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RECOMMENDATIONS

The developmental model of sport participation: 15 years after its first conceptualization

Le modèle de développement à la participation sportive : 15 ans après sa première conceptualisation

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KEYWORDS
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Summary The Developmental Model of Sport Participation (DMSP) is a model of athlete development which has been comprehensively researched and refined over the last 15 years. The DMSP is based upon theoretical and empirical data and describes the processes, pathways, and outcomes associated with sport development throughout childhood and adolescence. Côté, Lidor, and Hackfort (in 2009) proposed seven postulates associated with the different pathways of the DMSP. More specifically, five postulates focus on the influence of sampling and deliberate play on youth's participation, performance, and personal development in sport and two postulates focused on important transitions. The purpose of the present article is to systematically grade the quality of empirical evidence supporting each of these seven postulates, and provide recommendations for best practice to help guide sport policy in each of these areas.

MOTS CLÉS
Sport enfant ;
Développent de l'athlète ;
Performance ;
Participation ;

Résumé Le Modèle de Développement de la Participation Sportive (MDPS) est un concept qui s'est raffiné tout au long de ces 15 dernières années, au travers des recherches scientifiques menées sur le développement des athlètes. Le MDPS a été conçu à partir de données empiriques et théoriques et vise à décrire le cheminement de la pratique sportive de l'enfance à l'adolescence. Côté, Lidor, et Hackfort (in 2009) ont proposés 7 postulats associés aux différentes trajectoires sportives identifiées par le MDPS. Plus particulièrement, cinq postulats sont centrés sur l'influence de la diversification sportive et du jeu délibéré tandis que deux

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postulats font références à des étapes de transitions importantes dans le développent de la participation sportive. L'objectif de cet article est d'analyser de façon systématique la qualité des évidences qui supportent chacun des 7 postulats du MDPS. De plus, nous offrons des recommandations qui peuvent servir de guide dans l'élaboration de politiques pour les programmes sportifs.

Over the last three decades, research has led to the growth of a number of athlete development models that integrate the concepts of practice/play and early specialization/diversification. In 2007, Alfermann and Stambulova [1] reviewed this area of study and highlighted five major research-based models [2—6]. More recently, Bruner, Erickson, Wilson, and Côté [7] conducted a citation network analysis which subsequently revealed two additional models published in peer-reviewed journals [8,9]. Along with these research efforts, commercial versions of athlete development models have emerged and have been adapted by sport organizations around the world. For example, the Long-Term Athlete Development model (LTAD) [10] has been well-received and implemented by national sporting organizations in countries such as Canada, the United Kingdom, and Australia [11].

While a number of methodological approaches have been utilized in the construction of the various athlete development models, few of these models have moved beyond the description of general concepts related to athletes' development. As such, most models of athlete development in sport have been atheoretical and descriptive in nature, providing no account of individual differences in attained performance or participation rates among athletes with similar developmental opportunities. There is consequently a need to move from description to prediction of athletes' development and assess the variables that affect their progression in sport.

One model that has attempted to move toward the prediction of athlete development is the Developmental Model of Sport Participation (DMSP) [3,12]. The DMSP has been developed and refined over the last 15 years and presents a set of concepts and variables about the development of athletes that are quantifiable and testable. The various stages of the DMSP are consistent with both sport-specific and general theories of child and adolescent development. Furthermore, research conducted with the DMSP has been guided by a unique methodology [13] that can be effectively used to empirically test the seven postulates (Table 1) related to the process variables inherent to the different pathways of the DMSP and its various outcomes [12,14]. More specifically, the postulates of the DMSP feature characteristics of sport programs that promote not only performance, but continued participation, and personal development for all involved in sport. The DMSP and its postulates integrate the various outcomes of sport — Performance, Participation, and Personal development — by focusing on key proximal processes (deliberate play, deliberate practice, early specialization, and early diversification) and the environment in which the processes are happening (e.g., role of coaches, peers, and parents).

