Age of Early Specialization, Competitive Volume, Injury, and Sleep Habits in Youth Sport: A Preliminary Study of US Youth Basketball

Peter L. Meisel, MSPH,*† John P. DiFiori, MD,†‡ Jean Côté, PhD,§ Joseph T. Nguyen, MPH,‡ Joel S. Brenner, MD, MPH,|| Robert M. Malina, PhD,¶ Ed Ryan III, ATC,# and Arne Güllich, PhD**

Background: Concerns for youth sports in the United States often focus on early sport specialization, overemphasis on competition, injuries, and burnout. Little research has addressed relationships among the preceding and other concerns, including time away from organized sport, sleep, and perceptions of physical and psychological well-being.

Hypothesis: There is an association between reported competitive gameplay volume and specialization, injury, and fatigue among elite youth basketball players.

Study Design: Cross-sectional study; convenience sample.

Level of Evidence: Level 4.

Methods: An anonymous questionnaire was administered to a convenience sample of youth basketball players between 13 and 18 years of age from across the United States. Participants were queried about multiple factors, including the extent of their participation in organized basketball and other sports, time away from organized basketball, injury, sleep, and feelings of exhaustion related to basketball participation.

Results: A total of 772 participants (145 girls, 627 boys) completed a survey. All participants played for a select or elite club basketball team and/or a high school basketball team. Overall, 49% played more than 50 games within the past year. A total of 73% were specialized in basketball, 58% prior to age 14 years, and 35% prior to age 11 years. In all, 70% reported less than 1 month away from organized basketball within the past year, and 28% reported no time away. A total of 54% reported sleeping less than the recommended 8 hours each night during the school year. Within the prior year, 55% reported feeling physically exhausted and 45% reported feeling mentally exhausted from basketball. Regression analysis did not find any significant relationships between early specialization prior to age 14 years and basketball-related injury or feelings of mental or physical exhaustion.

Conclusion: In this select group of youth basketball players, the majority specialized in basketball prior to age 14 years and reported a large number of competitive events with little time away from organized basketball.

Clinical Relevance: The results from a sample of highly competitive youth basketball players indicate issues that warrant further attention and research regarding the potential impact of specialization, frequent competitions, lack of time away from organized sport, and perceptions of well-being in young athletes.

Keywords: basketball; specialization; competition; sport

From †National Basketball Association, New York, NY, ‡Hospital for Special Surgery, New York, New York, §School of Kinesiology and Health Studies, Queens University, Kingston, Ontario, Canada, ||Children's Hospital of The King's Daughters, Eastern Virginia Medical School, Norfolk, Virginia, ¶Department of Kinesiology and Health Education, University of Texas at Austin, Austin, Texas, #USA Basketball, Colorado Springs, Colorado, and **Department of Sports Science, University of Kaiserslautern, Kaiserslautern, Germany

*Address correspondence to Peter L. Meisel, MSPH, National Basketball Association, Olympic Tower, 645 Fifth Avenue, New York, NY 10022 (email: pmeisel@nba.com).

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Emphasis on competitive success in youth sports has led to concerns regarding early sport specialization and the overall youth sport experience. While there has been a focus on a possible relationship between early sport specialization and injury, little research has detailed competition volume and the extent of year-round competition and overall participation.[8,11,33] In addition, key issues such as sleep and perceptions of physical and psychological effects remain poorly described.[13,25,26,30,31]

The view that single-sport training as a child enhances future sport success has been widely disseminated in the popular media, yet there is little data to support this strategy.[14] In fact, much of the existing literature indicates that early sport specialization is not a predictor of success and may even impede long-term achievement in some sports.[2-4,7,15,16,18,20,22,27,28,37]

For some young athletes, the youth sport experience involves nearly continuous year-round participation in a single sport, frequent travel, and regular competitive events that can feature a number of games played over a short period of time, all in addition to the demands of academic work and family and community commitments. This may leave youth athletes with limited time for rest or peer socialization outside of sport and may also negatively affect nutrition and sleep. Although the importance of consistent sleep for growth and development is increasingly recognized, the influence and demands of competitive youth sport on sleep has only recently received attention.[26,41]

In 2016, the National Basketball Association (NBA) through its Jr NBA program partnered with USA Basketball (USAB) to address issues facing youth basketball in the United States. As part of this initiative, a multidisciplinary team of experts collaborated in developing the first guidelines for youth health and basketball.[10] These guidelines were intended to foster a positive overall youth basketball experience, emphasizing the promotion of player health and encouraging youth players to refrain from early sport specialization and avoid levels of organized competition that could contribute to overuse injuries and burnout.

