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# Developmental pathways of Para athletes: Examining the sporting backgrounds of elite Canadian wheelchair basketball players

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## Introduction

The past two decades has seen increasing attention to the nuances of athlete development, such as determining the role of various forms of practice (e.g., Baker & Young, 2014), understanding the value of perceptual cognitive training interventions (e.g., Schorer, Loffing, Rienhoff, & Hagemann, 2015) and questioning

the necessity of early specialization (e.g., Baker, Cobley, & Fraser-Thomas, 2009). However, this research has almost exclusively focused on the development of expertise in able-bodied sport athletes despite considerable growth in Para sport, defined by the International Paralympic Committee as sport for athletes with an impairment that leads to a competitive disadvantage ("Explanatory Guide to Paralympic Classification", 2015). Although there are

## ABSTRACT

This study examines developmental history data to identify common pathways for elite Para sport performance and contextualizes these findings using known models of athlete development (e.g., the Developmental Model of Sport Participation, Côté, 1999). Seventy-three Canadian wheelchair basketball players completed a modified version of the Developmental History of Athletes Questionnaire (Hopwood, 2013). Overall, the results emphasized considerable variability in measures related to 'other' organized sport participation regardless of disability status and competition level, including the proportion of participants that participated in at least one other sport, the number of other sports participated in, the age first participated in other sports, and the number of years spent participating in other sports. This variability suggests there may be multiple Para athlete development narratives and highlights a need for more evidence-based models that are sufficiently nuanced for this athlete cohort.

### Keywords:

development – disability sport – Para athlete – performance – team sport

obvious similarities between the performance contexts of able-bodied and Para sports, the developmental trajectories, and factors affecting these trajectories are considerably different between these two groups. The domain of Para sport is incredibly complex with a wide range of impairments and classification systems; thus, those working in Para sport must be cautious in subscribing to a popular model of athlete development initially designed for able-bodied athletes, such as the 'early engagement hypothesis' and importance of deliberate practice (e.g., Ericsson, Krampe, and Tesch-Römer, 1993; Ford, Ward, Hodges, & Williams, 2009), or the Developmental Model of Sport Participation (DMSP) which supports early diversity and later specialization (Côté, 1999).

For example, researchers in the area of athlete development have noted strong skill-based differences in time spent in sport specific practice across a range of sports (see Baker & Young, 2014). Generally, this work emphasizes the importance of training in the development of exceptional performers, highlighting that the skills distinguishing elite performers from their non-elite counterparts are highly domain specific and largely the result of training adaptations (e.g., Loffing, Schorer, Hagemann, Lotz, & Baker, 2012). While the solitary importance of deliberate practice for explaining skill-based differences has recently been challenged (c.f., Ericsson, 2016; Macnamara, Hambrick, & Oswald, 2014), research consistently emphasizes the value of high quality, sport specific training to becoming an expert.

Conversely, there is robust evidence suggesting participation in *several* sports is valuable, particularly during early phases of development. Côté and his colleagues (e.g., Côté & Fraser-Thomas, 2010), for example, have suggested through the DMSP that most high-performance athletes move through three qualitative stages on their way to expertise (i.e., sampling, specializing and investment). Although other trajectories have been noted in athlete development (e.g., early engagement/specialization: Ford et al., 2009; specialized sampling: Sieghartsleitner, Zuber, Zibung, & Conzelmann, 2018), researchers in this area generally argue that early sampling followed by gradual specialization is a more effective and developmentally appropriate approach (for a detailed clinical report on the drawbacks of early sport specialization, see Brenner & American Academy of Pediatrics Council on Sports Medicine and Fitness, 2016). Indeed, other athlete development models worldwide have emphasized the importance of early sampling and/or the development of physical literacy or fundamental movement skills (e.g., Gulbin, Croser, Morley, & Weissensteiner, 2013).

