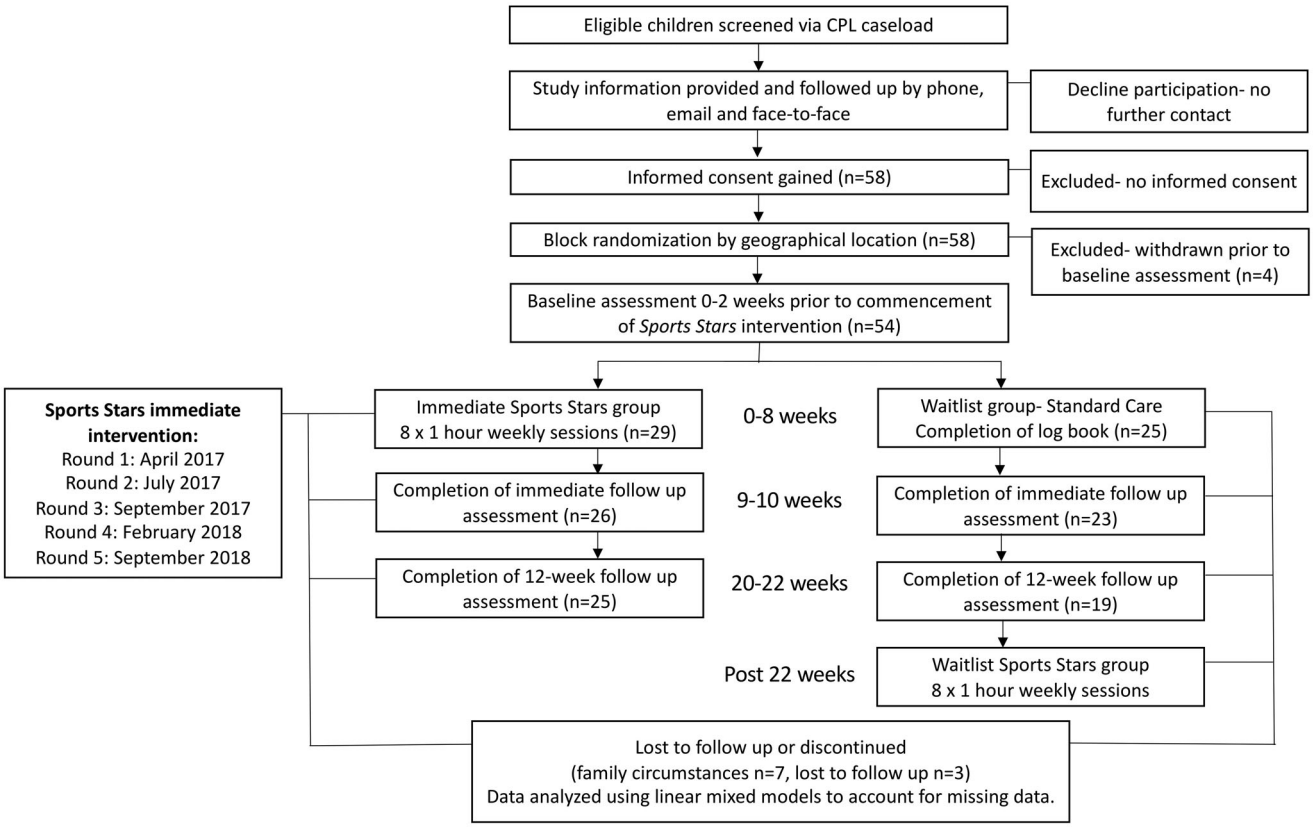


**Figure 1.** CONSORT flowchart describing flow of Sports Stars randomized controlled trial.

blinded to group allocation. Children's motor function (GMFCS) [8], functional mobility (Functional Mobility Scale (FMS)) [26], type of motor disorder (primary motor type) and anatomical distribution (unilateral or bilateral distribution) were recorded.

### *Participation*

Sports-specific participation goals were identified collaboratively between the primary caregiver, child and blinded assessor to be consistent with the fPRC participation constructs – i.e., attendance or involvement in sport [27]. Goals were set using a modified Canadian Occupational Performance Measure (mCOPM) [28] and rated for performance and satisfaction on a scale of 0-10 by the caregiver in collaboration with their child. An improvement of two points was considered clinically meaningful [29].

The Children's Assessment of Participation and Enjoyment (CAPE) [30] was used to measure changes to more general participation (i.e., not sports-specific). The CAPE evaluates the fPRC concept of attendance by collecting data relating to who a child participates with, and the diversity and intensity of participation. It evaluates involvement through collecting data relating to enjoyment. Scores analysed include CAPE Diversity (0–55), Intensity (1–7), With Whom (1–5), Where (1–6), and Enjoyment (1–5), domains. The Preferences of Activities for Children (PAC) [30] was used to evaluate the participation related construct of activity preferences. The total PAC score was analysed.

### *Physical activity competence*

Sports-specific physical activity competence goals were developed at the same time and with the same approach used to set mCOPM participation goals [13].