Since the launch of the guidelines in October 2017, the Health and Wellness Working Group has initiated a study of youth basketball players with the objective of

1. Assessing the current state of youth basketball with respect to time spent playing organized basketball and participation in structured competition.
2. Providing data to educate parents, youth athletes, and other stakeholders about issues facing youth players, including highly competitive high school age players.
3. Informing future initiatives aimed at promoting health, wellness, long-term skill development, and enhancing the overall youth basketball experience.
4. Evaluating the impact of such initiatives on future generations of youth basketball players.

The purpose of this preliminary study is to assess the age of sport specialization in the context of the NBA/USAB guidelines in order to describe the current experience of a select group of youth basketball players and to begin to assess the potential relationships among athletes who specialize in basketball prior to age 14 years and time spent playing organized basketball, extent of participation in competitive events, sleep habits, and perceptions of fatigue.

Sport specialization is a multidimensional construct with no clear consensus definition in the literature. Some definitions consider specialization to be strictly related to the athlete's participation in one sport to the exclusion of other sports, while other definitions incorporate factors related to time spent in organized training or competitions and include an athlete's involvement in unorganized sports.[5,21] This study does not attempt to define specialization; rather, it is the goal of the authors to evaluate the age at which athletes reported specializing in organized basketball only, which for the purpose of this article is referred to as sport specialization (noting that in the NBA/USAB guidelines recommend delaying single sport specialization until the age of 14 years) and its potential relationship with several outcomes.

METHODS

Participants

Basketball players attending five youth basketball events in the United States in 2018 and 2019 were invited to participate in the study. Participation was voluntary and anonymous. Eligible participants were 13 to 18 years. Surveys were administered on tablets by NBA Basketball Operations and Player Health staff (none of whom were the players' coaches) during off-court programming sessions. It was made clear to the athletes that individual results would not be shared with their current or any prospective coach, scout, staff, or team. The study was approved by the institutional review board of the Hospital for Special Surgery (New York, NY).

After the initial survey administration in 2018, review of feedback from athletes resulted in an update to make questions about time missed due to injury more concise and less subject to recall bias (the original question asked participants whether they had missed time because of injury at given ages and was changed to "in the last year, have you had to sit-out from basketball for one month or longer due to a basketball-related injury") and the addition of questions aimed at capturing self-reported sleep and perception of physical and mental exhaustion from basketball (Tables 1, 2, and 3). These modifications were also approved by the institutional review board.

In addition to demographic information, participants provided information on number of games played, time spent training under a coach's supervision, and time away from basketball over the previous 12 months. The players reported whether or not they were involved in organized sports other than basketball and, if yes, during what age periods. The age of sport specialization was defined as the age at which the athlete reported participation in organized basketball only with no

Table 1. Study population characteristics (percentages column-wise)

Variable	Group	Total (N = 772)		Male (N = 627)		Female (N = 145)		*P*[a]
		n	%	n	%	n	%	
Age, y, at survey	Mean (SD)	16.3 (1.5)		16.6 (1.3)		14.9 (1.3)		<**0.001**[b]
	13	49	6	19	3	30	21	
	14	172	22	95	15	77	53	
	15	70	9	59	9	11	8	
	16	159	21	149	24	10	7	
	17	214	28	203	32	11	8	
	18	108	14	102	16	6	4	
	Total	772		627		145		
What is your current national recruiting ranking among all players in your class?	1-50	170	22	154	25	16	11	<**0.001**[c]
	50-100	47	6	44	7	3	2	
	101-250	38	5	37	6	1	1	
	Outside the top 250	102	13	101	16	1	1	
	Not available or player did not know	410	53	288	46	122	85	
	Total	767		624		143		
How old were you when you first started playing on a select or elite club basketball team?	≤10	328	43	256	41	72	50	**0.002**[d]
	11	106	14	82	13	24	17	
	12	84	11	67	11	17	12	
	13	70	9	50	8	20	14	
	14	69	9	62	10	7	5	
	15	30	4	29	5	1	1	
	16	9	1	9	1	0	0	
	17	4	1	4	1	0	0	

(continued)

Table 1. (continued)