Despite the general consistency of these trends in able-bodied sport, their relevance for understanding the development of Para athletes is unknown. For example, Para athletes may be born with their disability or acquire it through an injury, which makes the application of systematic models of development such as Côté's (1999) DMSP problematic (e.g., do athletes with disabilities have opportunities to 'sample' several sports?). Surprisingly, very little is known about the development of high-performing Para athletes despite greater need for more effective athlete development systems from policy makers and sport administrators (e.g., Smith's "Long Term Athlete Development Guide for Athletes with Disability" was published in 2009).

Recently, a systematic review which examined the development of Para athletes (Dehghansai, Lemez, Wattie, & Baker, 2017a) noted that few studies have examined issues relating to training and development (e.g., Liow & Hopkins, 1996) or how these factors might relate to the development of expertise. In addition, Dehghansai, Lemez, Wattie and Baker (2017b) examined development in Canadian wheelchair basketball athletes by focusing on the association between the nature of athletes' disabilities (i.e., acquired versus congenital disability) and milestone achievement. Their results demonstrated that athletes with a congenital disability reached various milestones at significantly younger ages, such as 'age at first wheelchair basketball participation'; nevertheless, athletes with an acquired disability debuted at varying levels of competition at similar ages as athletes with congenital disabilities, despite starting their general sporting careers later in life. This provided the impetus for this study since our foundational knowledge regarding general training histories and sporting backgrounds of Para athletes remains relatively unexplored in research, particularly in the area of participation in other organized sports (Dehghansai et al., 2017a).

Therefore, the primary purpose of this study was to advance our knowledge of Para athlete development by examining the Canadian wheelchair basketball players' history of sport participation, and in particular their experiences sampling 'other' sports, which has been consistently identified as being important in able-bodied sport. A second objective was to compare our results to the literature for able-bodied sport athletes to determine whether existing sport participation models are suitable/appropriate for Para athletes. We believe that this cohort of sport participants is particularly important to study from a sport and exercise psychology perspective as literature examining the experiences of being an athlete with a physical disability is relatively limited, and the existing data accentuates unique barriers to involvement. Recent systematic reviews (Jaarsma, Dijkstra, Geertzen, & Dekker, 2014; Martin Ginis, Ma, Latimer-Cheung, & Rimmer, 2016) have acknowledged that environmental barriers such as accessibility issues (e.g., lack of facilities, difficulties with travel) can act as important constraints to participation, which further denotes the importance of improving our understanding of how a lack of equal opportunities in physical activity are cognitively appraised in a Para sport context (e.g., Campbell & Jones, 2002). As such, we hypothesized that 1) our elite sample of wheelchair basketball players would contain significant variation in both the ages of first participation on a team at the junior and/or senior levels of competition, and 2) that there would also be significant variation in measures related to other sport participation during their developmental years.

## Methods

### *Participants*

Seventy-three Canadian male and female provincial to international level wheelchair basketball players participated in this study. Inclusion criteria were that the participants had been registered

attendees of the Wheelchair Basketball Canada National Academy, located in Toronto, Canada. This study received local ethics committee approval and all participants over the age of 18 years provided informed consent, and those under the age of 18 years had parental consent.

### Data Collection

The same data collection methods as in the Dehghansai et al. (2017b) study were used and produced a similar sample of participants (i.e., some participants were the same); however, this study examined different variables and different research questions using a different dataset. Participants were also recruited within the Wheelchair Basketball Canada National Academy by the authors and the director of the Academy. A modified version of the Developmental History of Athletes Questionnaire (DHAQ; Hopwood, 2013; Hopwood, Baker, MacMahon, & Farrow, 2010) was then disseminated by the Academy director<sup>1</sup>. The questionnaire was administered over the course of several weeks to the attendees who were asked to return the completed forms to the Academy director. Modifications of the questionnaire were restricted to wording changes (i.e., to better represent the sample population) and the removal or addition of a small number of questions to make the instrument more specific to our research question examining sporting backgrounds (e.g., "At what age did you first start participating in non-wheelchair basketball or organized sports?").