Sports-specific gross motor function was measured with the Test of Gross Motor Development-second edition (TGMD-2) [31]. Raw scores for the total score (0-96 points) and locomotor (0–48 points) and object control (0–48 points) subscales were examined in order to identify changes in skill performance irrespective of changes in age category during the study. The minimal detectable change (MDC) for the raw total score was estimated as 3.34 points based on data from the study by Kim and Park [32] involving children with disabilities. This is greater than the sum of the Standard Error of Measurement (SEM) for both subscales reported in the TGMD-2 examiner's manual for children with typical development (one point per sub scale, or two points in total) [31].

Overall gross motor function was measured with the CP-specific Gross Motor Function Measure-Challenge Module (GMFM-Challenge) [33]. Authors of the GMFM-Challenge indicate that the total score may be calculated using either the sum of the scores of the (i) mean of the three trials of each item, (ii) first item in each trial in each item, or (iii) best trial of each item [33]. In this study, the mean score (0-112 points) was used to capture each child's performance consistency which is most relevant to participation in sport. The MDC of the GMFM-Challenge total score is 4.47 points for children with CP [34].

Gross motor assessment items were used to measure walking (Timed Up and Go (TUG)) [35], running ($10 \times 5$ Meter Sprint Test (10x5mST) [36] and Muscle Power Sprint Test (MPST) [36]), jumping (Standing Broad Jump [37] and Vertical Jump [37]) and throwing (Seated Throw [37]) performance. These assessment tools provided a functional indication of balance, cardiorespiratory fitness, agility and strength. The TUG measures functional mobility often required to access sporting opportunities and has a MDC of 1.4 s for children at GMFCS Level I and 2.9 s for children at GMFCS Level II [38]. The 10x5mST measures running agility required for direction changes in sports such as soccer [39]. A decrease in running time of 3.2 s in the 10x5mST is considered real improvement

[36]. The protocol for the Muscle Power Sprint Test (MPST) [36] was used to measure sprint speed required for sports such as T-ball [39]. A decrease in power of 18 watts (8-13 s) is considered real improvement [36]. The Standing Broad Jump, Vertical Jump and Seated Throw were used to measure functional strength of the upper and lower limbs [37]. No MDC was available for these items. Reina, Iturricastillo [40] reported SEM as less than 10% when measuring jumping assessments for adult soccer players with CP. Therefore, an improvement of at least 10% will be considered real improvement in this study.

### *Quality of life*

General quality of life was measured using the parent proxy of the Cerebral Palsy Quality of Life- Child (CP QOL-Child) [41]. The following subscales were analysed: Social Wellbeing and Acceptance, Feelings about Functioning, Participation and Physical Health, Emotional Wellbeing and Self-Esteem, Access to Services, Pain and Impact of Disability and Family Health.

### *Statistical analysis*

The sample size of 50 children (25 in each group) was calculated *a priori* [25]. Statistical analyses were performed by the chief investigator using SPSS statistical software, version 25 [42]. Participants who withdrew after randomisation but prior to baseline assessment were excluded, because they had no baseline data available for analysis [43]. These withdrawals occurred due to scheduling conflicts where families could no longer commit to participating in the study, therefore making them ineligible to continue. Children with missing data at other timepoints were retained in analyses since missing data was able to be managed using the linear mixed model analysis.

Baseline data was examined for each group using descriptive statistics and visual inspection. Data was aggregated using the mean and standard deviation for normally distributed data, and median and interquartile range for non-normally distributed data. Linear mixed models were used to compare groups. Linear mixed models were able to account for variation in individuals over time, manage missing data, and examine changes in the outcomes over time and across groups [44,45]. In this study, missing data were expected to occur due to individual circumstances (e.g., illness) or family circumstances (e.g., unable to schedule follow up assessments due to school, work or transport). Factors that were significantly different at baseline were modelled as covariates to account for variation. When significant group by time effects were identified, post-hoc analyses using paired t-tests were performed to determine within group differences between time points. Significance was set at $p < 0.05$. Residuals of the fitted models were examined and required assumptions were met for all analyses.

## Results

A total of 54 children were clustered into 12 subgroups of 4–6 children across seven locations. Subgroups were randomised into immediate *Sports Stars* or waitlist-control groups. Slight differences in subgroup sizes led to four more participants in the immediate *Sports Stars* group ($n = 29$; GMFCS $I = 7$, II = 22; male = 19; $8.9 \pm 2$ years) compared to the waitlist-control group ($n = 25$; GMFCS $I = 10$, II = 15; male = 14; $8.6 \pm 2$ years). Nine physiotherapists with between one and 15 years of experience provided the *Sports Stars* groups. *Sports Stars* and waitlist-control groups had similar demographic characteristics (Table 1). Performance of each group at baseline is presented in Supplementary Table S1.