Variable	Group	Total (N = 772)		Male (N = 627)		Female (N = 145)		P[a]
		n	%	n	%	n	%	
	Never played on select team	40	5	38	6	2	1	
	Unknown/missing	29	4	27	4	2	1	
	Total	769		624		145		
Is basketball currently the only organized sport that you play?[e]	Yes	349	73	280	77	69	62	**0.002**
	Total	476		365		111		
At what age did you begin to specialize in basketball only?	5-10	168	48	126	45	42	61	0.235
	11	34	10	26	9	8	12	
	12	39	11	32	11	7	10	
	13	37	11	33	12	4	6	
	14	28	8	23	8	5	7	
	15	20	6	19	7	1	1	
	16	8	2	8	3	0	0	
	17	1	0	1	0	0	0	
	I don't know	14	4	12	4	2	3	
	Total	349		280		69		
Total number of games played in the last 12 months	≤25	101	14	76	13	25	18	
	26-50	273	37	226	38	47	33	
	51-75	263	36	210	36	53	37	
	76-100+	93	13	76	13	17	12	
	Total	730		588		142		
Reported time off in the past 12 months	No time off reported	199	28	164	29	35	25	0.163
	<1 month	295	42	218	39	77	55	
	1-2 months	126	18	109	19	17	12	

(continued)

Table 1. (continued)

Variable	Group	Total (N = 772)		Male (N = 627)		Female (N = 145)		P[a]
		n	%	n	%	n	%	
	2+ months	85	12	75	13	10	7	
	Total	705		566		139		
During the basketball season (from November through March), when my coach gives the team a day off, I typically:	Take off the entire day to rest	198	29	150	27	48	35	0.344
	Shoot around or play pick-up	242	35	194	35	48	35	
	Skill development workout	114	17	94	17	20	15	
	Strength and agility, or cardio	102	15	87	16	15	11	
	Not applicable, I have no off days	32	5	26	5	6	4	
	Total	688		551		137		
Have you undergone a surgery for a basketball-related injury?	Yes	123	17	109	18	14	10	**0.015**
	No	622	83	492	82	130	90	
	Total	745		601		144		
Have you had to sit-out from basketball for one month or longer due to a basketball-related injury	Yes	116	49	78	58	38	37	**0.001**
	No	122	51	57	42	65	63	
	Total	238		135		103		
During the school year, how many hours of sleep do you get in a typical night?*f*	≤5	12	6	8	7	4	4	0.410
	6	27	13	10	9	17	17	
	7	74	35	39	35	35	35	
	8	78	37	42	38	36	36	
	9	18	9	11	10	7	7	
	≥10	1	0	1	1	0	0	
	Total	210		111		99		

(continued)

Table 1. (continued)

Variable	Group	Total (N = 772)		Male (N = 627)		Female (N = 145)		P^a
		n	%	n	%	n	%	
During the summer (when school is not in session), how many hours of sleep do you get in a typical night?	≤5	20	10	9	8	11	11	0.803
	6	34	16	19	17	15	15	
	7	25	12	15	14	10	10	
	8	49	23	26	24	23	23	
	9	44	21	20	18	24	24	
	≥10	37	18	21	19	16	16	
	Total	209		110		99		
In the past year, have you felt physically exhausted from basketball?	Yes	112	55	47	44	65	66	**0.001**
	No	93	45	60	56	33	34	
	Total	205		107		98		
In the past year, have you ever felt mentally exhausted from basketball?	Yes	94	45	51	47	43	43	0.585
	No	113	55	57	53	56	57	
	Total	207		108		99		

[a]Boldfaced *P* values indicate statistical significance.
[b]*P* value indicates mean age of male players was higher than female players.
[c]Analysis for *P*-value calculation indicates association between rank and player gender.
[d]*P* value indicates statistical association between age at which player first started playing on select team and player gender. Post hoc analysis reports that female players had higher rate of playing on select team at age 10 years or younger compared with males ($P = 0.050$).
[e]Design error in the online survey resulted in a subset of sports specialization questions being skipped in by 293 participants at the first event, resulting in the lower n available for the specialization analyses.
[f]Questions related to sleep and perception of physical and mental exhaustion from basketball were added after the first event and were therefore not provided to all participants.