### Modified DHAQ

The modified DHAQ contained three sections: (i) demographic information, (ii) career information, and (iii) participation in other organized sports (both able-bodied and Para sport). Demographic information collected data on participants' age, sex, and disability type. Career information collected data on the highest level of competition reached and the level of competition athletes were currently participating in (i.e., junior or senior level). Participants were further asked to disclose their competitive his-

tories at the junior and senior competition levels relative to first participating on a team that competed against others a) within the local area, b) within the state or province, c) from across the country, and/or d) from different countries. Thus, age level refers to athletes competing at the junior or senior level, while competition level refers to athletes' experience at the highest level (i.e., local, provincial, national, or international level). Participants were also asked to disclose their participation in organized sports other than wheelchair basketball. The DHAQ defined "organized sports" as "sporting activities in which you have *regular practice sessions* under the *formal supervision* of a coach or adult." Participants were asked not to include informal games and sporting activities that were completed as part of compulsory physical education classes at school, but to include any school sporting activities in which they participated in regular, supervised practice sessions.

### Measures

The unique developmental restrictions imposed by Para sport (e.g., smaller availability of opportunities for participation at organized youth levels relative to able-bodied sport) generated a more descriptive quantitative analyses that attempts to identify the qualitatively different pathways elite wheelchair basketball players take during the course of their development. Therefore, data were descriptively analyzed using SPSS Version 24. The small amount of missing data was cleaned in SPSS using the missing value function through the 'select cases' option.

## Results

### Demographic and Career Information

**Sample.** The majority of responders were male ( $n = 47$ ; 64.4%) and players ranged in age from 14.2 to 40.6 years, with a mean age of 22.95 years ( $SD = 6.21$ ). Of the 73 participants, 36 reported their disability type as 'acquired' (i.e., post-birth impairment) and 27 reported their disability type as 'congenital' (i.e., birth impairment).

**Table 1.** Frequency distributions of demographic and disability data.

| Sample              | Age Level    |              | Sex<br>Total / Mean | Disability Type <sup>e</sup>            |                | Sex<br>Total   |
|---------------------|--------------|--------------|---------------------|-----------------------------------------|----------------|----------------|
|                     | Junior       | Senior       |                     | Junior                                  | Senior         |                |
| Sex, M <sup>a</sup> | 17           | 30           | 47                  | 9 (C) <sup>c</sup> ; 5 (A) <sup>d</sup> | 9 (C); 19 (A)  | 18 (C); 24 (A) |
| Sex, F <sup>b</sup> | 9            | 17           | 26                  | 4 (C); 2 (A)                            | 5 (C); 10 (A)  | 9 (C); 12 (A)  |
| Age level, Total    | 26           | 47           | 73                  | 13 (C); 7 (A)                           | 14 (C); 29 (A) | 27 (C); 36 (A) |
| Age (years; SD), M  | 18.71 (2.77) | 23.75 (6.19) | 21.86 (5.70)        |                                         |                |                |
| Age, F              | 20.14 (3.50) | 26.08 (6.82) | 24.02 (6.48)        |                                         |                |                |

<sup>a</sup> Males; <sup>b</sup> Females; <sup>c</sup> Congenital; <sup>d</sup> Acquired; <sup>e</sup> The mean age for participants with a congenital disability was 20.65 years ( $SD = 4.46$ ) and 24.86 years ( $SD = 7.30$ ) for participants with an acquired disability

1 Although the psychometrics of the DHAQ has not been published due to its extensive length, it underwent considerable reliability and validity testing. These analyses are publicly available at [http://vuir.vu.edu.au/22353/1/Melissa%20Jayne%20Hopwood\\_Part1.pdf](http://vuir.vu.edu.au/22353/1/Melissa%20Jayne%20Hopwood_Part1.pdf)

Ten participants did not disclose their disability status. See Table 1 for demographic and disability type information broken down by sex and age level.