Côté and Hancock [15] recently wrote a policy paper that focused on how youth sport programs should be structured to achieve the outcomes of continued participation, high levels of performance, and personal development (i.e., the 3 Ps). The Developmental Model of Sport Participation (DMSP) and its associated seven postulates (Table 1) were reviewed to present recommendations that impact the design and structure of youth sport programs. The goal of the present article is to extend the review of Côté and Hancock by rating the quality of evidence available in the literature. Accordingly, the seven postulates of the DMSP will be evaluated according to the quality of the research that supports the prediction of a specific sport outcome, whether it is performance, participation, or personal development.

1. Rating the evidence

An adapted version of the GRADE approach [16—18] will be used to rate the quality of evidence that support each of

Table 1 Seven postulates associated with the Developmental Model of Sport Participation (DMSP) [14].

Postulate 1: early diversification (sampling) does not hinder elite sport participation in sports where peak performance is reached after maturation
Postulate 2: early diversification (sampling) is linked to a longer sport career and has positive implications for long-term sport involvement
Postulate 3: early diversification (sampling) allows participation in a range of contexts that most favorably affects positive youth development
Postulate 4: high amounts of deliberate play during the sampling years build a solid foundation of intrinsic motivation through involvement in activities that are enjoyable and promote intrinsic regulation
Postulate 5: a high amount of deliberate play during the sampling years establishes a range of motor and cognitive experiences that children can ultimately bring to their principal sport of interest
Postulate 6: around the end of primary school (about age 13), children should have the opportunity to either choose to specialize in their favorite sport or to continue in sport at a recreational level
Postulate 7: late adolescents (around age 16) have developed the physical, cognitive, social, emotional, and motor skills needed to invest their effort into highly specialized training in one sport

the DMSP postulates. The adapted version of the GRADE approach is based on a recent report commissioned by UK Sport to systematically review talent development research in sport [19] and focuses on four aspects of the GRADE guidelines: (a) Study design; (b) study quality; (c) consistency; and (d) directness. Study design refers to the type of study undertaken (e.g., experimental or quasi-experimental, observation, survey-based, qualitative, case study). Study quality refers to the quality and rigor of a study's methods and execution. Consistency refers to the similarity of results across multiple studies. Directness refers to the extent to which the results and study are aligned with the outcomes of Performance, Participation, and Personal development.

Because of the scarcity of prospective/longitudinal studies or randomized control trials in athlete development research, this article will use the adapted version of the GRADE system utilized in the UK Sport report. Specifically, the quality rating was downgraded to account for the absence of longitudinal or randomized control trials studies conducted on athletes' development. Therefore, the new rating considered that methodologically sound observational studies of athletes' development can be rated as ''high quality'' when confounding variables are controlled and the magnitude of the effects are reported. Below are the GRADE definitions used to evaluate each postulate of the DMSP:

- high = further research is unlikely to change our confidence in the postulate;
- moderate = further research is likely to have an important impact on our confidence and may change the postulate;
- low = further research is very likely to have an important effect on our confidence and is likely to change the postulate;
- very low = the postulate is uncertain.

Following the GRADE system, the rated evidence for each postulate will be followed by a recommendation for best practice. It is important to note that a strong body of evidence does not automatically translate into a strong recommendation for best practice. For example, the potential benefits of applying a particular postulate in youth sport may lead to only modest practical gains. On the other hand, a strong recommendation can emerge from a weaker body of evidence if its potential benefits are compelling and address multiple outcomes. Therefore, a recommendation for each postulate will take the form of either *strong* — indicating a judgement that most well-informed people would make, or *weak* — indicating a judgement that a majority of well-informed people would make but a substantial minority would not [17,19].

2. Performance and early diversification

This postulate focuses on the association between early diversification and the long-term performance outcome of youth sport. Evidence from several retrospective studies of adult athletes has supported the concept of diversity before specialization as an important foundational element for talent development in one sport [20—28]. Further,

Postulate 1: Early diversification does not hinder elite sport participation in sports where peak performance is reached after maturation.