Table 2. Comparison of player characteristics currently specialized in basketball by age of basketball specialization (percentages column-wise)

		Age <11 y		Age 11-13 y		Age 14+ y		
Variable	**Group**	**n**	**%**	**n**	**%**	**n**	**%**	***P*[a]**
Sex	Male	126	75	91	83	51	89	**0.042**[b]
	Female	42	25	19	17	6	11	
	Total	168		110		57		
Age at survey, y	Mean (SD)	15.8 (1.5)		16.0 (1.4)		17.2 (1.1)		<**0.001**[c]
	13	19	11	5	5	0	0	**0.002**[d]
	14	52	31	35	32	11	19	
	15	17	10	6	5	5	9	
	16	32	19	35	32	17	30	
	17	36	21	21	19	12	21	
	18	12	7	8	7	12	21	
	Total	168		110		57		
What is your current national recruiting ranking among all players in your class?	1-50	50	30	35	32	18	32	0.098
	50-100	7	4	7	6	5	9	
	101-250	9	5	0	0	1	2	
	Outside the top 250	13	8	8	7	9	16	
	Unknown	89	53	60	55	24	42	
	Total	168		110		57		
How old were you when you first started playing on a select or elite club basketball team?	≤10	101	60	34	31	21	37	<**0.001**[e]
	11	25	15	18	16	7	12	
	12	14	8	22	20	5	9	
	13	12	7	16	15	4	7	
	14	7	4	7	6	11	19	
	15	1	1	6	5	3	5	
	16	2	1	1	1	1	2	

(continued)

Table 2. (continued)

Variable	Group	Age <11 y		Age 11-13 y		Age 14+ y		
		n	%	n	%	n	%	P[a]
	17	1	1	0	0	0	0	
	Never played on select team	1	1	2	2	2	4	
	Unknown/missing	4	2	4	4	3	5	
	Total	168		110		57		
Total games played approximately (all seasons)	≤25	13	8	13	13	5	9	0.798
	26-50	64	40	39	38	18	33	
	51-75	62	39	37	36	25	46	
	76-100+	21	13	15	14	6	11	
	Total	160		104		54		
Across a typical year, I . . . (choose one answer)	Never have time off from organized basketball; I play organized basketball all year	57	38	30	29	9	17	**0.006**[f]
	Have a few weeks off (but less than a full month) from organized basketball without any games or practice	67	44	42	41	28	52	
	Have about 1 full month off from organized basketball without any games or practices	21	14	24	23	8	15	
	Have 2 or more months off from organized basketball without any games or practices under a coach's supervision	7	5	7	7	9	17	
	Total	152		103		54		
During the high school basketball season (from November through March), when my coach gives the team a day off, I typically: (choose one)	Take off the entire day to rest (no physical activity)	37	25	23	24	10	20	0.347
	Go to the gym to shoot around or play pick-up	55	37	35	36	23	45	

(continued)

Table 2. (continued)

		Age <11 y		Age 11-13 y		Age 14+ y		
Variable	**Group**	**n**	**%**	**n**	**%**	**n**	**%**	***P*[a]**
	Put myself through a skill development workout	22	15	19	20	13	25	
	Put myself through a strength and agility, or cardiovascular workout, but I do not do anything on the basketball court	22	15	15	16	5	10	
	Not applicable; my coach does not give us any days off	11	7	4	4	0	0	
	Total	147		96		51		
Have you undergone a surgery for a basketball-related injury?	No	129	83	87	82	43	84	0.941
	Yes	27	17	19	18	8	16	
	Total	156		106		51		
Have you ever seen a doctor for a basketball related injury?	No	14	40	4	19	1	20	0.223
	Yes	21	60	17	81	4	80	
	Total	35		21		5		
Have you had to sit out from basketball for 1 month or longer due to a basketball-related injury?	No	44	54	25	53	6	35	0.369
	Yes	38	46	22	47	11	65	
	Total	82		47		17		
During the school year, how many hours of sleep do you get in a typical night?	≤5	5	7	2	5	0	0	0.974
	6	7	10	4	10	1	6	
	7	26	36	16	38	7	44	
	8	30	41	17	40	6	38	
	9	5	7	3	7	2	13	
	Total	73		42		16		

(continued)

Table 2. (continued)

