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Exploring the Impacts of Early Sport Specialization Among Québec's Adolescent Hockey Players

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Abstract

Early sport specialization has recently become a growing concern among sport federations, because it is associated with deleterious effects that may lead to sport attrition. More specifically in ice hockey, some studies found that the dropout rate is approximately 5% per year. This study aims to assess the prevalence of early sport specialization (ESS) among adolescent hockey players and analyze the relationship between the degree of ESS and characteristics associated with long-term sports participation such as attitudes toward other active behaviors, physical self-perceptions, and social support. A sample of 404 adolescent hockey players (competitive/elite vs. recreational) from the province of Québec (Canada) completed a questionnaire during their hockey season. Group comparisons were performed based on ESS degree and for both levels of competition. Results revealed that early sport specialization seemed to be more prevalent among less competitive, non-elite, and older players. Furthermore, players who reported ESS showed less favorable scores on self-reported physical activity, less favorable attitudes toward sport and exercise, less social support in their sport, and they had lower scores in physical self-perceptions. This study highlights the importance of introducing adolescents to a range of sports and other types of active behaviors, especially during the off-season. Practical implications for sport stakeholders who want to promote long-term athlete development are discussed.

Keywords

Sport specialization, ice hockey, adolescence, attitudes, self-concept, social support

Introduction

In Canada, one of the most popular types of physical activity for young people is organized sport. Indeed, 75% of Canadian youth aged 5 to 19 years old reportedly engage in such activity type regularly, 47% of them outside the school environment (Barnes et al., 2016). Participation in organized sport has several potential benefits including prevention of long-term health problems (Janssen & LeBlanc, 2010), reduction of school dropout, upgraded academic performance (Ruiz-Ariza, Grao-Cruces, de Loureiro, & Martinez-Lopez, 2017) and acquisition of personal skills such as self-confidence, perseverance, and respect for others (Chinkov & Holt, 2016). However, the reality of competitive sport sometimes involves abusive practices that lead to undesirable consequences such as overtraining, increased risk of overuse injuries, and a greater likelihood of sports exhaustion (DiFiori et al., 2014; Myer et al., 2015; Brenner, 2016). Currently, many stakeholders and leaders of the various sports federations appear particularly concerned with the concept of early sport specialization (ESS),

believed to be one of the factors most associated with sport dropout occurring at adolescence (Wall & Côté, 2007; Fraser-Thomas, Côté, & Deakin, 2008; Myer et al., 2015). ESS is also associated with an increased risk of musculoskeletal injuries (Hall, Foss, Hewett & Myer, 2015; Fabricant et al., 2016; Pasulka, Jayanthi, McCann, Dugas, & LaBella, 2017). To conceptualize ESS, the term must first be accurately defined. For Baker (2003), one example of ESS is an athlete who during childhood confines their participation to a single sport, with a strong focus on training and development in that sport (Baker, 2003). The most recent operational definition, formulated by the American Orthopaedic Society for Sports Medicine (AOSSM, 2016), is based on three criteria (LaPrade et al., 2016): intensive participation in a sport (training + competition) for more than 8 months per year, participation that excludes engagement in other sports or physical activities, and participation that involves prepubertal children; i.e., those under 12 years of age. The first two criteria seem to be generally accepted by the scientific community (DiFiori et al., 2014). There is some debate, however, about the age range to include in the operational definition of ESS and the possible differences as regards various sports contexts (Feeley, Agel, & LaPrade, 2016), a state of affairs that limits the application of research results to some extent. Thus, the definition proposed by Jayanthi (Jayanthi, Pinkham, Dugas, Patrick, Patrick, & LaBella, 2013) offers a simpler understanding of ESS as involving an intense practice of a single sport for more than 8 months that excludes or significantly prevents the practice of other sporting activities.

ESS also has other drawbacks that are reported in the scientific literature. Moesch et al. (2011) showed that young people who specialized by attending intensive training camps and participating in more competitions at an early age tend to be less successful athletes in adulthood (Güllich et al., 2019; Barreiros, Côté & Fonseca, 2013; Moesch, Elbe, Hauge, & Wikman, 2011). There is also reason to believe that athletes who specialize at an early age face greater risks of sport exhaustion and dropout before the end of adolescence (Russell & Limle, 2013), resulting in negative feelings about their sporting experience, which could be related with a lack of interest in physical activity as adults.