**Competition level.** A total of 68 (93.2%) participants reported their highest level of competition reached. The majority of the sample were national ( $n = 21$ ; 30.9%) or international ( $n = 37$ ; 54.4%) competitors. As expected, there was a linear increase in 'first participation age' in both the junior and senior level players as it related to their debut in local level to international competition. More specifically, Table 2 provides within-participant data, where the normal progression for each participant was to begin participation in the lower-levels of competition (i.e., local and state/province levels) when they were younger before competing at the highest stages (i.e., national and international levels).

### Organized Sports

A total of 32 males and 19 females (69.9% of the entire sample) participated in organized sports other than wheelchair basketball, including 12 with a congenital disability (44.4%) and 19 with an acquired disability (52.8%; see Table 3). Overall, participants played an average of 4.27 ( $SD = 3.18$ ) other sports during their earlier athletic endeavours, although their age at first other sport involvement varied ( $M = 7.21$  years;  $SD = 3.94$ ). This variation in the number of other sports was more noticeable in those who acquired an impairment post-birth ( $SD = 2.89$ ) in comparison to

athletes with a congenital impairment ( $SD = 1.16$ ). International level players sampled more sports on average ( $M = 5.25$ ;  $SD = 3.46$ ) than national level ( $M = 3.69$ ;  $SD = 2.86$ ) and provincial level players ( $M = 2.33$ ;  $SD = 1.41$ ). The average age in which participants first participated in an organized sport other than wheelchair basketball was 7.21 years ( $SD = 3.94$ ); those who had an acquired impairment ( $M = 9.89$  years;  $SD = 6.90$ ) and provincial level athletes ( $M = 10.00$  years;  $SD = 4.18$ ) began their sampling at relatively older ages. There was no difference in the average age of first involvement between males and females ( $M = 7.21$  years), although females had slightly more variability in comparison to males ( $SD = 4.57$  vs  $SD = 3.58$ , respectively).

The average number of years of participation in other sports was 7.33 ( $SD = 5.36$ ), where national ( $M = 7.64$ ;  $SD = 5.40$ ) and international level ( $M = 7.54$ ;  $SD = 5.41$ ) players had descriptively longer involvement compared with provincial level players ( $M = 4.85$ ;  $SD = 4.61$ ). In addition, males spent more time involved in other sports ( $M = 8.28$  years;  $SD = 5.49$ ) in comparison to females ( $M = 5.87$  years;  $SD = 4.83$ ). There were minimal differences in the average number of years of participation in other sports between athletes with a congenital impairment and athletes with an acquired impairment (8.81 vs. 9.39 years, respectively). In total, 28 different other organized sports were recorded by the participants, with track and field / wheelchair athletics / wheelchair racing ( $n = 19$ ), able-bodied basketball ( $n = 15$ ), and ice-hockey/Para ice hockey ( $n = 15$ ) being the most frequently cited sports.

**Table 2.** Ages of first participation on a team at the junior and/or senior levels of competition.

| Sample  | Age level | M (SD; total response rate from respective sample <sup>a</sup> ) – in years |                     |                     |                     |
|---------|-----------|-----------------------------------------------------------------------------|---------------------|---------------------|---------------------|
|         |           | Local                                                                       | State/province      | National            | International       |
| Males   | Junior    | 13.98 (3.86; 85.4%)                                                         | 14.98 (3.09; 83.3%) | 15.92 (2.95; 81.2%) | 17.00 (1.94; 39.6%) |
|         | Senior    | 15.58 (3.54; 54.2%)                                                         | 15.96 (3.41; 47.9%) | 16.88 (2.90; 52.1%) | 19.67 (3.99; 31.2%) |
| Females | Junior    | 15.29 (3.81; 80.8%)                                                         | 15.95 (3.26; 80.8%) | 16.76 (3.56; 80.8%) | 17.62 (2.75; 50%)   |
|         | Senior    | 17.71 (4.63; 53.8%)                                                         | 17.79 (4.80; 53.8%) | 18.15 (4.82; 50%)   | 20.44 (4.90; 34.6%) |
| Total   | Junior    | 14.42 (3.86; 83.8%)                                                         | 15.31 (3.16; 82.4%) | 16.22 (3.17; 81.1%) | 17.25 (2.28; 43.2%) |
|         | Senior    | 16.33 (4.03; 54%)                                                           | 16.65 (4.03; 50%)   | 17.32 (3.66; 51.3%) | 19.96 (4.26; 32.4%) |

