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DETERMINANTS OF PARTICIPATION IN YOUTH BASKETBALL: MULTIDIMENSIONAL ANALYSIS

Florianópolis
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Orientador: Professor Doutor Humberto Moreira Carvalho

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O presente trabalho em nível de mestrado foi avaliado e aprovado por banca examinadora composta pelos seguintes membros:

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Certificamos que esta é a **versão original e final** do trabalho de conclusão que foi julgado adequado para obtenção do título de mestre em Educação Física.

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Professor Doutor Humberto Moreira Carvalho
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“Quando você melhora um pouco a cada dia, coisas grandes começam a ocorrer. Não procure por melhoras rápidas e grandiosas, busque uma pequena melhoria, um dia de cada vez. É o único modo para que aconteça - e quando acontece, dura.” - **John Wooden**

RESUMO

DETERMINANTES DE PARTICIPAÇÃO NO BASQUETEBOL DE JOVENS: ANÁLISE MULTIDIMENSIONAL

Mestrando: André Luiz de Almeida Soares
Orientador: Dr. Humberto Moreira Carvalho

Programas esportivos de jovens são frequentemente baseados em modelos de "academias de elite", em que aqueles que são considerados "talentosos" têm acesso a melhores oportunidades e infraestruturas para seu próprio desenvolvimento. O engajamento deliberado na prática e no treinamento têm sido reconhecidos como uma das características indispensáveis para que se atinja a expertise em diversos domínios, e pode ser determinante para diferenciar aqueles que terão maiores chances de atingir os mais altos níveis de desempenho. Dadas diversas mudanças que ocorrem nos jovens durante sua infância e adolescência, esses modelos de seleção podem estar superestimando alguns atletas por suas características pessoais. Especialmente no basquetebol, o tamanho corporal e as capacidades funcionais podem proporcionar algumas vantagens no jogo. Sendo assim, a maturação biológica é um dos fatores que causam maiores divergências no processo de seleção. Treinadores e outros agentes do sistema esportivo podem estar sobrevalorizando jogadores de maturação precoce, ao invés de considerar os diferentes ritmos de crescimento de cada atleta. Essa variabilidade pode influenciar na progressão e no engajamento de atletas na prática esportiva formal. Além disso, características psicológicas podem ser afetas por essa abordagem, e sua relação com as mudanças ao longo do crescimento também deveriam ser consideradas no esporte de jovens. Portanto, treinadores e pesquisadores deveriam considerar abordagens multidimensionais e holísticas na avaliação de jovens atletas. Uma compreensão multidimensional, e o tratamento analítico adequado, dos fatores que influenciam no desenvolvimento de jovens atletas podem favorecer melhores intervenções de treinadores e outros agentes do esporte. Dada a escassez de evidências empíricas acerca de jovens jogadores de basquetebol, esse estudo teve como objetivos: (i) examinar as contribuições relativas à idade cronológica, experiência acumulada no esporte, desenvolvimento físico e biológico (tamanho corporal e estágio maturacional), capacidades funcionais (desempenho funcional específico) e domínios psicológicos e comportamentais (motivação e orientação) para a progressão ou abandono de programas de basquetebol de jovens; e, (ii) verificar quais são as determinantes para a decisão de treinadores quando selecionam atletas para competir em seleções estaduais organizadas formalmente. Duas diferentes amostras compuseram esse estudo. A primeira amostra considerou 57 jovens jogadores de basquetebol (10,5 a 15,5 anos) engajados no treino e competição formal, medidos durante a temporada competitiva. Através de uma abordagem interdisciplinar, examinamos a variação do estágio maturacional, do tempo de experiência de treino, tamanho corporal, capacidades funcionais (*Line Drill test* e *Yo-Yo Intermittent Recovery level 1 test*) e motivação para a realização, competitividade e prática deliberada de jovens jogadores de basquetebol, de acordo com seu status de participação no esporte, dois anos depois das avaliações. Dois anos depois, verificamos se os jogadores deixaram a prática (*drop-out*), ou permaneceram jogando em programas estruturados de treinamento de basquetebol. Jogadores adolescentes mais altos tiveram maior propensão de serem selecionados/promovidos em jovens jogadores de basquetebol, apesar de sua menor capacidade funcional. Motivação para realização e competitividade (vontade de se destacar e competitividade) estiveram