At the psychological level, ESS enhances the opportunities for over-comparison of one's performance with one's peers, which can lead young athletes to develop an inadequate perception of their skills. The young athlete's objective may be result-based, resting solely on performance criteria (ego oriented), which is a deterrent to maintaining a healthy sporting practice (Horn, 2015). From this perspective, it is important for young athletes to keep or develop interests toward other types of sport or exercise behaviors. Developing positive attitude toward other active behaviors may be a crucial factor that could lead young athletes to try other activities. In this regard, it is plausible to suggest the hypothesis that adolescents who have positive attitudes towards other sports and activities will be more likely to attach importance to other types of exercise, and will therefore be better prepared to try out other activities once their "athletic career" is over (Wiersma, 2000).

On the other hand, the literature reveals that the body image and self-perceptions of specialized young athletes may also be affected negatively during adolescence (Rowland, 1997; Gould, 2010). In all likelihood, self-perceptions (competence, efficacy, self-esteem) of *early* specialized athletes may also vary according to the experience they had in their chosen sport. Furthermore, it is possible that they possess a low level of perceived competence in other types of activities in which they were never involved. By way of consequence, specialized young adolescents, especially those involved in very popular sports, tend to identify themselves as "jocks" and consequently engage in behaviors that include alcohol consumption, delinquency, misconduct in school. and irresponsible sexual behaviors (Miller, 2009).

There is little information on the prevalence of ESS in different sports. A recent study of the Canadian Hockey Development Model found that most young players face stressful selection processes and demanding practice schedules.

They feel compelled to play the sport year-round to ensure they can compete with their peers for a place on elite teams (Ogden & Edwards, 2016), thus creating an environment that may favor ESS. Generally speaking, however, ESS is observed more often and at an earlier age in individual sports rather than team sports in North America (Buckley et al., 2017). Several organizations are trying to forestall the negative consequences associated with high volumes of sport participation. For example, the American Sports Medicine Institute offers recommendations regarding the quantity and frequency of baseball throws to minimize the risk of overuse injuries and the surgeries that may result (American Sports Medicine, 2019). Moreover, the National Basketball Association (NBA)'s Youth Basketball Guidelines offer recommendations about sport participation, rest, ESS and sport sampling relative to the athlete's age (NBA, 2016). An interesting case is hockey, in Canada. Considered as the national winter sport and a major part of popular culture, hockey attracts more than 600,000 young Canadian hockey players annually (Hockey Canada, 2017). In Québec province more specifically, a new strategic plan promoting sport diversification was very recently implemented (Hockey Québec, 2019). In any case, very little information is available on the distribution of ESS across the different age categories or competition levels in Québec and Canada, although the subject is of growing concern to many stakeholders (Adams, 2018). The vast majority of studies conducted on ESS were conducted on competitive or elite status athletes (Wall & Coté, 2007; Moesch et al., 2011; Barreiros, Côté & Fonseca, 2013; Gullich et al., 2019). Despite previous research, little is known about the relationship of level of play and sport specialization. It therefore seems appropriate to investigate sport specialization outcomes, especially for sport federations, including Canadian ice hockey federation: how is ESS related to variables such as physical activity participation during and after the season, attitudes towards other types of physical activity, self-perceptions and social support? Such relationships are meaningful since it is relevant to know more about adolescents' predispositions to be or stay active at the end of, say, their "hockey career." However, little is known about such interrelations, especially in the context of organized hockey in Canada. At present, it is also difficult to know the differences of practice of various types of physical activities during and outside the season depending on the presence or absence of ESS. The purpose of this research, therefore, is to take a descriptive look at ESS in ice hockey, aiming at two specific objectives: (1) to measure the prevalence and distribution of ESS in organized hockey among adolescent hockey players; (2) to gauge the strength of relationship between ESS and three psycho-social characteristics associated with long-term sports practice: attitudes toward different active behaviors, physical self-perceptions, and social support from coaches and parents.

Methods

Participants and Data Collection

The sample consisted of 404 hockey players age 12 to 17 (15.4 ± 1.9 years) from 30 Québec teams playing in urban and rural areas. To determine the total sample size required for the study (power = $1 - \beta \geq 0.80$), an *a priori* estimate was made using G*Power software (Institute for Digital Research and Education, 2019), using $d = 0.2$. Thus, a sample size ranging from 275 to 400 participants was sufficient to obtain a satisfactory level of statistical power. Participants came from three different age groups and categories based on the definitions of the provincial hockey federation (Hockey Québec, 2019): Peewee (11-12 years old: $n = 95$), Bantam (13-14 years old: $n = 63$), and Midget (15-17 years old: $n = 246$), and two different levels of play (competitive and elite [$n = 202$; 50%] and recreational [$n = 202$; 50%]), as determined by the provincial hockey federation. A convenience sample was used for the study, but an effort was made nevertheless to respect the proportions of participants at each level of play. The project was approved by the ethics committee of the researchers' academic institution (CER-17-240-08-01.10) and by the provincial hockey federation (Hockey Québec).