<sup>a</sup> Participants who did not provide an age of when they reached a milestone selected the box corresponding to "this milestone is not applicable to me / I have not yet reached this milestone."

Note: Disability type was not included in this table because there were insufficient data on age of acquiring a disability. The DHAQ included a question asking participants with an acquired disability to answer, 'How old were you when the incident occurred?'; however, only two participants provided a response.

**Table 3.** Participation in other organized sports, by sex, disability type, competition level, average number of other sports, average age during which participation in the first non-wheelchair basketball related organized sport occurred (both able-bodied and Para sport), and the total years of participation in other organized sports.

|                               | Frequency (proportion) |                 |                            |                   |                   |                              | M (SD <sup>a</sup> ) – in years |                   |                           |                   |                   |
|-------------------------------|------------------------|-----------------|----------------------------|-------------------|-------------------|------------------------------|---------------------------------|-------------------|---------------------------|-------------------|-------------------|
| Sample                        | Yes <sup>b</sup>       | No <sup>c</sup> | No. of sports <sup>d</sup> | Min. <sup>e</sup> | Max. <sup>f</sup> | Age at first OS <sup>g</sup> | Min. <sup>h</sup>               | Max. <sup>i</sup> | No. of years <sup>j</sup> | Min. <sup>k</sup> | Max. <sup>l</sup> |
| <i>Males</i>                  | 32 (68.1%)             | 15 (31.9%)      | 3.96 (3.27)                | 1                 | 15                | 7.21 (3.58)                  | 2                               | 15                | 8.28 (5.49)               | 0.5               | 22                |
| <i>Females</i>                | 19 (73.1%)             | 7 (26.9%)       | 4.78 (3.04)                | 1                 | 10                | 7.21 (4.57)                  | 2                               | 26                | 5.87 (4.83)               | 0.5               | 20                |
| <i>Congenital</i>             | 12 (44.4%)             | 15 (55.6%)      | 2.08 (1.16)                | 1                 | 4                 | 8.54 (3.55)                  | 4                               | 14                | 8.81 (5.36)               | 1                 | 19                |
| <i>Acquired</i>               | 19 (52.8%)             | 17 (47.2%)      | 3.94 (2.89)                | 1                 | 10                | 9.89 (6.90)                  | 2                               | 26                | 9.39 (6.26)               | 0.5               | 20                |
| <i>Provincial</i><br>(n = 10) | 9 (90%)                | 1 (10%)         | 2.33 (1.41)                | 1                 | 5                 | 10.00 (4.18)                 | 3                               | 14                | 4.85 (4.61)               | 0.5               | 18                |
| <i>National</i><br>(n = 21)   | 13 (61.9%)             | 8 (38.1%)       | 3.69 (2.86)                | 1                 | 9                 | 7.30 (3.85)                  | 3                               | 15                | 7.64 (5.40)               | 1                 | 22                |
| <i>Int'l</i><br>(n = 37)      | 28 (75.7%)             | 9 (24.3%)       | 5.25 (3.46)                | 1                 | 15                | 6.39 (3.64)                  | 2                               | 21                | 7.54 (5.41)               | 1                 | 22                |
| Total                         | 51 (69.9%)             | 22 (30.1%)      | 4.27 (3.18)                | 1                 | 15                | 7.21 (3.94)                  | 2                               | 21                | 7.33 (5.36)               | 0.5               | 22                |