Although groups were randomised between the *Sports Stars* and waitlist-control groups, visual inspection showed a slightly higher number of children at GMFCS Level II in the *Sports Stars* group. Initial analysis showed that the waitlist-control group had higher scores at baseline on the GMFM-Challenge, TGMD-2-locomotor, TGMD-2-total, the mCOPM-performance rating for their activity competence goal and their PAC-Skill score. After analysis for collinearity the TGMD-2-total and PAC-Skill score were modelled as covariates in linear mixed model analysis to account for this difference at baseline (Table 2). Post-hoc results are reported in-text below, and full analysis is presented in Supplementary Table S2.

Participants of the *Sports Stars* group attended a mean of $6 \pm 2.5$ sessions, (range = 1–8). A small number of participants in both immediate *Sports Stars* and waitlist-control groups withdrew from the study due to family circumstances or were not contactable (lost to follow up) and therefore did not complete assessments at T2 and/or T3 (*Sports Stars* $n = 4$, waitlist-control $n = 6$). In addition, some participants were unable to complete the CAPE-PAC and/or CPQoL-Child during their assessment session (e.g., because the parent was caring for another child during the assessment session) and did not return these surveys at a later date (*Sports Stars* $n = 6$, waitlist-control $n = 3$). This missing data was managed by using linear mixed model analysis which is designed to manage missing data without case-wise exclusion [44,45].

### *Participation*

There was a significant group by time effect for self-identified sports participation goals on both mCOPM-performance ($F = 10.29$, $p < 0.001$) and mCOPM-satisfaction ratings ($F = 7.21$, $p < 0.001$). Post-hoc analysis confirmed that the *Sports Stars* group showed clinically and statistically significant improvements immediately after intervention in COPM-performance (4.3 points, $t = -6.787$, $p < 0.001$, Figure 2(a)) and mCOPM-satisfaction ratings (3.2 points, $t = -5.435$, $p < 0.001$) for sports participation. This improvement was retained at follow up. There was no significant change in the waitlist-control group at any time point ($p = 0.064$–$0.910$). There were no significant group by time interactions for CAPE-PAC items ($F = 0.40$–$1.99$, $p = 0.390$–$0.848$).

**Table 1.** Characteristics of Sports Stars and waitlist-control group participants.

| | *Sports Stars* ($n = 29$) | Waitlist-Control ($n = 25$) | Significance |
|---|---|---|---|
| Child characteristics | | | |
| Females, *n* (%) | 10 (34) | 9 (36) | 0.907[a] |
| Males, *n* (%) | 19 (66) | 14 (64) | |
| Mean age ± SD years (age range) | 8.930 ± 2.05 (6–12) | 8.640 ± 2.04 (6–12) | 0.604[b] |
| Distribution | | | |
| Unilateral, *n* (%) | 18 (62) | 18 (72) | 0.440[a] |
| Bilateral, *n* (%) | 11 (38) | 7 (28) | |
| Motor Type | | | |
| Spastic, *n* (%) | 23 (79) | 24 (96) | 0.069[a] |
| Other, *n* (%) | 6 (21) | 1 (4) | |
| Ambulatory status | | | |
| GMFCS I, *n* (%) | 7 (24) | 10 (40) | 0.211[a] |
| GMFCS II, *n* (%) | 22 (76) | 15 (60) | |
| FMS 50m, level 6 | 15 (52) | 14 (56) | 0.753[a] |
| FMS 50m, level 5 | 14 (48) | 11 (44) | |
| FMS500, level 6 | 7 (24) | 7 (28) | 0.747[a] |
| FMS500, level 5 | 22 (76) | 18 (72) | |

[a]Chi squared, [b]*t*-test, GMFCS: Gross Motor Function Classification System; FMS: Functional Mobility Scale.

**Table 2.** Effect of intervention (group by time effect) using Linear Mixed-Model Analysis to compare Sports Stars and waitlist-control groups.

| | Group by time interaction GMFCS I & II ($n = 54$) | |
|---|---|---|
| | F | *p* |
| Participation | | |
| Modified Canadian occupational performance measure | | |
| Participation goal- performance | **10.29** | **<0.001** |
| Participation goal- satisfaction | **7.21** | **<0.001** |
| Children's assessment of participation & enjoyment | | |
| Diversity | 0.40 | 0.848 |
| Intensity | 1.99 | 0.094 |
| Whom | 1.07 | 0.390 |
| Where | 0.86 | 0.515 |
| Enjoyment | 0.85 | 0.524 |
| Preferences of activities for children (Overall) | 0.94 | 0.460 |
| Physical activity competence | | |
| Modified Canadian occupational performance measure | | |
| Activity goal-performance | **8.43** | **<0.001** |
| Activity goal-satisfaction | **5.49** | **<0.001** |
| Test of gross motor development | | |
| Total (Raw) | **5.19** | **0.001** |
| Locomotor (Raw) | **3.45** | **0.009** |
| Object control (Raw) | **5.18** | **0.001** |
| GMFM-Challenge | 0.79 | 0.565 |
| Timed up and go | 0.53 | 0.754 |
| 10x5m Sprint Test | **3.84** | **0.005** |
| Muscle Power Sprint Test | **3.31** | **0.011** |
| Vertical Jump | 0.62 | 0.686 |
| Standing Broad Jump | **2.81** | **0.025** |
| Seated throw | 0.09 | 0.994 |
| Quality of life | | |
| Cerebral Palsy Quality of Life- parent proxy | | |
| Social wellbeing & acceptance | 0.85 | 0.524 |
| Feelings about functioning | 0.61 | 0.693 |
| Participation & physical health | 0.07 | 0.997 |
| Emotional wellbeing & self esteem | 0.37 | 0.867 |
| Access to services | 0.71 | 0.621 |
| Pain & impact of disability | 0.69 | 0.632 |
| Family health | 0.34 | 0.886 |