Two data collection procedures were carried out. The first was conducted during the teams' meetings following their bi-weekly training session. For this approach, 15 teams (9 agreed to participate) at the competition/elite level were randomly identified on the Hockey Québec website, and their coaches were contacted by phone to obtain permission to meet the players and inform them of the project. At this meeting, a parent's written consent was required for children under the age of 14. Once the coaches agreed, the research team distributed questionnaires to the players who were placed in an isolated room to ensure their uninterrupted concentration. The second procedure was performed directly at tournaments. To this end, the tournament directors' approval was solicited a few weeks beforehand. We contacted five tournament directors and three accepted to take part in the study. Afterwards, the coaches of the randomly selected teams were contacted for permission to meet the players, inform them of the project and distribute the questionnaires. To avoid interfering with the running of the tournaments and to ensure the players' full concentration on the task at hand, the players were allowed the duration of the tournament to complete the questionnaires. A parent's written consent was required for children under the age of 14. When the tournament was over, the players returned their completed questionnaires to members of the tournament organizing committee before leaving for their respective regions.

Variables and Measurement

The questionnaire used to collect data for this project was pre-validated in a previous project involving a pilot group of young adolescent hockey players (CDERS-17-10-06.02). The validation procedure made it possible to restructure the scales of social influences, physical self-perceptions, attitudes towards active behaviors, and ESS. Four areas of active behaviors were measured: (1) organized hockey, (2) strength training, (3) cardiovascular activities, and (4) leisure-time physical activities. Strength training and cardiovascular activities are two popular fitness behaviors among Canadian male adolescents (Katzmarzyk, Lee, Martin, & Blair, 2017). Active leisure-time activities remain popular and are frequently recommended since they can be practiced throughout life, as can the two other behaviors as mentioned earlier (Hulteen et al., 2017). Because hockey is a seasonal sport and summer is viewed as an "off" season, we found it relevant to measure the four behaviors in both contexts. Participants were asked the following question regarding each active behavior: "During the season, indicate the number of sessions per week you devote to organized hockey." The same question format was used for the other active behaviors in both practice settings (in-season [in] versus off-season [off]). Practice of active behaviors was measured in terms of weekly frequency (days per week). Composite scores representing the number of weekly sessions of total physical activity were calculated ($freq_{in} + freq_{off}$). For subsequent analyses, these two scales were each categorized based on Canadian physical activity guidelines, which call for daily activity (Tremblay et al., 2011); i.e., 0-3 sessions / week $\rightarrow$ sedentary, 4-6 sessions / week $\rightarrow$ active, more than 7 sessions / week $\rightarrow$ very active.

Attitudes towards sport and exercise behaviors studied were measured using a 12-item semantic scale (3 items $\times$ 4 active behaviors). Participants were asked to rate their level of agreement on a 6-point scale (low score = negative attitude, high score = positive attitude) by completing the following sentence: "For me, [playing ice hockey] is [useless-useful, unpleasant-pleasant, demotivating-motivating]." Preliminary analyses showed good reliability for each subscale, with very satisfactory McDonald's omega coefficients ($\omega_{Hockey} = .89$, $\omega_{strength} = .94$, $\omega_{cardio} = .89$, $\omega_{sports} = .88$). Thus, a composite score (mean of the items) of attitudes was calculated for the 4 subscales (organized hockey, strength training, cardiovascular activities, leisure-time physical activities). Scores reflect the global attitudes towards these behaviors, and no distinctions between in and off season were considered for attitudes measures. Attitudes towards the various active behaviors were subsequently categorized into

three levels: 1 = unfavorable (mean score < 3), 2 = neutral (mean score between 3 and 5), and 3 = favorable (mean score > 5).

Physical self-perceptions were studied using an abbreviated version of the Physical Self-Description Questionnaire (Ninot, Delignières, & Fortes, 2000). Thus, three dimensions of physical self-perception were measured based on 12 items: perceived sport competence (4 items), perceived cardiovascular endurance (4 items), and perceived strength (4 items); each subscale was presented as a 6-point Likert scale (from 1 = very negative perception to 6 = very positive perception). Questions were worded as follows: "I do well in all sports" (sport competence), "I can run 5 km without stopping" (cardiovascular endurance), and "I think I'm physically stronger than average" (perceived strength). Preliminary analyses show a high level of reliability for each subscale (ω_{sport} = .87, ω_{Force} = .85, $\omega_{Endurance}$ = .83). Composite scores for all three scales were calculated, and the same scoring categorization procedure was performed (1= unfavorable [< 3)], 2 = neutral [3-5], and 3 = favorable [> 5]). Similar to the attitude components, scores were based on participants' global perceptions about their perceived abilities regarding each category of behavior, both in and out of season.