Quality of Evidence Supporting Postulate 1: Study Design — MODERATE; Study Quality — HIGH; Consistency/Frequency — HIGH; Direct Relevance — HIGH.

the link between early diversification and performance has been established using a standardized methodology [13] and across contexts, including different countries [23,24,29] and communities [30].

Although there is evidence that early specialization can lead to elite performance in adult sport [31], the associated personal development and long-term participation costs of this approach can be devastating for a large number of youth. It is clear, for instance, that early specialization leads to less enjoyment in sport and more dropout, burnout, and injuries [32—35]. The diversity of sport activities during the sampling years should not be seen as a discriminating factor that predicts sport expertise, but rather as a foundation to optimal development in an elite performance pathway. The nurturing of talent through diverse sport activities without an intense focus on performance in one sport during childhood can have more positive and less negative consequences for all children involved in sport, while still facilitating the long-term development of elite performance [36].

The overall quality of the evidence supporting this postulate can be rated as HIGH and therefore, we can make a STRONG recommendation that the development of elite athletes and the long-term performance of elite athletes will not be adversely affected if sport programs around the world encourage early diversification in sports where peak performance is achieved in adulthood.

3. Participation and early diversification

Postulate 2: Early diversification is linked to a longer sport career and has positive implications for long-term sport involvement.

Quality of Evidence Supporting Postulate 2: Study Design — MODERATE; Study Quality — MODERATE; Consistency/Frequency — HIGH; Direct Relevance — MODERATE.

This postulate focuses on the association between early diversification and the participation outcome of youth sport. The physical and psychological benefits of varied involvement in sports on long-term participation have been supported through dropout and participation studies. Dropout studies show a strong association between early specialization and increased sport attrition — a link which has been reasonably well established across ability levels [33,35,37,38]. Participation studies indicated that trying out numerous sports and physical activities during childhood is associated with continued engagement in sport [39,40]. Early diversification promotes prolonged long-term

engagement in sport by providing the foundational skills for a range of recreational sports options in later life [41]. An early diversification approach to youth sport may also help prevent excessive and repeated injuries to a specific area of the body that often results from performing the same movement patterns repeatedly [42].

The overall quality of the evidence supporting this postulate can be rated as MODERATE because of lower ratings in terms of study design, quality, and direct relevance. Despite this moderate rating of the available evidence, we can still make a STRONG recommendation that sport programs that encourage early involvement in different sports and contexts will facilitate the development of long-term participation in sport.

4. Personal development and early diversification

Postulate 3: Early diversification allows participation in a range of contexts that most favourably affects positive youth development.

Quality of Evidence Supporting Postulate 3: Study Design — MODERATE; Study Quality — MODERATE; Consistency/Frequency — MODERATE; Direct Relevance — LOW.

This postulate focuses on the association between early diversification and the personal development outcome of youth sport. The success of sport programs for the development of elite performers continues to be measured, in many countries, by the performance of a fraction of young athletes who reach elite levels of performance in adulthood — with little attention being provided to the more than 99% of young athletes who participate in these sport programs without going on to elite performance [36]. Strong empirical evidence exists in developmental psychology [43—45] showing that a wide breadth of experiences in early development is an indicator of successful development. In sport, Wright and Côté [46] showed that diversified sport experiences in childhood fostered positive peer relationships and leadership skills.

In an article that reviews the impact of breadth and intensity of extra-curricular activities on youth development, Busseri and Rose-Krasnor [47] suggested that diversity before specialization promoted the development of a healthy identity, provided participants the opportunity to self-regulate their involvement, and promoted a wide range of interpersonal skills through exposure to various social settings. Wilkes and Côté [48] reviewed the youth sport literature and suggested that children who sampled a variety of sports were also exposed to unique socialization experiences that shaped development. The following are five personal development outcomes that can be facilitated through sampling different sports: intrapersonal skills; prosocial behaviour; healthy identity; diverse peer groups and social capital.