		Age <11 y		Age 11-13 y		Age 14+ y		
Variable	**Group**	**n**	**%**	**n**	**%**	**n**	**%**	***P*[a]**
During the summer (when school is not in session), how many hours of sleep do you get in a typical night?	≤5	10	14	0	0	0	0	0.169
	6	13	18	9	21	2	13	
	7	7	10	4	10	2	13	
	8	20	27	9	21	2	13	
	9	12	16	11	26	6	38	
	≥10	11	15	9	21	4	25	
	Total	73		42		16		
In the past year, have you felt physically exhausted from basketball?	No	36	51	15	36	7	44	0.268
	Yes	34	49	27	64	9	56	
	Total	70		42		16		
In the past year, have you ever felt mentally exhausted from basketball?	No	47	65	19	45	6	40	**0.049**[g]
	Yes	25	35	23	55	9	60	
	Total	72		42		15		
Survey date	January 2018	42	25	26	24	6	11	0.183
	June 2018	52	31	25	23	17	30	
	August 2018	45	27	33	30	19	33	
	August 2019	29	17	26	24	15	26	
	Total	168		110		57		

[a]Boldfaced *P* values indicate statistical significance.
[b]Post hoc tests indicate a significantly higher percentage of females in the specialized <11 years age group versus 14+ years ($P = 0.021$).
[c]Post hoc tests indicate the mean age of the specialized 14+ years age group was significantly higher than the age 11 to 13 years ($P = 0.011$) and age <11 years ($P < 0.001$) specialization groups.
[d]Post hoc tests indicate that the percentage of 13-year-old players in the <11 years group was significantly higher than 11 to 13 years ($P = 0.050$) and 14+ years ($P = 0.006$) specialization groups.
[e]Post hoc tests indicate that the percentage of players who began playing on a select or club basketball team before the age of 10 years was higher in players who began their specialization before age 11 years compared with those who specialized between age 11-13 years ($P < 0.001$) and those who specialized at age 14 years and older ($P = 0.004$).
[f]Post hoc tests indicate the percentage of players who specialized at age <11 years reported a significantly higher percentage of never having time off from organized basketball compared with players who specialized at age 14+ years ($P = 0.005$).
[g]Post hoc tests indicate that players who specialized in basketball before age 11 years had significantly lower percentage of feeling mentally exhausted from basketball in the past year compared with players who specialized between age 11 to 13 years ($P = 0.037$) and age 14 years and older ($P = 0.050$).

Table 3. Multivariable logistic regression models for factors associated with physical and mental exhaustion

		95% CI		
Factor	**Odds Ratio**	**Lower**	**Upper**	***P***
In the past year, have you felt physically exhausted from basketball? (N = 199)				
Player age at survey	1.8	1.1	3.1	0.030
Female (vs male)	5.1	2.3	11.3	0.000
Specialized in basketball, age <11 y (vs currently not specialized in basketball)	1.0	0.4	2.2	0.971
Specialized in basketball, age 11-13 y (vs currently not specialized in basketball)	1.4	0.6	3.7	0.452
Specialized in basketball, age 14+ y (vs currently not specialized in basketball)	0.8	0.2	3.4	0.768
During the school year, <8 hours sleep (vs 8+)	2.6	1.3	5.0	0.006
Felt mentally exhausted from basketball in the past year	7.8	3.8	16.0	0.000
In the past year, have you felt mentally exhausted from basketball? (N = 199)				
Female (vs male)	0.6	0.3	1.1	0.108
Specialized in basketball, age <11 y (vs currently not specialized in basketball)	0.7	0.3	1.4	0.276
Specialized in basketball, age 11-13 y (vs currently not specialized in basketball)	1.2	0.5	3.0	0.634
Specialized in basketball, age 14+ y (vs currently not specialized in basketball)	1.5	0.4	5.5	0.532
During the summer (when school is not in session), <8 hours sleep (vs 8+)	1.8	0.9	3.5	0.091
Had to sit out from basketball for 1 month or longer due to a basketball-related injury	2.2	1.1	4.2	0.023
Felt physically exhausted from basketball in the past year	7.5	3.7	15.2	0.000
Had to sit-out from basketball for one month or longer due to a basketball-related injury (N = 199)				
Player age at survey	1.5	1.0	2.3	0.061
Specialized in basketball, age <11 y (vs currently not specialized in basketball)	1.1	0.5	2.4	0.718
Specialized in basketball, age 11-13 y (vs currently not specialized in basketball)	0.8	0.3	1.8	0.543
Specialized in basketball, age 14+ y (vs currently not specialized in basketball)	1.9	0.5	7.2	0.317
Underwent a surgery for a basketball-related injury	12.5	3.4	45.4	0.000
Felt mentally exhausted from basketball in the past year	2.3	1.2	4.3	0.010