The social influences of coaches and parents towards participation in the active behaviors considered were measured using a 7-point Likert-type scale. The first question regarded the motivation to follow an adult's recommendations: "I'm motivated to follow my parents' recommendations (from 1 = totally agree to 7 = totally disagree). The next three questions focused on active behaviors and were similarly worded: "My parents encourage me to participate in [hockey, active recreation, strength training, and cardiovascular activities, in or off-season]." The same items were then used for the "coach" subscale. Analyses of the psychometric properties of the two subscales show satisfactory reliability ($\omega_{parents}$ = .76, $\omega_{coaches}$ = .82). Composite scores for the two scales were obtained by averaging, and the same scoring categorization procedure was performed: (1 = unfavorable [< 3)], 2 = neutral [3-5], and 3 = favorable [> 5]).

Conceptualization of Sport Specialization

As previously mentioned, we used the training volume and engagement in hockey as indicators of sport specialization (Jayanthi et al., 2013). The age at which players began competitive hockey was also considered as a proxy for ESS (before, or not, age 12), but only from a descriptive way. Then, the presence of early sport specialization was measured using two items, weighted on a three-point scale and based on antecedent literature. The first item was the number of months of participation in organized hockey, for which participants were asked: "On average, how many months per year do you play ice hockey including training and summer camps" (1 = 0 to 6 months, 2 = 6 to 8 months, and 3 = more than 8 months). The second concerned the possibility of engaging in other types of physical activity: "Over the course of a full year, does ice hockey prevent you from engaging in other types of physical activity or sport?" (1 = certainly, 2 = a few times and 3 = not at all). For this second item, we inverted the reported score for the calculation of ESS. An averaged score of the ESS items was then obtained to form a sport specialization score, with higher scores indicating a higher level of ESS. Indeed, three categories of specialization were obtained ($ESS_{mean} \leq 2$: "little or no specialization"; $2 < ESS_{mean} < 3$: "moderate specializers"; $ESS_{mean} = 3$: "high specializers").

Statistical Analyses

Objective 1: Describe the prevalence of ESS in ice hockey players. We used frequency analyses to describe the prevalence of ESS across the sample, presenting the proportions of players for each category of specialization, and describing the prevalence of ESS. Next, we compared proportions (chi square tests) for two playing levels and three age groups (12-14; 15-16; 17-18 years old). Finally, we tested the possible interaction by conducting tests on proportions across six interaction sub-groups (3 age groups x 2 playing levels).

Objective 2: Analyze the associations between ESS and its potential outcomes. First, we analyzed the number of missing data. In congruence with recommendations from Dong and Chao-Ying (2013), the amount of missing data was found negligible (< 5%) and did not require the use of imputation methods. Normality assumption of Likert-type data was checked by examining data skewness and kurtosis indices. We used the skewness and kurtosis cut-offs values proposed by Garson (2012, pp. 17-19) to check for a critical deviation from normality. Values obtained for most scales (AP off-season, AP in season, attitude towards hockey, attitude towards active leisure-time activities, and perception of cardiovascular endurance) indicated that a non-parametric approach was preferable: To verify the influence of ESS, we used tests on proportions. Moreover, contingency coefficients (*C*) were used for association estimation, and Cramer's V (*V*) were calculated to estimate the effect size. To interpret each effect size, we used the values proposed by Akoglu (2018): $V > 0.25$ = very strong, $V > 0.15$ = strong, $V > 0.10$ = moderate, $V > 0.05$ = weak, and $V < 0.05$ = no relationship.

Results

Objective 1. Prevalence of ESS in Ice Hockey Players

When the prevalence of ESS is examined, we observe that a very high proportion of participants are either considered moderately (32%, $n = 129$) or highly specialized (40%, $n = 162$), 28% ($n = 113$) reporting a low level of sport specialization. Moreover, 92% of participants started playing competitive hockey before the age of twelve, which suggests that players tend to be exposed to sport specialization at a young age. When ESS is compared across play levels (Figure 1), results revealed significant differences ($\chi^2_{(df)} = 20.80_{(2)}$, $p \leq 0.001$), in which a higher proportion of recreational players are highly specialized (50%), comparatively with those who evolve in competitive hockey (29%). Within the total sample, 55% of young players say they participate in at least one other organized sport. The most popular alternate sports were soccer (13%), baseball (8.7%), Dek hockey (5%) and football (3%), all team sports like hockey.