<sup>a</sup> Standard deviations; <sup>b</sup> The frequency of participants that participated in 'other' organized sports; <sup>c</sup> The frequency of participants that did not participate in 'other' organized sports; <sup>d</sup> The average number of 'other' organized sports participated in, including the standard deviations; <sup>e</sup> The least number of 'other' organized sports participated in; <sup>f</sup> The largest number of 'other' organized sports participated in; <sup>g</sup> Age (in years) at first 'other' organized sport participation; <sup>h</sup> The youngest age (in years) at first 'other' organized sport participation; <sup>i</sup> The oldest age (in years) at first 'other' organized sport participation; <sup>j</sup> The average number of years spent participating in 'other' organized sports, including the standard deviations; <sup>k</sup> The shortest number of years spent participating in 'other' organized sports; <sup>l</sup> The longest number of years spent participating in 'other' organized sports

Note: Only 63 of 73 participants disclosed their disability type

## Discussion

This study explored the "macro-structure" of developmental sport participation histories of elite Canadian wheelchair basketball players (see Güllich, 2019 for an example of a "macro-structure" framework). The results provide an interesting portrait of elite Para athlete developmental backgrounds, particularly as it relates to trends from previous research on able-bodied athletes and to the propositions of theoretical frameworks on athlete development.

### Variation in Developmental Pathways

We hypothesized that our elite sample of Para athletes would contain significant variation in both the ages of first participation on a team at the junior and/or senior levels of competition and in measures related to other sport participation during their developmental years. Our first hypothesis was supported; high standard deviations were generally found in the ages of first participation on a team for both junior and senior level players who competed at all levels of competition for both sexes, particularly the senior age level players. The fact that our sample reported a wide age range for first participation on a team suggests high-performance wheelchair basketball is a relatively open system that responds to a dynamic talent pool. Alternatively, athlete development path-

ways in wheelchair basketball may allow more flexibility by the virtue that athletes may enter their athlete development system earlier because of a congenital condition or later as a result of an acquired condition. The data suggest this additional layer is salient to athlete development in wheelchair basketball (e.g., Dehghansai et al., 2017b).

**DMSP.** Our second hypothesis relating to variation in other sport participation measures, namely the proportion of participants who participated in at least one other sport, the number of other sports participated in, the age first participated in other sports, and the number of years spent participating in other sports, was also supported. The DMSP (Côté, 1999) suggests early sampling followed by a gradual to exclusive focus on training/participation in their primary sport is an effective method for athletes as they progress in their career. However, the current results suggest at both national and international levels of competition, approximately 30% of Para athletes did *not* participate in other organized sports. In addition, the current results suggest those who participated in other sports averaged approximately four other sports, and that frequency of other sport engagement may have some influence on current competition level, as international level players participated in more other sports relative to the lower competition level players. As well, participants with an acquired impairment had a

higher proportion of participation in non-wheelchair basketball related organized sport, sampled more sports on average, and spent more time participating in other sports than those with a congenital impairment; however, those with an acquired impairment began sampling other sports at a later age relative to those who were born with an injury. Therefore, the variability in the developmental histories of our sample suggests there may be multiple Para athlete development narratives.

On the other hand, the apparent relationship between the frequency and length of other sport involvement and competition level supports the DMSP proposition that sampling is a viable talent development pathway. Nevertheless, attention should be given to how Para athletes may be constrained by a lack of opportunities to partake in multiple para-sports. For example, 55.6% of our sample that had a congenital impairment never participated in another sport other than wheelchair basketball in comparison to 47.2% who had an acquired impairment and thus had an opportunity to participate in able-bodied sports growing up. This may reflect a lack of infrastructure for 'lower skill levels' in Para sport, which constrains participation and training (this theory is supported by the aforementioned systematic reviews where accessibility issues along with a lack of program availability may influence participation patterns; Jaarsma et al., 2014; Martin Ginis et al., 2016). Indeed, while 'sampling' may be a good idea in theory, the reality of the developmental environments for many Para athletes may preclude sampling as a realistic option. Conversely, we also must consider the possibility that those who did not sample other sports and had a congenital impairment (15 participants from our sample) may not entirely be explained by a lack of opportunities, but rather a desire to specialize in a single sport from an early age (i.e., the early engagement hypothesis).