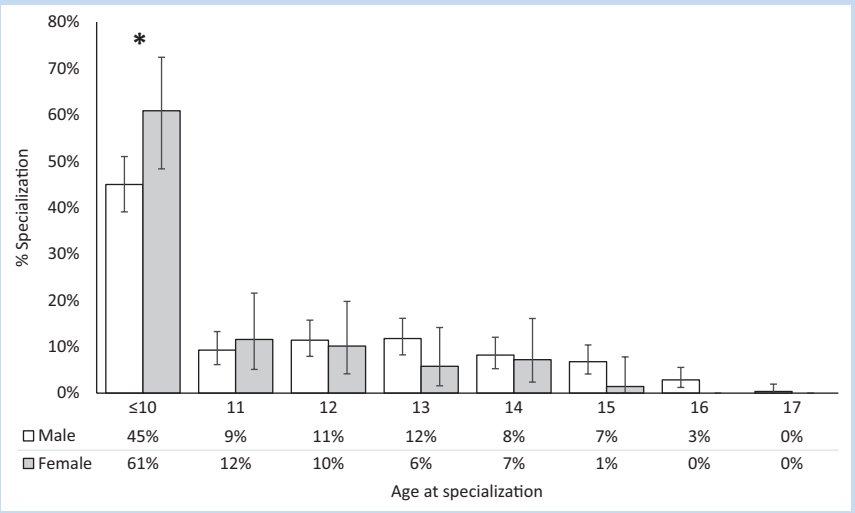

Figure 1. Reported age at which players began to specialize in basketball by gender. Error bars indicate 95% confidence intervals.
*Significantly higher percentage of females specialized at 10 years or younger (61%) compared with males at that same age (45%) ($P = 0.018$).

participation in any other organized sports.[1,23] Basketball-related injury history, sleep habits, and perception of basketball-related physical and mental exhaustion were also reported. Although some players participated in more than one of the events at which surveys were collected, only one survey per player (the initial survey) was retained for analysis.

Statistical Analysis

The data are reported as means and standard deviations for continuous data and as frequencies and percentages for categorical variables. Shapiro-Wilks tests were used to confirm the assumption of normality for the continuous data of the study cohort. Independent-samples *t* tests were used to compare continuous variables between groups. Chi-square analysis was used to compare discrete variables between comparison groups. Fisher's exact test was used in lieu of chi-square analysis when sample size limitations warranted. Multivariable logistic regression models were generated to identify potential risk factors associated with physical and mental exhaustion. Candidate variables for the analyses were drawn from survey data related to demographic information, frequency of games played, and past medical history. Adjusted odds ratio (OR) and 95% confidence intervals (95% CI) are reported for each model. All analyses were conducted using 2-sided hypothesis testing; significance was defined as $P \leq 0.05$. All analyses were performed using SPSS Version 22.0 (IBM Corporation).

RESULTS

A total of 855 youth basketball players agreed to complete the survey; 83 respondents were excluded from the analysis for failing to provide age and gender data. The sample for analysis was thus 772 participants (90.2%; 627 male and 145 female). A design error in the online survey resulted in a subset of specialization questions that were not completed by 293 participants; 476 participants answered the specialization questions and are included in the specialization analyses (Tables 1 and 2; Figure 1).

The mean age of survey respondents was 16.6 years for boys and 14.9 years for girls (Table 1). Of the respondents, 33% reported a national recruiting ranking in the top 250 among basketball players in their respective class. It should be noted that while youth rankings exist, participants aged 13 and 14 years are less likely to have a class ranking or to know if they are ranked. Overall, 43% of participants started playing on a select or elite club basketball team prior to age 11 years, with girls joining such teams at a younger age than boys ($P < 0.01$).

Participation in more than 50 organized games over the previous year (defined as timed, full-court 5 vs 5 games played under coach supervision) was reported by 49% of the participants, while 13% reported having played more than 75 games in the past year. Among respondents, 70% had less than 1 month away from organized basketball, while 28% reported no time away from the sport. During the most recent middle or high school basketball season, 29% of players reported resting from all basketball activities on off days, while 67% report participating in training or other basketball activities outside regular team practice (eg, strength training or playing pick-up basketball) and 5% reported having a coach-supervised practice or game every day with no days off during the season. A total of 54% reported sleeping less than 8 hours per night during the school year. Within the prior year, 17% of participants reported having undergone surgery for a basketball-related injury and 49% had to sit out from basketball for at least 1 month due to a basketball-related injury. Of interest, 55% reported feeling