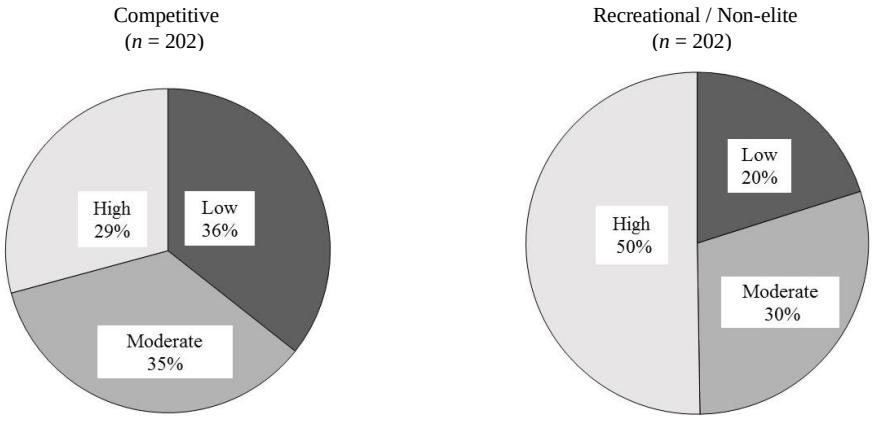

Figure 1. ESS prevalence among competitive and recreational players

Further analyses showed (Figure 2) that ESS seemed to be more prevalent among older players ($\chi^2_{(df)} = 11.43_{(4)}$, $p = 0.02$). In fact, 45% of the "17-18 years old" category was highly specialized, comparatively with younger players (12-13 years: 24%; 15-16 years: 31%). An inverse pattern was observed: More than 60% of recreational players reported high sport specialization (63% versus 37%), and 64% of competitive players were categorized as low sport specializers. When testing for the interaction between age groups and playing

levels, the "age × level" effect was significant ($\chi^2_{(df)} = 29.14_{(4)}$, $p < 0.001$). The "young-competitive" players consist of 5% of the high specializers, comparatively with the old-recreational ones who represent 40% of the high-specialized group.

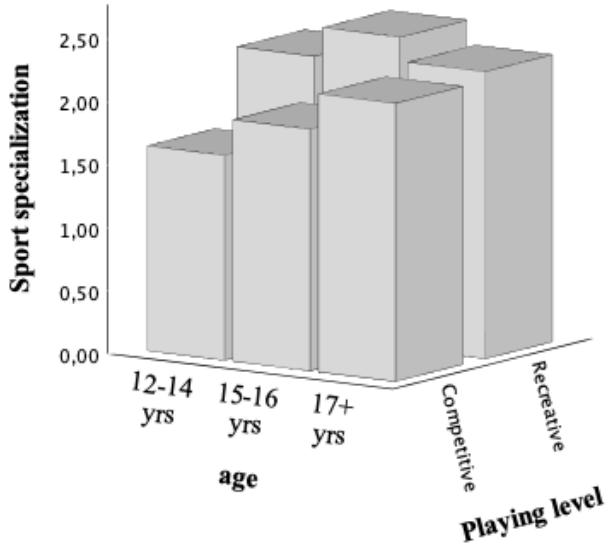

Figure 2. ESS prevalence across age and playing levels

Objective 2. Outcomes Associated with ESS

Involvement in physical activity. Analyses about the levels of "in" and "off" season physical activity behaviors revealed significant differences in favor of hockey players with lower levels of ESS (in season: $\chi^2_{(df)} = 27.30_{(4)}$, $p \leq 0.001$; off-season: $\chi^2_{(df)} = 44.96_{(4)}$, $p \leq 0.001$). As Table 1 indicates, 93% of hockey players with low level of ESS were active on a daily basis, versus 68% within those with a high level of ESS.

Attitudes toward hockey and other active behaviors. The analysis of attitudes towards the various active behaviors (Table 2) reveals there is no link between ESS and attitudes regarding the practice of organized hockey ($\chi^2_{(df)} = 5.82_{(4)}$, $p > 0.10$) or active leisure-time activities ($\chi^2_{(df)} = 9.04_{(4)}$, $p > 0.05$). However, there is a significant relation between ESS level and attitudes towards weight training ($\chi^2_{(df)} = 24.49_{(4)}$, $p \leq 0.001$), which tends to benefit hockey players with a low ESS level. A significant link between ESS and attitudes towards cardiovascular activity was also found ($\chi^2_{(df)} = 14.27_{(4)}$, $p \leq 0.01$), demonstrating that a lower level of ESS is associated with favorable attitude.