Factors modelled as covariates in linear mixed model: (1) GMFM-Challenge, (2) TGMD-2-locomotor, (3) mCOPM-performance rating for activity competence goal, (4) PAC-Skill score. Statistically significant values are in bold.

### *Physical activity competence*

Similar to above, for the overall group there was a significant group by time effect for self-identified, sports-specific physical activity competence goals for both mCOPM-performance ($F = 8.43$, $p < 0.001$) and mCOPM-satisfaction ratings ($F = 5.49$, $p < 0.001$). Post-hoc analysis confirmed that the *Sports Stars* group showed clinically and statistically significant improvements immediately after intervention in their mCOPM-performance (3.2 points, $t = -6.755$, $p < 0.001$, Figure 2(b)) and mCOPM-satisfaction (2.7 points, $t = -4.392$, $p < 0.001$). This improvement was retained at follow up. There was no significant change in the waitlist-control group any time point ($p = 0.079$–$0.498$).

There was a significant group by time effect for sports-specific gross motor function on the TGMD-2-total ($F = 5.19$, $p = 0.001$), TGMD-2-locomotor ($F = 3.45$, $p = 0.009$), TGMD-2-object control ($F = 5.18$, $p = 0.001$). Post-hoc analysis confirmed that the *Sports Stars* group showed clinically and statistically significant improvements immediately after intervention for TGMD-2-total (Figure 2(c) $t = -4.824$, $p < 0.001$), TGMD-2-locomotor (Figure 2(d) $t = -3.864$, $p < 0.001$) and TGMD-2-object control (Figure 2(e) $t = -5.105$, $p < 0.001$). Improvements exceeded the estimated total MDC of 3.34 points (total-19.3 points, locomotor 10.0 points, object control 9.4 points) immediately post intervention. This was retained at follow up. In contrast, the waitlist group showed statistically significant decreases in their performance on the TGMD-2 total and locomotor scores at the 12-week follow-up time point ($p = 0.013$). There was no significant change in the waitlist-control group for the immediate post intervention time point for total or locomotor scores ($p = 0.155$–$0.264$) or for object control any time point ($p = 0.059$–$0.566$).

While there was no significant group by time effect for GMFM-Challenge performance when adjusted for variables different at baseline ($F = 0.79$, $p = 0.565$), visual inspection of data showed a large increase in the *Sports Stars* group immediately after intervention (14.6 points). Therefore, further analysis was undertaken of the *Sports Stars* and waitlist-control groups using paired t-tests. The within-group change in the *Sports Stars* group exceeded the MDC of 4.47 points and was statistically significant immediately after intervention ($t = -2.536$ $p = 0.014$, Figure 2(f)). This was retained at follow up. There was no significant change in the waitlist-control group any time point ($p = 0.0.581$–$0.672$).

There was a significant group by time effect for performance on the 10 x 5mST ($F = 3.84$, $p = 0.005$), MPST ($F = 3.31$, $p = 0.011$) and Standing Broad Jump ($F = 2.81$, $p = 0.025$), however, *post hoc* calculations did not show a significant change in the *Sports Stars* ($p = 0.215$–$0.714$) or waitlist-control groups ($p = 0.700$–$0.908$). This is despite the *Sports Stars* group showing larger mean improvements immediately after intervention compared to the waitlist-control (10 x 5mST *Sports Stars* = −4.3s, waitlist-control = −0.2 s; MPST *Sports Stars* = −1.1 s, waitlist-control = 0.7; Standing Broad Jump *Sports Stars* = 11.1 cm, waitlist-control = 2.9 cm).

There was no significant group by time effect for walking (TUG: $t = 0.53$, $p = 0.754$), jumping (Vertical Jump: $F = 0.62$, $p = 0.686$) or throwing (Seated Throw: $F = 0.09$, $p = 0.994$) despite apparently greater improvements in the *Sports Stars* group immediately after intervention in jumping and throwing (Vertical Jump: *Sports Stars* change = 2.4 cm, waitlist-control change = 0.0 cm; Seated Throw: *Sports Stars* change = 27.5 cm, waitlist-control change = 7.8 cm).

### *Quality of life*

There was no significant group by time effect for the CPQoL-Child ($F = 0.07$–$0.85$, $p = 0.524$–$0.997$).

### *Adverse events*

No injuries were recorded during 98 h of scheduled intervention (54 children in 12 subgroups for eight weeks). Two trips (without injury) were reported. Modifications to activities were reported by treating physiotherapists on four occasions to manage participant behaviour in the group environment. Details about recording adverse events are available in the published protocol [25].