Baker, Côté, and Abernethy's (2003) study on able-bodied basketball, netball and field hockey players found considerable variation in the amount of other sports participated in ( $M = 8.6$ ,  $SD = 3.6$ ; Range: 3 – 14). Interestingly, athletes from sports that needed the fewest number of hours of sport specific practice to reach their respective national team typically sampled more other sports. For example, netball players sampled the most additional sports but required relatively the least amount of total practice hours. International level players from this study participated in slightly more than five other sports on average, similar to able-bodied basketball players from Baker and colleagues' (2003) study. Therefore, although there was not an overwhelming majority who sampled other sports in our sample (69.9%), the international level players who did resembled patterns seen in able-bodied national level basketball players.

There are some notable limitations to the current study. First, the inaccessibility of the severity and type of congenital and acquired disability data may have impacted the results (i.e., the DHAQ did not specifically require participants to provide a more detailed description of their disability). For example, the functionality of the player sample (i.e., impairment level and categorization) likely affects the sport selection process. This may also be evident in the lack of normality in the age distributions of our sample, which was positively skewed and clustered around 23 years of age and

younger. However, the purpose of this study was to focus on one popular developmental pathway in able-bodied sport of sampling other sports in an elite group of wheelchair basketball players to ascertain a better understanding of behavioural factors that may facilitate (or impede) expertise.

Further, it may also be useful to explore whether Para athletes participated in other sports for particular reasons, such as fitness conditioning or availability, and if certain sub-groups of athletes are more likely to participate in these other sports. In addition, the self-report nature of our questionnaire may have affected the results; for instance, the participants were asked to report their first age of participation in a non-wheelchair basketball organized sport, which is a retrospective measure that may be susceptible to recall bias. As such, it is possible that methodological differences attributed to the variation in our other sport participation measures, and not necessarily cohort differences. Finally, while the advantages of diversifying sport involvement from an early age in multiple sports have been widely disseminated through research, it is also important to consider these implications from a feasibility standpoint as accessibility, time, financial, and transportation constraints may prevent many families from enrolling their children (regardless of health status and availability of programs) in multiple organized sports.

#### *Future Directions*

The exploratory nature of this study is important because there is a significant lack of work in this area, and our investigation comparing a popular model of athlete development from able-bodied sport represents the type of situation those working in Para sport must work with daily as they try to understand the complexity of development in their unique group. In addition to the range of research questions yet to be examined in this population, the unique characteristics of this group will require novel methodological approaches. One important methodological consideration is the relatively small sample sizes for studies of performers at the highest levels of performance. As in other studies of expertise, researchers are often left with the dilemma of choosing the truly elite, which in turn weakens statistical power, or broadening the level of performance, thereby 'watering down' the definition of elite. It is also necessary to understand how impairment classification influences development (i.e., severity of injury) and resultantly how to better structure learning environments to maximize skill acquisition. Here, recruitment of sufficient sample sizes to account for disability variations and differences will allow a more holistic understanding of the nuances of para-athlete development. It is noteworthy that although inconsistencies in methods may limit the ability to compare or contrast findings, a consistent theoretical approach to guide research could mitigate the limitations that may stem from flexible and novel methodological approaches.