Physical self-perceptions (sport and exercise). The analysis of physical self-perceptions (Table 3) reveals that ESS does not appear to impact perceived sport competence ($\chi^2_{(df)} = 4.74_{(4)}$, $p > 0.50$, $V = 0.11$) and perceived strength ($\chi^2_{(df)} = 8.38_{(4)}$, $p > 0.50$, $V = 0.11$). There is, however, a link between ESS level and perceived cardiovascular endurance ($\chi^2_{(df)} = 12.37_{(4)}$, $p \leq 0.05$, $V = 0.13$), which benefits less specialized participants.

Perceived support from parents and coaches. Results show a significant relation between level of ESS and perceived support from parents ($\chi^2_{(df)} = 21.68_{(4)}$, $p \leq 0.01$, $V = 0.17$) and coaches ($\chi^2_{(df)} = 18.94_{(4)}$, $p \leq 0.01$, $V = 0.16$) (Table 4). Thus, less specialized hockey players have positive perceptions of perceived encouragement from both parents and coaches while those who are highly specialized have quite negative perceptions.

Table 1. Sport Specialization (ESS) associations with the level of physical activity

Season	ESS level	Sedentary (0-3)	Active (4-6)	Very active (7+)	χ^2 (df)	*V*	*C*
Off	**L**	9 (10)	10 (11)	81 (91)	44.96** (4)	0.24**	0.32
	M	26 (34)	14 (19)	60 (79)			
	H	40 (64)	18 (29)	42 (66)			
In	**L**	3 (3)	4 (4)	93 (105)	27.30** (4)	0.18**	0.25
	M	11 (15)	8 (10)	81 (105)			
	H	14 (23)	17 (27)	69 (109)			

Note. Values are expressed in proportions (%). Values in parentheses represent cell count for each category. ESS= early sport specialization; L: Low level of ESS; M: Moderate; H: High; *V* = Cramer's V, *C* = contingency coefficients, * = $p \leq 0.05$, ** = $p \leq 0.01$.

Table 2. ESS association with attitudes towards active behaviors

Behavior (days per week)	ESS level	Unfavorable (< 3)	Neutral (3-5)	Favorable (>5)	χ^2 (df)	*V*	*C*
Organized hockey	**L**	0 (0)	5 (5)	95 (105)	5.82 (4) ns	0.09	0.12
	M	3 (4)	8 (10)	89 (113)			
	H	3 (4)	10 (13)	87 (138)			
Strength training	**L**	6 (7)	28 (30)	66 (72)	24.50(4) **	0.18**	0.24
	M	14 (18)	29 (36)	57 (71)			
	H	22 (36)	39 (59)	39 (60)			
Cardio-vascular activities	**L**	4 (5)	36 (39)	60 (66)	14.27**	0.14**	0.19
	M	11 (14)	36 (44)	53 (66)			
	H	13 (21)	47 (74)	40 (62)			
Leisure-time activities	**L**	0 (0)	6 (7)	94 (102)	9.04 (4)	0.11	0.15
	M	3 (4)	15 (19)	82 (102)			
	H	2 (3)	15 (23)	83 (130)			

Note. Values are expressed in proportions (%). Values in parentheses represent cell count for each category. ESS= early sport specialization; L: Low level of ESS; M: Moderate; H: High; *V* = Cramer's V, *C* = contingency coefficients, * = $p \leq 0.05$, ** = $p \leq 0.01$.

Table 3. ESS association with physical self-perceptions

Perception	ESS level	Lower (< 3)	Neutral (3-5)	Higher (> 5)	χ^2 (df)	*V*	*C*
Sport competence	**L**	2 (2)	41 (44)	57 (62)	4.74 (4)	0.08	0.11
	M	4 (5)	38 (45)	58 (70)			
	H	6 (9)	45 (69)	49 (75)			
Perceived strength	**L**	10 (11)	65 (69)	25 (26)	8.38 (4)	0.11	0.15
	M	23 (29)	50 (62)	27 (33)			
	H	21 (32)	54 (82)	25 (38)			
Perceived endurance	**L**	2 (2)	93 (100)	5 (6)	12.37* (4)	0.13*	0.18
	M	9 (11)	80 (98)	11 (14)			
	H	12 (19)	80 (124)	8 (12)			

Note. Values are expressed in proportions (%). Values in parentheses represent cell count for each category. ESS= early sport specialization; L: Low level of ESS; M: Moderate; H: High; *V* = Cramer's V, *C* = contingency coefficients, * = $p \leq 0.05$, ** = $p \leq 0.01$.