The overall quality of the evidence supporting this postulate can be rated as MODERATE because of the lack of studies in sport that directly address this postulate. Based on the lack of direct evidence, we suggest a WEAK recommendation that sport programs that encourage early diversification affect positive youth development. Future studies conducted within a youth sport context are needed to further assess the validity of this postulate.

5. Performance and play

Postulate 4: A high amount of deliberate play during the sampling years establishes a range of motor and cognitive experiences that children can ultimately bring to their principal sport of interest.

Quality of Evidence Supporting Postulate 4: Study Design — MODERATE; Study Quality — MODERATE; Consistency/Frequency — HIGH; Direct Relevance — MODERATE.

This postulate focuses on the association between deliberate play and the sport performance outcome. A number of studies employing retrospective designs to examine the developmental histories of elite and expert athletes have reported high levels of participation in deliberate play activities during childhood [20,23,28,49]. Furthermore, Memmert, Baker, and Bertsch [50] showed an association between time spent in unstructured play activities and increased creativity in sport. Chow, Davids, Renshaw, and Button [51] argued from a non-linear pedagogy perspective, that unstructured sport play during childhood provides optimal conditions for the display of variability, flexibility, and adaptability in motor skill performance that is key to successful athletic performance. Finally, studies of motor learning and skill acquisition in sport [52] have revealed performance advantages, particularly in conditions of stress or pressure, for motor skills learned implicitly through activities such as play.

The overall quality of the evidence supporting this postulate can be rated as MODERATE because of the retrospective nature of the studies. Based on the consistency of the findings, we can, however, still suggest a STRONG recommendation that sport programs that encourage deliberate play activities in youth sport will create an environment that will ultimately affect performance outcomes.

6. Participation and play

Postulate 5: High amounts of deliberate play during the sampling years builds a solid foundation of intrinsic motivation through involvement in activities that are enjoyable and promote intrinsic regulation.

Quality of Evidence Supporting Postulate 5: Study Design — LOW; Study Quality — MODERATE; Consistency/Frequency — MODERATE; Direct Relevance — MODERATE.

This postulate focuses on the association between deliberate play and the participation outcome of youth sport.

Theories of motivation such as self-determination theory [53,54] and achievement goal theory [55,56] suggest that early participation in intrinsically motivating activities such as deliberate play will have a positive long-term effect on an individual's overall motivation. Direct support for this postulate has emerged mostly from qualitative studies of athletes' careers [2,3,57] as well as from quantitative studies of expert and non-expert athletes' training and experiences [20,23,28,49]. Furthermore, studies that compared dropout and active athletes provide additional evidence that deliberate play during childhood is an important determinant of continued participation and commitment to sport [35,37,58].

Although empirical evidence exists to support this postulate, the strongest evidence comes from theories of motivation which only provide indirect theoretical support. Therefore, the overall quality of the evidence supporting this postulate can be rated as MODERATE because of the lack of methodologically sound studies that directly address this postulate. Based on the available evidence and the strong theoretical basis of this postulate, we can still suggest a STRONG recommendation that sport programs that encourage deliberate play will positively affect athletes' long-term participation in sport.

7. Transition I: childhood to adolescence

Postulate 6: Around the end of primary school (about age 13), children should have the opportunity to either choose to specialize in their favourite sport, or to continue in sport at a recreational level.

Quality of Evidence Supporting Postulate 6: Study Design — MODERATE; Study Quality — MODERATE; Consistency/Frequency — MODERATE; Direct Relevance — MODERATE.

This postulate focuses on the transition between childhood and adolescence as an important period to specialize in one sport or to stay involved in sport at a recreational level. Several studies have supported the concept of diversity during childhood and a mixture of play and practice activities, with more play during childhood [20—28,40].