The lack of available programs and difficulty accessing existing programs remain significant obstacles to participation for many individuals with disabilities, particularly for families with lower socioeconomic status (Radtke & Doll-Tepper, 2014). Research has shown that a lack of programs and facilities can be the main driving factor for the lack of participation (e.g., Martin, 2013). Given

the wide range of impairments in Para sport and unique needs of each individual, when programs are available, facilities may not be tailored to meet everyone's needs. This may partly explain the low number of athletes competing at grassroots levels of competition (Radtko & Doll-Tepper, 2014). This was shown in our sample where the average age of first participation in an organized sport other than wheelchair basketball was 8.54 years ( $SD = 3.55$ ) for those with a congenital impairment, which is later than most able-bodied active children in North America. On the other hand, as suggested by Martin Ginis and colleagues (2016), a shift in focus from conducting studies that simply describe participation barriers and facilitators to developing strategies to increase physical activity participation among individuals with physical disabilities may be necessary. The structure and culture of able-bodied sports typically makes it difficult to enter a high level of a sport without having progressed from the previous levels within systems of that sport. In this respect, able-bodied sport progressively restricts the size of the talent pool from an early age, and research has documented that this approach creates several biases that constrain talent identification and development over time (see MacDonald & Baker, 2013; Wattie, Schorer & Baker, 2015). Therefore, we must be aware of the potential juxtaposition between these two systems of sport as it relates to development.

Given the issues noted above, devising a holistic model or modifying existing models that addresses these issues will be difficult. Currently those working in Para sport settings often must rely on models adapted from able-bodied sports to navigate development and complement coaches/directors' programs. For example, a basic assumption of the 'pyramid model' of sport participation (Green, 2005) is that an appropriate environment increases both participation and developmental opportunities, which ultimately leads to a more competitive pool of athletes at the higher levels of competition. This assumption, although reasonable, has not been examined in studies of athletes with impairments. Understanding environmental barriers such as policies and ecological factors can have a ripple effect on other aspects of the paradigm in the complex network of Para athletes' development as well. Another potentially suitable model to consider for Para athletes is Canada's Long-Term Athlete Development model (Stages of LTAD, 2017), a seven-stage model (i.e., active start, fundamentals, learn to train, train to train, train to compete, train to win, and active for life) with the addition of two stages (i.e., awareness and first contact) for Para athletes. According to this model, the 'first contact' stage is especially important for individuals with an acquired impairment who may not be aware of existing programs and opportunities of sport participation. Although the model considers the chance of athletes entering the system at any given time (i.e., through an acquired impairment), it is still an age- and maturation-driven model. As a result, recommendations are uniquely tailored to specific age categories (e.g., learn to train stage for wheelchair basketball is 8-11 years for females and 9-12 years for males, +/- 1-2 years). However, given the variability associated with impairment onset, and the availability of resources within different developmental environments, it is difficult to place Para athletes' developmental trajectories within the boundaries of this model.

In total, the development or expansion of Para athlete development models should reflect the considerable variability in developmental trajectories in Para sport (Baker, Lemez, Wattie, & Van Neutegem, 2017). Looking beyond competition, those working in Para sport and in the community must also explore identifiable lifelong patterns of sport behaviour in this group of individuals to promote physical activity participation across the lifespan (see Harada, 1994 for an example of possible lifelong sports participation patterns, such as continuity, withdrawal, and resocialization).

## Conclusion

The domain of Para sport is exceptionally complex. As we continue to study the acquisition of sport expertise and sport psychology in Para athletes, it will be important to distinguish approaches from the traditional systematic models of development in able-bodied sport athletes from the approaches that may be more suitable and ecologically valid to Para sport. Athlete development models will need to be more flexible in Para sport given the diverse constraints on athletes and subsequent trajectories that exist to attain expertise. As participation in Para sport continues to grow, there is a need for more evidence-based models of Para athlete development that reflect the variability in developmental pathways and are sufficiently nuanced to address the unique aspects of skill acquisition in differently abled athletes. Using developmental history data to predict acquired skill levels may be one way to identify common pathways for elite Para sport performance by juxtaposing highly personalized and variable individual pathways often seen in sport expertise development.

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## Data Availability Statement

All relevant data are within the paper.

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