Table 4. ESS association with social support

Perceived Influences	ESS level	Unfavorable (< 3)	Neutral (3-5)	Favorable (> 5)	$\chi 2$ (df)	*V*	*C*
Parents	**L**	12 (13)	23 (26)	65 (72)			
	M	20 (25)	21 (27)	59 (73)	18.94 (4) **	0.24**	0.32
	H	26 (41)	33 (51)	41 (63)			
Coaches	**L**	8 (9)	25 (28)	67 (74)			
	M	18 (22)	29 (36)	53 (66)	21.68 (4) **	0.17**	0.23
	H	22 (34)	39 (60)	39 (60)			

Note. Values are expressed in proportions (%). Values in parentheses represent cell count for each category. ESS= early sport specialization; L: Low level of ESS; M: Moderate; H: High; *V* = Cramer's V, *C* = contingency coefficients, * = $p \leq 0.05$, ** = $p \leq 0.01$.

Discussion

This study aimed to describe the prevalence of ESS in organized hockey in Québec and evaluate its relation to factors associated with long-term practice of sport. Sport specialization is a multi-dimensional continuum that involves the age at which an athlete began to compete and the volume of engagement in one specific sport. To our knowledge, ours is one of the first studies to focus on the sport specialization of young people based on their level of play while measuring physical activity (PA) during the season and off-season. The first part of this investigation aimed to estimate ESS prevalence: Our results showed a high proportion of participants reporting a moderate to high level of ESS. Furthermore, more than 90% of the participants respond to the "age criteria" suggested by LaPrade et al. (2016), which means that young hockey players are exposed to sport specialization before age 12. Despite such results, it seems that younger players were not as much specialized compared with their older counterparts, whereas older players tend to be more specialized. Such results were expected because, according to the Hockey Canada long term development model (Hockey Canada, 2013), it's perfectly normal and even beneficial performance-wise for athletes to invest more time in training and competition when they get closer to the end of their maturation process. Models such as the Developmental Model of Sport Participation (Côté & Vierimaa, 2014) also recommend increasing the level of deliberate practice towards the later stages of adolescence.

Higher levels of specialization appeared in recreational compared to competitive players, which may seem surprising considering Ericsson's concept of deliberate practice (Ericsson, Krampe, & Tesch-Römer, 1993), which stipulates that young people who specialize do so mainly with a view to improving their performance and reaching an elite level. Despite this putative process of expertise development, the existing scientific literature tends to show the opposite (Moesch et al., 2011; Barreiros, Côté & Fonseca, 2013; Güllich et al., 2019). A possible explanation may be attributed to three factors. First, coaching education programs for elite coaches identify the potential drawbacks of SSE and encourage coaches to more effectively advise their elite players on sports diversification. A second explanation may be that elite players possess superior athletic abilities and that these attributes lead them to diversify their sport practice from an early age. However, such hypothesis of reciprocity between skill level and sport diversification among hockey players, cannot be confirmed with our data, thus deserving further research. Finally, youth in recreational settings, often outside elite development programs, may not have access to trained coaches in the field or to programs that support diversification of sport activities, which may partially explain this discrepancy (DiSanti et al., 2019) between competitive and recreational athletes. Our results therefore support the idea that efforts should be made to educate young athlete, their parents and coaches

about this issue, even for players at a lower level of competition (i.e. recreational).

In the second part of our study, we showed that stronger levels of ESS tend to show no favorable associations with attitudes, self-perceptions and social influences regarding sport and exercise. Results also show that ESS is negatively related to active behaviors, regardless of time of year. This seems surprising again, as previous studies tend to associate ESS with the intensive and exclusive practice of an organized sport throughout most of the year (LaPrade et al., 2016). On the other hand, practicing a single sport, especially when it requires expensive infrastructure, reduces significantly the chances of being active in the long term (Halonen et al., 2015). Since highly specialized players mainly play ice hockey, a winter sport, the relationship between ESS and physical activity level is even stronger during off-season. By almost only playing ice hockey, highly specialized players might not have learned or experienced other sports enough to feel comfortable practicing them regularly (Myer et al., 2015). A possible short-term solution to attain PA participation standards may involve introducing players to other sports at the end of their season, thus offering them opportunities to participate in sport during summer (Loy, Hoffmann, & Holland, 1995). For instance, and aside from soccer (already very popular among young Canadians), another sport could be lacrosse. Indeed, lacrosse has musculoskeletal and tactical similarities to hockey, being another traditional Canadian sport in which many professional hockey players have already achieved success.