## Discussion

Following participation in *Sports Stars,* participants demonstrated clinically significant improvements on self-identified sports-focussed participation and activity level goals. These self-reported outcomes were supported by significant improvements in physical activity competence for locomotor and object control skills on the TGMD-2. There was no change in the individual gross motor skills measured. As seen in other studies, there were no changes in general participation using the CAPE-PAC [46] or general quality of life.

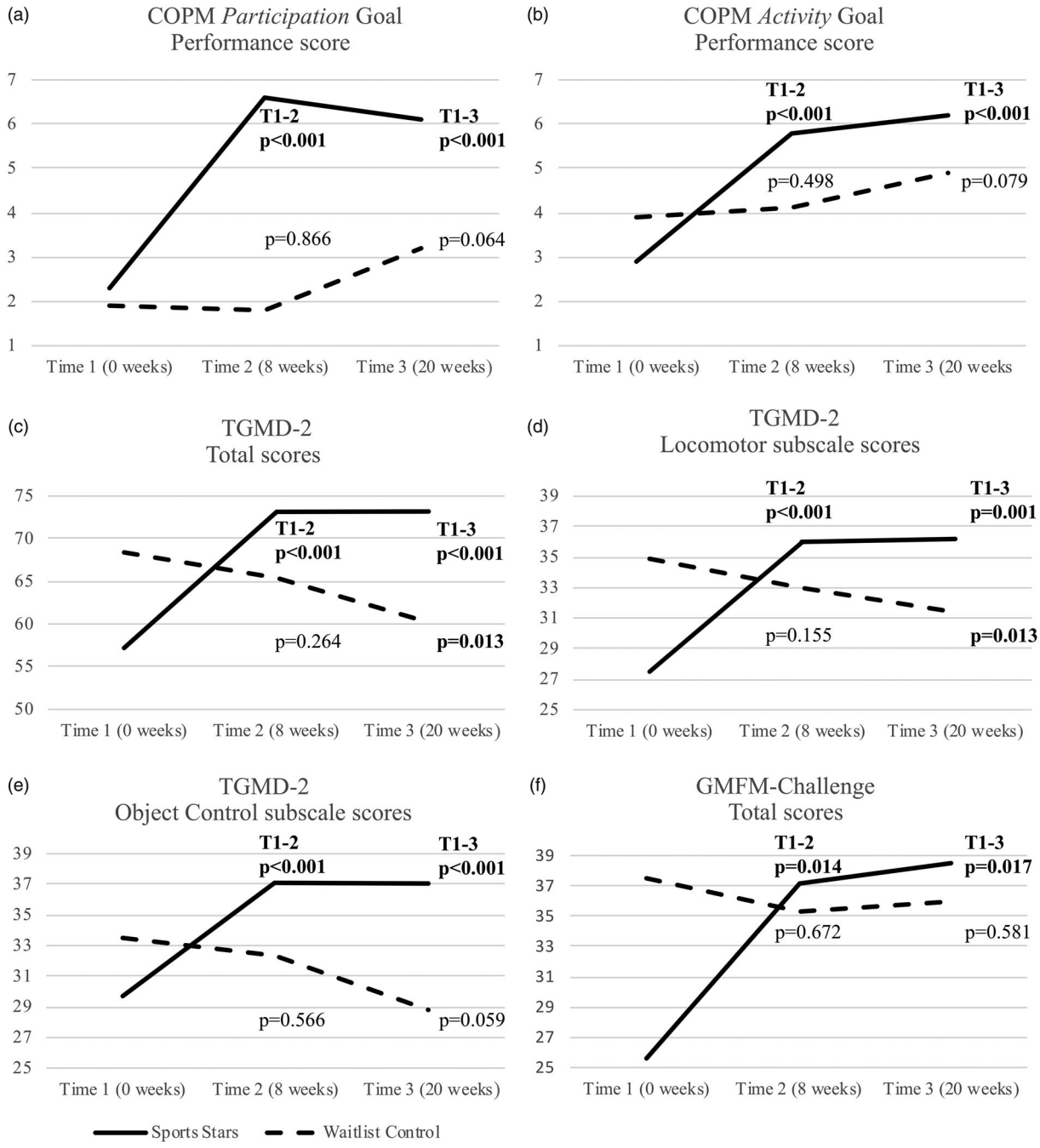


**Figure 2.** Changes in performance after participation in Sports Stars compared to waitlist-control ($p$ = significance of within-group change). T1: time 1; T2: time 2; T3: time 3; TGMD-2: Test of Gross Motor Development, Second Edition; GMFM-Challenge: Gross Motor Function Measure- Challenge Edition.