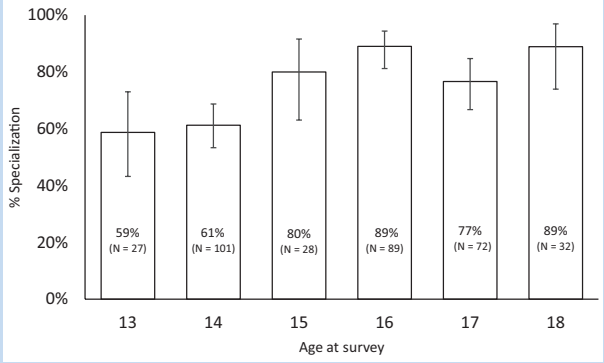

Figure 2. Frequency of specialization by age at the time of survey. Error bar indicates 95% confidence interval.

physically exhausted from basketball within the year they were surveyed, and 45% reported feeling mentally exhausted from basketball within the year.

Sport Specialization

Among players surveyed regarding specialization (n = 476), 73% (349 of 476) were specialized in basketball (ie, basketball was the only organized sport in which they currently participated). These included 58% (278 of 476) specializing prior to age 14 years with 35% (168 of 476) specializing prior to age 11 years (Table 1 and Figure 1). In contrast, 39% (184 of 476) did not specialize until 14 years or older or were not specialized (Table 1 and Figure 1).

In all, 61% of participants aged 13 to 14 years and 83% of participants aged 15 to 18 years reported being specialized at the time of the survey (Figure 2). Girls who were specialized were more likely to do so prior to age 11 years than boys (P = 0.02) (Table 1 and Figure 1). Nevertheless, players who were specialized did not significantly differ from those who were not specialized in age of first playing on a select or elite club basketball team, games played within the past 12 months, and in time away from basketball (Table 2). No relationship was found between age of specialization and surgery for a basketball-related injury or time out for 1 month or more due to a basketball-related injury (Table 2).

Multivariate analyses did not identify an association between feeling physically exhausted or mentally exhausted and specialization, games played, and time away from basketball (Table 3). Girls were more likely to report having felt physically exhausted from basketball than boys ($P < 0.01$). Sleeping less than 8 hours per night during the school year was also associated with feeling physically exhausted ($P < 0.01$) (Table 3). Feelings of mental exhaustion were associated with having a basketball-related injury that resulted in missing at least one month of play (Table 3). Having felt mentally and physically exhausted from basketball were demonstrated to be linked ($P < 0.01$).

DISCUSSION

A variety of factors may influence the sport experiences of youth, especially among elite youth athletes. In the United States and perhaps other countries, a number of issues affect the youth sport experience, including an emphasis on short-term competitive success, a culture of elite travel and club teams, and exclusive camps and showcase events that may be perceived to be essential in achieving college scholarships and professional careers. These have contributed to a youth sports experience that fosters early sport specialization, high-intensity and year-round training, and frequent, organized competition.[9,12] In contrast, research of top athletes has consistently shown that youth sport achievement and early specialization are not prerequisites for eventual elite-level performance, may correlate with overuse injury and burnout, and may be detrimental to long-term success and performance in many sports.[2,17,19,20,34,35,39]

To understand the current youth basketball experience and begin to define the extent of these issues among US youth athletes, players attending 5 youth basketball events were surveyed. Although the NBA and USAB recommend delaying specialization in basketball until at least age 14 years, the results indicated that 57% of the youth basketball players in this preliminary study specialized at younger ages, girls more so than boys. Interestingly, there was no difference between players specializing at younger or older ages and nonspecialized players with respect to numbers of games played and time away from organized basketball. Furthermore, specialization was not associated with having had surgery or missing at least 1 month due to a basketball-related injury—although, of concern, 49% reported missing at least 1 month of basketball activity due to a basketball-related injury, and 17% reported having undergone surgery from a basketball-related injury. These observations are based on a subset (n = 426) of an already highly selected population; as such, caution is warranted in interpreting the results. Moreover, the findings are contrary to several studies which demonstrated associations between specialization and injury.[32,37]

Girls specialized earlier than boys, which was consistent with findings from a recent study of NCAA (National Collegiate Athletic Association) athletes.[38] A larger sample size, with a larger percentage of girls and a broader range of competitive levels will provide a better assessment of the impact of early specialization on these relationships and potentially illuminate the motivating factors behind these trends.