Regarding attitudes towards physical activities other than sport, we note that more highly specialized hockey players do not have a favorable opinion of physical fitness (strength training and cardiovascular exercises) compared with those of lower levels of ESS. An explanation may be that, all too often, training programs for youth are designed for adults, tend to be less enjoyable and place participants in situations with a higher risk of injury (Fleck & Kraemer, 2014). It is hardly surprising that the importance of fitness stands higher among competitive and elite players. This category of players is familiar with the fitness standards required to evolve at the most competitive levels of play. In the longer term, it could be interesting to scrutinize the motives of competitive players regarding their behaviors based on the development of physical fitness. Vehrs (2005) recommends that the various professionals in the training field be creative when designing programs: they should adapt them to the athlete's age group, avoid putting players in a context where they may feel judged, reward good behavior in the gym and incorporate an educational component to ensure that young players become more independent in the long term. In terms of physical self-perceptions, the presence of ESS has been negatively associated with interest in activities involving the development of cardiovascular endurance. At first glance, it may appear surprising that young people with strong hockey skills do not consider themselves to be in good cardiovascular condition. One possible explanation is that, by competing all year round, specialized players are increasingly exposed to their colleagues' potentially superior performances, especially at summer camps where they are not ranked according to skills. These more frequent comparisons of cardiovascular endurance can have a negative impact on their self-perceptions (Chanal, Marsh, Marsh, Sarrazin, & Bois, 2005). One possible and obvious solution would be to promote active extracurricular recreational activities for young people. They would thus be given an opportunity to reinvest the skills acquired playing hockey in a less competitive environment, which may help improve their physical as well as overall self-perceptions (Colchico, Zybert, & Basch, 2000).

Finally, the presence of social influences from the coach and parents appears to be negatively related to ESS. This result seemingly contradicts the lay opinion that ESS is often twined with parental over-involvement (Gould, 2010), which often has the effect of damaging their relationship with the child, or at least the child's relationship with the sport. Parental hyper-involvement has already been revealed as

harmful to the child's physical activity participation and psychological state (Hesse, Mikkelson, & Saracco, 2018; Janssen, 2015). Of course, parental behavior is already a top priority for stakeholders, organizations and researchers who are committed to the development of the individual through sport (*Centre canadien multisports*, 2007).

Although this study offers a wealth of information about ESS in Québec hockey players, it has certain limitations. First, data collection regarding hockey players' PA practice was conducted using self-reported questionnaires. This method, less expensive and easier to attain larger sample sizes, is also less accurate and often displays greater variability in its results compared to other more demanding methods such as the use of accelerometers (Dowd et al., 2018). Second, it must be kept in mind that this study was conducted in the specific context of Québec's hockey, making it difficult to generalize the results to other environments such as American or European sports programs. Prior to generalizing, contextual variables should be taken into account, including length of the sports calendar, availability of infrastructure, and age of athletes at transition to the elite level. In addition, our conceptualization and measurement of ESS, while innovative in that we have contrived continuous scoring, could be further refined. Indeed, it should be feasible to incorporate other variables, such as the time spent in practices or competition, the frequency and the volume of practice regarding other physical activities. This addition could improve the validity and accuracy of the SSE measure and improve its generalization to different sports.

Conclusion

The results of this study are consistent with previous research, which suggests diversifying active behaviors at a young age for the physical and overall benefit of young people, a conclusion that should be conveyed to stakeholders (coaches, decision-makers, parents). This study contributes to refine our understanding of the relationships between sport specialization and the level of play among Canadian hockey players, by showing that a vast majority of players began competitive hockey at an early age. Despite such situation, it seems that older players and those who evolve in less competitive levels are those who showed higher levels of specialization. Overall, this study improves our knowledge of the prevalence of ESS within the context of Québec hockey and it provides information about its links to other psychosocial variables having an impact on young people's sporting experience. It also opens the door to several other research opportunities, such as longitudinal designs and a more exhaustive understanding on the determinants of sport specialization (social influences, environment, motivations, etc.) among less competitive players. First, a longitudinal look at the evolution of physical activity practice and other parameters relevant to long-term active participation should be conducted among sport-specialized youth to provide further information on how this phenomenon unfolds during childhood and adolescence. In addition, very few studies consider the effectiveness of programs aimed at either reducing the rate of ESS in a given sport or limiting the negative consequences associated with it. The growing interest in ESS and its impact in most Western countries has made this issue a salient topic for research in the short and medium term.

Author's Declarations

The authors declare that there are no personal or financial conflicts of interest regarding the research in this article.

The authors declare that they conducted the research reported in this article in accordance with the Ethical Principles of the Journal of Expertise.

The authors declare that they are not able to make the dataset publicly available but are able to provide it upon request.

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