The significant participation and activity improvements following *Sports Stars* are likely to be the result of the congruence between children's self-identified sports-focussed goals and the sports-specific intervention. *Sports Stars* included gross motor activity training which has been shown to improve gross motor function relevant to the activities practiced [18]. Children subsequently showed a significant improvement on the TGMD-2 which evaluates sports-specific physical activity competence commonly targeted in national physical education curriculums [47,48]. The TGMD-2 captures a child's cognitive understanding of how to perform common sports *Activities* alongside their physical ability to perform them. The GMFM-*Challenge* is used to examine a larger selection of novel tasks, most of which reflect a child's ability to plan and perform physical *Activities* relevant to sport. The *Sports Stars* group showed a significant improvement in their GMFM-Challenge scores (Figure 2(f)) after participation in the group, however the absence of a group by time difference may be related to the group's lower scores at baseline.

The design of *Sports Stars* as a practitioner-led, peer-group, sports intervention in the community is vastly different to the context of traditional individual interventions. In addition to improvements in sports-specific physical activity competence, participants improved their performance and satisfaction of individual sports participation goals outside of the program. Goals such as "*to attend an after-school sports activity once per week*" and "*to be involved in a game of soccer by trying to kick a ball to teammates*

*during the game."* Previous studies of group interventions for children with CP attribute positive outcomes to improved motivation and confidence, which can be difficult to attain and maintain via individual therapy [9,24]. For this reason, a sports intervention with peer-group support in a community setting is likely to be the most relevant avenue for children to achieve their sports-focussed goals.

*Sports Stars* was designed to introduce children to multiple sports. The intervention prioritised acquisition of a range of sports skills in a participation context rather than fitness outcomes. This was reflected in results where the *Sports Stars* group improved in the sports-specific skill battery (TGMD-2), however, did not report statistically significant changes to individual gross motor items (running, jumping and throwing items) that would be impacted by improvements to fitness. It is likely that children with fitness-specific goals should participate in interventions that target fitness more strongly through higher doses of up to 150 min per week of moderate-vigorous intensity exercise [49]. Further research should measure the effect of participation in a practitioner-led, peer-group, sports intervention on ongoing sports participation, and associated long-term changes to fitness.

The absence of improvement in general participation and quality of life outcomes should be considered with caution due to missing data. While linear mixed models were used to minimise the impact on analyses, it is possible that the reduced sample size lead to inadequate power for analysis. The absence of improvement in general participation and quality of life outcomes may also reflect the difficulty for generalised outcome measures to show change on specific life dimensions, even if subsections are included. For example, of the 55 items within the CAPE-PAC, only three directly relate to common land-based sports [30]. This may explain the lack of change in this measure after intervention. By comparison, additional sports-specific participation goals were set using a mCOPM approach and a significant improvement was shown for this measure. This supports the use of domain-specific participation measures. Similarly, the broad CPQoL-Child did not reflect specific changes to a child's quality of life. Therefore, if *Sports Stars* is provided to children specifically aiming to improve their sports participation it is recommended that future sports-focussed interventions include domain specific outcome measures for participation and quality of life. In addition, mixed-methods strategies such as incorporating qualitative interviewing may be used to further appraise outcomes [46].

The improvements in the *Sports Stars* group's sports-specific activity and participation outcomes demonstrates that a low-dose (8 h) practitioner-led, peer-group sports intervention is effective for children with CP at GMFCS Level I-II. Further details regarding the positive parent and practitioner perceptions of the *Sports Stars* intervention, and methods of managing environmental challenges, group cohesion and engagement are provided in a separate paper [50]. The detailed structure of the *Sports Stars* intervention means that activities could be modified to target the most popular sports in different communities or cultures, thereby improving children's preparedness to transition into locally available community sports. This research therefore significantly builds on evidence that specific individual sports-focussed interventions improve activity competence in the individual sports that are trained [9–12]. Future research could investigate an adapted *Sports Stars* program in different countries and/or cultures.

In terms of limitations, although the strict inclusion criteria of this study allowed the investigation of a homogenous population of children with CP at GMFCS Level I-II, it may have impacted generalisability of outcomes. First, stratification for GMFCS was not performed due to the combined challenges of inclusion criteria and geography when recruiting for a group intervention. Future studies could use stratification for GMFCS to prevent the slightly higher numbers of children with GMFCS II in the *Sports Stars* group compared to the waitlist-control group. Second, the improvements shown by children in this study were specific to children with CP at GMFCS Level I-II who had not received recent botulinum neurotoxin or surgery. It is likely that similar interventions would be effective for populations of children with disabilities other than CP, and future research could investigate the effectiveness of practitioner-led sports groups for different groups of children with disability (e.g., children with spina bifida), or a group of children with a variety of disabilities. Further research should also investigate if the benefits of a practitioner-led, peer-group sports intervention could be enhanced in conjunction with other interventions (e.g., botulinum neurotoxin, or context-focussed therapy). Third, this study investigated a practitioner-led sports group facilitated by physiotherapists. There is great scope for other health practitioners such as Occupational Therapists or Exercise Physiologists to provide practitioner-led sports groups and future research would benefit from investigating if children respond similarly to groups run by different types of health practitioners.