Specialization in one sport typically does not occur, nor does it need to occur, before age 13 in sports where peak performance is reached in adulthood. One of the most important reasons that all children should be provided with diverse sampling opportunities can be understood from a motivational perspective. The quality of early learning experiences through diversification and deliberate play during childhood develop not only physical competencies, but also perceptions of competence, which in turn lead to motivation for continued participation, performance, and personal development [59]. Motivation theories suggest that children's perceptions of competence in late childhood (ages 8—12) are largely the results of comparison with their peers. It is only at about the age of 12 or 13 that children are able to fully understand the differing effects that effort, practice, and ability have on their performance [60]. Because children do not understand competition and sport performances the same way adults do, coaches should not overemphasize performance through deliberate practice or overly structured practices during childhood.

The overall quality of the evidence supporting this postulate emerge from theories of child development and empirical data that identified childhood sport as qualitatively and quantitatively different from adolescent and adult sport and therefore could be rated as HIGH. Based on the available evidence, we can suggest a STRONG recommendation that sport programs for children (before age 13) should include high amount of diversification and play. Divergent pathways of sport involvement (i.e., specializing or recreational years) should occur only after childhood.

8. Transition II: early to late adolescence

Postulate 7: By late adolescence (around age 16), youth have developed the physical, cognitive, social, emotional, and motor skills needed to invest their efforts into highly specialized training in one sport.

Quality of Evidence Supporting Postulate 7: Study Design — LOW; Study Quality — LOW; Consistency/Frequency — LOW; Direct Relevance — LOW.

This postulate focuses on the transition to an intense period of training with the sole purpose of developing elite performance in one sport. For those few athletes with the talent, dedication, and potential to reach elite status, it is important to enter the investment stage at the developmentally appropriate time. By about age 13, youth are cognitively and physically ready to increase their commitment to one sport; however, investing in one sport requires a few more years of maturity [61]. In fact, sport studies indicate that it is not an appropriate time to commit to intense training in one sport until athletes are about 16 years of age [3,20,21,39,62,63]. Moreover, research in sports where intense investment in one sport occurs before age 16 (e.g., female gymnastics and figure skating) has indicated several negative outcomes associated with this specialization such as more injuries and less enjoyment [34,64].

The evidence is clear that all future expert athletes need to adopt intensive, sport-specific training programs in order to be internationally competitive and successful; however, these programs should only be implemented gradually at developmentally-appropriate times. The commitment to full time training in one sport before the age of 16 appears to not be necessary to achieve high level of performance in most sports. The evidence that support this postulate is mostly indirect; therefore, a LOW rating is appropriate. Based on the evidence, a WEAK recommendation can be made to suggest that a transition to a full training commitment to one sport should not occur before age 16.

9. Conclusion

The sport outcomes known as the 3 Ps include performance, participation, and personal development. Frequently,

governing bodies structure sport with the aim of achieving one of the 3 Ps at the expense of the others. The evidence reviewed in this article highlights the changing developmental environment of sport and has many implications for the design of sport programs. The choice of learning objectives, curriculum sequencing, and teaching methods will need to vary greatly for athletes of different ages. Early sport diversification, high amounts of deliberate play, child-centered coaches and parents, and being around peers that are involved in sport, appear to be essential characteristics of environments for young children that encourage their later investment in structured practice activities. Accordingly, we suggest that the seven postulates associated with the DMSP can be adapted and used to structure youth sport programs that meet the multiple needs of youth in sport. Within the diversity of early sport experiences, this optimal developmental progression should also incorporate high levels of participation in deliberate play activities prior to later transitioning to an emphasis on deliberate practice activities with specialization for elite level athletes. While expert performance can be achieved with early specialization in one sport and a high amount of deliberate practice during childhood, it provides a sport structure that is more costly in terms of mass participation and long-term personal development through sport. The DMSP and its 7 postulates have received sufficient support from research in the last 15 years to warrant strong recommendations regarding the role that early diversification and deliberate play have in the development of an integrated sport system that value athletes' performance, mass participation, and personal development through sport.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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