Nearly one-half of the study population reported playing more than 50 full-length, timed, 5 on 5 games within the past 12 months. For context, this exceeds the number of games played during an NCAA Division 1 basketball season or WNBA season. In addition, 13% of study participants reported playing 76 or more competitive games which approaches the 82-game schedule of a typical NBA regular season. Moreover, it is likely that a significant percentage of these games are concentrated over a short interval of tournament play (eg, 3 or more games in the same day and 5 or more games over the course of 2

consecutive days). Further evaluation is needed to understand the effect of competitive game schedules and the mental and physical load on youth athletes.

In the context of the preceding observations, the NBA and USAB youth guidelines recommend a maximum of 7 months per year in organized basketball for players aged 12 to 14 years, and a maximum of 9 to 10 months per year in organized basketball for players in grades 9 through 12.[10] Of interest, among the players we surveyed, no more than 12% met the NBA and USAB recommendations. In addition, 54% of players reported less than the recommended 8 to 10 hours of sleep per night during the school year. This finding is consistent with research among general adolescent populations that shows that more than half of US 16-year-olds regularly get less than 7 hours of sleep and that US adolescents commonly have schedules that restrict their sleep during the school year; more research is needed to further understand how inadequate sleep in young athletes may affect health, well-being, and performance.[6,24,29,36,40,42,43]

This study also noted that 55% reported having felt physically exhausted and 45% felt mentally exhausted from basketball participation within the past year. Although multivariate analysis suggested that girls were more likely to report physical exhaustion, and less than 8 hours of sleep during the school year was also associated with this outcome, this question was added late in the survey period and the observations were thus limited to a subsample (n = 205) of the study group. Analysis of the players included in this subsample versus those excluded yielded a statistically significant increased representation of female athletes (48% vs 8%), younger average age (14.5 vs 16.9 years), and nonspecialized athletes (36% vs 21%). Nonetheless, these findings raise concerns about well-being that warrant further study. More particularly, it would be important for future studies to examine the long-term physical and psychological effects that results from high-intensity engagement in basketball during adolescence, as noted in this study.

Study Limitations

This study was based on a relatively small convenience sample. Among high school–aged participants, female athletes were significantly underrepresented. Additionally, players were likely to be highly self-selected with regard to injury, since injured or recently injured players were not likely to have traveled to the events where the survey was administered. In addition, early sport specialization raises concern about long-term overuse injuries; this study, however, does not distinguish between acute and overuse injury and given both the age of those surveyed as well as the questions used to assess injury, the current load and long-term future risk of overuse injury requires investigations of older, adult players and was not examined in this survey.

The definition of specialization used in this study focuses only on participation in organized basketball; the results thus do not consider several key factors such as starting age and the amount of coach-led practice and peer-led play in both basketball and other sports at different ages. Moreover, this study considers athletes to be specialized using a binary categorization such that athletes that participate only in organized basketball are categorized as specialized. Other definitions or levels of specialization, including those which stratify specialization or incorporate additional indicators of specialization status and reveal a multisport athlete to still be highly specialized; they are not included in this analysis.

The study sample represented a subset of some of the most highly competitive youth basketball players in the United States. As such, the findings may not represent the overall US youth basketball experience or the experiences of youth basketball players outside the United States. Similarly, they may not reflect the experiences of youth athletes in other sports.

Potential recall bias is also a limitation. The survey attempted to address this issue by standardizing and restricting drop-down options, and by asking athletes to recall experiences from the past 12 months for most questions, although timing of survey administration during the year (eg, in January during the high school basketball season vs July during the summer travel season) may further have biased responses. In addition, an error in the online survey design resulted in a number of athletes not completing the specialization questions, while a smaller number of athletes completed the questions regarding sleep and fatigue; the latter were added based on feedback from players after the initial survey questions.

CONCLUSION

This preliminary study begins to describe the current youth basketball experience within a subset of the US youth basketball population. Compared with the NBA and USAB basketball guidelines, the majority of youth basketball athletes in this study reported specializing earlier than the recommended age of 14 years, exceeded the participation recommendations in terms of competitive events played, and did not obtain the recommended amount of time away from organized basketball for rest and recovery. The initial results serve to provide a starting point for further research and the development of strategies to address these issues and to evaluate efforts at implementing change based on youth basketball guidelines, and related research. Nevertheless, results of this preliminary study may also help to inform parents, young athletes and youth sport organizations in assessing their programs and developing policies to further promote healthy and positive sport experiences.

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