## Conclusion

To our knowledge, this study of *Sports Stars* is the first randomised, controlled trial of a practitioner-led, peer-group sports intervention that aims to prepare children with CP at GMFCS Level I-II for participation in team sport in the community. *Sports Stars* participants improved their sports participation and sports-specific physical activity competence through variable practice of sports-specific gross motor activity training, sports education, teamwork development and confidence building in a real-world environment. These findings suggest that practitioners can provide effective and feasible practitioner-led, peer-group sports interventions for children with CP at GMFCS Level I-II with sports-focussed goals.

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## Disclosure statement

No potential conflict of interest was reported by the author(s).

## Ethical approval

This study was approved by CPL-2016-004 and the University of Queensland: 2017000006.

## Australian New Zealand Clinical Trials Registry

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## References

[1] Access to Sport 'a Fundamental Human Right', Says Secretary-General in Video Message for Summit of Rio Paralympic Games [Internet]. Rio de Janeiro, Brazil; 2016. Available from: https://www.un.org/press/en/2016/sgsm18063.doc.htm

[2] Reedman SE, Boyd RN, Trost SG, et al. Efficacy of participation-focused therapy on performance of physical activity participation goals and habitual physical activity in children with cerebral palsy: A randomized controlled trial. Arch Phys Med Rehabil. 2018;11(4):676–686.

[3] Te Velde S, Lankhorst K, Zwinkels M, et al. Associations of sport participation with self-perception, exercise self-efficacy and quality of life among children and adolescents with a physical disability or chronic disease – a cross-sectional study. Sports Med Open. 2018;4(1):1–11.

[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. (Clinical report). Pediatrics. 2008;121(5):1057–1061.

[5] Wind WM, Schwend RM, Larson J. Sports for the physically challenged child. J Am Acad Orthop Surg. 2004;12(2):126–137.

[6] Carroll K, Leiser J, Paisley T. Cerebral palsy: physical activity and sport. Curr Sports Med Rep. 2006;5(6):319–322.

[7] 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(5):436–442.

[8] Palisano R, Rosenbaum P, Bartlett D, et al. Content validity of the expanded and revised Gross Motor Function Classification System. Dev Med Child Neurol. 2008;50(10):744–750.

[9] Gibson N, Chappell A, Blackmore AM, et al. The effect of a running intervention on running ability and participation in children with cerebral palsy: a randomized controlled trial. Disabil Rehabil. 2017;40(25):1–9.

[10] Sterba JA. Adaptive downhill skiing in children with cerebral palsy: effect on gross motor function. Pediatr Phys Ther. 2006;18(4):289–296.

[11] Walsh SF, Scharf MG. Effects of a recreational ice skating program on the functional mobility of a child with cerebral palsy. Physiother Theory Pract. 2014;30(3):189–195.

[12] Cook O, Frost G, Twose D, et al. CAN-flip: a pilot gymnastics program for children with cerebral palsy. Adapt Phys Activ Q. 2015;32(4):349–370.

[13] Imms C, Granlund M, Wilson PH, et al. Participation, both a means and an end: a conceptual analysis of processes and outcomes in childhood disability. Dev Med Child Neurol. 2017;59(1):16–25.

[14] Cleary SL, Taylor NF, Dodd KJ, et al. Barriers to and facilitators of physical activity for children with cerebral palsy in special education. Dev Med Child Neurol. 2019;61(12):1408–1415.

[15] Sentenac M, Ehlinger V, Michelsen SI, et al. Determinants of inclusive education of 8-12 year-old children with cerebral palsy in 9 European regions . Res Dev Disabil. 2013;34(1):588–595.

[16] Dewar R, Love S, Johnston LM. Exercise interventions improve postural control in children with cerebral palsy: a systematic review. Dev Med Child Neurol. 2015;57(6):504–520.

[17] Asmussen E. Some physiological aspects of fitness for sport and work. Proc R Soc Med. 1969;62(11 Part 2):1160–1164.

[18] Clutterbuck G, Auld M, Johnston LM. Active exercise interventions improve gross motor function of ambulant/semi-ambulant children with cerebral palsy: a systematic review. Disabil Rehabil. 2018;41(10):1131–1151.

[19] Rogers A, Furler BL, Brinks S, et al. A systematic review of the effectiveness of aerobic exercise interventions for children with cerebral palsy: an AACPDM evidence report. Dev Med Child Neurol. 2008;50(11):808–814.

[20] Dodd KJ, Taylor NF, Damiano DL. A systematic review of the effectiveness of strength-training programs for people with cerebral palsy. Arch Phys Med Rehabil. 2002;83(8):1157–1164.

[21] Reedman SE, Boyd RN, Sakzewski L. The efficacy of interventions to increase physical activity participation of children with cerebral palsy: a systematic review and meta-analysis. Dev Med Child Neurol. 2017;59(10):1011–1018.

[22] Brunton LK. Clinicians are the missing link to sustainable community-based physical activity participation for children with disabilities. Phys Occup Ther Pediatr. 2017;37(4):359–361.

[23] Australian Sports Commission. The Australian physical literacy framework. Canberra: Australian Government; 2019.

[24] Gilmore R, Ziviani J, Sakzewski L, et al. A balancing act: children's experience of modified constraint-induced movement therapy. Dev Neurorehabil. 2010;13(2):88–94.

[25] Clutterbuck G, Auld ML, Johnston LM. SPORTS STARS study protocol: a randomised, controlled trial of the effectiveness of a physiotherapist-led modified sport intervention for ambulant school-aged children with cerebral palsy. (Report). BMC Pediatr. 2018;18(258):1–10.

[26] Graham KH, Harvey RA, Rodda RJ, et al. The Functional Mobility Scale (FMS). J Pediatr Orthop. 2004;24(5):514–520.

[27] Imms C, Adair B, Rosenbaum P, et al. Participation': a systematic review of language, definitions, and constructs used in intervention research with children with disabilities. Dev Med Child Neurol. 2016;58(1):29–38.

[28] Law M, Baptiste S, McColl M, et al. The Canadian occupational performance measure: an outcome measure for occupational therapy. Can J Occup Ther. 1990;57(2):82–87.

[29] Law M, Baptiste S, Carswell A, et al. Canadian occupational performance measure. 2nd ed. Ottowa (ON): COAT publications; 1998.

[30] King G, Law M, King S, et al. Children's Assessment of Participation and Enjoyment (CAPE) and Preferences for Activities of Children (PAC). San Antonio (TX): Harcourt Assessment, Inc.; 2004.

[31] Ulrich DA. Test of gross motor development. 2nd ed. Austin (TX): Pro-Ed; 2000.

[32] Kim Y, Park I, Kang M. Examining rater effects of the TGMD-2 on children with intellectual disability. Adapt Phys Activ Q. 2012;29(4):346–365.
[33] Wilson A, Kavanaugh A, Moher R, et al. Development and pilot testing of the challenge module: a proposed adjunct to the Gross Motor Function Measure for high-functioning children with cerebral palsy. Phys Occup Ther Pediatr. 2011;31(2):135–149.
[34] Wright FV, Lam CY, Mistry B, et al. Evaluation of the reliability of the challenge when used to measure advanced motor skills of children with cerebral palsy. Phys Occup Ther Pediatr. 2017;18:1–13.
[35] Williams EN, Carroll SG, Reddihough DS, et al. Investigation of the timed 'up & go' test in children. Dev Med Child Neurol. 2005;47(8):518–524. English.
[36] Verschuren O, Takken T, Ketelaar M, et al. Reliability for running tests for measuring agility and anaerobic muscle power in children and adolescents with cerebral palsy. Pediatr Phys Ther. 2007;19(2):108–115.
[37] Australian Sports Commission. The national talent identification and development program. Instruction manual. Belconnen (Australia): Australian Government; 1998.
[38] Carey H, Martin K, Combs-Miller S, et al. Reliability and responsiveness of the timed up and go test in children with cerebral palsy. Pediatr Phys Ther. 2016;28(4):401–408.
[39] Clutterbuck G, Auld M, Johnston L. Performance of school-aged children with cerebral palsy at GMFCS levels I and II on high-level, sports-focussed gross motor assessments. Disabil Rehabil. 2019. DOI:10.1080/09638288.2019.1650964
[40] Reina R, Iturricastillo A, Sabido R, et al. Vertical and horizontal jump capacity in international cerebral palsy football players. Int J Sports Physiol Perform. 2018;13(5):597–603.
[41] Waters E, Davis E, Mackinnon A, et al. Psychometric properties of the quality of life questionnaire for children with CP. Dev Med Child Neurol. 2007;49(1):49–55.
[42] IBM corporation. SPSS Statistics. 25. Armonk (NY): IBM corporation; 2017.
[43] White I, Horton N, Carpenter J, et al. Strategy for intention to treat analysis in randomised trials with missing outcome data. Br Med J. 2011;342(7803):910.
[44] Chen G, Saad ZS, Britton JC, et al. Linear mixed-effects modeling approach to FMRI group analysis. Neuroimage. 2013;73:176–190.
[45] Shek DT, Ma C. Application of SPSS linear mixed methods to adolescent development research: basic concepts and steps. Int J Disabil Hum Dev. 2014;13(2):169–182.
[46] Adair B, Ullenhag A, Keen D, et al. The effect of interventions aimed at improving participation outcomes for children with disabilities: a systematic review. Dev Med Child Neurol. 2015;57(12):1093–1104.
[47] Australian Curriculum Assessment and Reporting Authority [ACARA]. The Australian curriculum, health and physical education. Canberra (ACT): Commonwealth of Australia; 2016.
[48] Welsh Assembly Government. Physical Development. Department for Children, Lifelong Learning and Skills. Cardiff (Wales): Welsh Assembly Government; 2008.
[49] Garber CE, Blissmer B, Deschenes MR, American College of Sports Medicine, et al. American College of Sports Medicine position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. Med Sci Sports Exerc. 2011;43(7):1334–1359.
[50] Clutterbuck GL, Auld ML, Johnston LM. SPORTS STARS: a practitioner-led, peer-group sports intervention for ambulant, school-aged children with cerebral palsy. Parent and physiotherapist perspectives. Disability Rehabil. In press.