relacionadas à condição de (des)continuidade nessa amostra de jovens jogadores. De forma geral, há a necessidade de serem consideradas as interações entre o crescimento físico, a maturação biológica, capacidades funcionais e características comportamentais, especialmente entre jogadores na trajetória em busca da expertise. A segunda amostra considerou a variação da experiência acumulada no treino de basquetebol, o tamanho corporal, o desempenho funcional, a motivação para a prática deliberada, para a realização e competitividade e as fontes de apreciação de jovens jogadoras de basquetebol, dividindo a potencial variação entre as características biológicas individuais (status da menarca) e características contextuais (categoria etária competitiva e o nível competitivo, i. e. nível de estado, n = 30; e clube, n = 84). Consideramos 114 jogadoras adolescentes de basquetebol (10,0 a 17,9 anos). Utilizamos a regressão multinível e estimativas de pós-estratificação para examinar a variação por nível competitivo, considerando o grupo etário e o estágio da menarca. As jogadoras selecionadas para o nível de estado tiveram maior experiência acumulada, eram mais altas e com melhores desempenhos funcionais. Considerando os dados, treinadores(as) de jovens atletas do sexo feminino tenderam a valorizar (provavelmente sobrevalorizar) o tamanho e a funcionalidade ao selecionar/promover jogadoras, mesmo em idades precoces, possivelmente contribuindo para uma maior representação de garotas maturadas precocemente nos grupos etários mais baixos. Jogadoras dos níveis de clube e estado estavam altamente motivadas para a prática deliberada e para a realização. Apenas para a competitividade, jogadoras do nível de estado tiveram maiores valores tiveram maiores valores que jogadoras de nível de clube. As fontes de apreciação foram influenciadas pelo contexto (níveis competitivos) para competências auto referenciadas e competências referenciadas pelos outros. Programas de treinamento e competição estruturados em jovens jogadoras de basquetebol proporcionaram um ambiente estimulantes para o desenvolvimento do engajamento e comprometimento ao treino e alcance da excelência das jogadoras.

Keywords: esporte de jovens, seleção de atletas, análise multidimensional.

RESUMO EXPANDIDO

DETERMINANTES DE PARTICIPAÇÃO NO BASQUETEBOL DE JOVENS: ANÁLISE MULTIDIMENSIONAL

Introdução

Programas esportivos de jovens são frequentemente baseados em modelos de "academias de elite", em que aqueles que são considerados "talentosos" têm acesso a melhores oportunidades e infraestruturas para seu próprio desenvolvimento. O engajamento deliberado na prática e no treinamento têm sido reconhecidos como uma das características indispensáveis para que se atinja a expertise em diversos domínios, e pode ser determinante para diferenciar aqueles que terão maiores chances de atingir os mais altos níveis de desempenho. Dadas diversas mudanças que ocorrem nos jovens durante sua infância e adolescência, esses modelos de seleção podem estar superestimando alguns atletas por suas características pessoais. Especialmente no basquetebol, o tamanho corporal e as capacidades funcionais podem proporcionar algumas vantagens no jogo. Sendo assim, a maturação biológica é um dos fatores que causam maiores divergências no processo de seleção. Treinadores e outros agentes do sistema esportivo podem estar sobrevalorizando jogadores de maturação precoce, ao invés de considerar os diferentes ritmos de crescimento de cada atleta. Essa variabilidade pode influenciar na progressão e no engajamento de atletas na prática esportiva formal. Além disso, características psicológicas podem ser afetas por essa abordagem, e sua relação com as mudanças ao longo do crescimento também deveriam ser consideradas no esporte de jovens. Portanto, treinadores e pesquisadores deveriam considerar abordagens multidimensionais e holísticas na avaliação de jovens atletas. Uma compreensão multidimensional, e o tratamento analítico adequado, dos fatores que influenciam no desenvolvimento de jovens atletas podem favorecer melhores intervenções de treinadores e outros agentes do esporte.

Objetivos

Dada a escassez de evidências empíricas acerca de jovens jogadores de basquetebol, esse estudo teve como objetivos: (i) examinar as contribuições relativas à idade cronológica, experiência acumulada no esporte, desenvolvimento físico e biológico (tamanho corporal e estágio maturacional), capacidades funcionais (desempenho funcional específico) e domínios psicológicos e comportamentais (motivação e orientação) para a progressão ou abandono de programas de basquetebol de jovens; e, (ii) verificar quais são as determinantes para a decisão de treinadores quando selecionam atletas para competir em seleções estaduais organizadas formalmente.

Metodologia

Duas diferentes amostras compuseram esse estudo. A primeira amostra considerou 57 jovens jogadores de basquetebol (10,5 a 15,5 anos) engajados no treino e competição formal, medidos durante a temporada competitiva. Através de uma abordagem interdisciplinar, examinamos a variação do estágio maturacional, do tempo de experiência de treino, tamanho corporal, capacidades funcionais (*Line Drill test* e *Yo-Yo Intermittent Recovery level 1 test*) e motivação para a realização, competitividade e prática deliberada de jovens jogadores de basquetebol, de acordo com seu status de participação no esporte, dois anos depois das avaliações. Dois anos depois, verificamos se os jogadores deixaram a prática (drop-out), ou permaneceram jogando em programas estruturados de treinamento de basquetebol. A segunda amostra considerou a variação da experiência

acumulada no treino de basquetebol, o tamanho corporal, o desempenho funcional, a motivação para a prática deliberada, para a realização e competitividade e as fontes de apreciação de jovens jogadoras de basquetebol, dividindo a potencial variação entre as características biológicas individuais (status da menarca) e características contextuais (categoria etária competitiva e o nível competitivo, i. e. nível de estado, n = 30; e clube, n = 84). Consideramos 114 jogadoras adolescentes de basquetebol (10,0 a 17,9 anos). Utilizamos a regressão multinível e estimativas de pós-estratificação para examinar a variação por nível competitivo, considerando o grupo etário e o estágio da menarca.

Resultados e discussão

Jogadores adolescentes mais altos tiveram maior propensão de serem selecionados/promovidos em jovens jogadores de basquetebol, apesar de sua menor capacidade funcional. Motivação para realização e competitividade (vontade de se destacar e competitividade) estiveram relacionadas à condição de (des)continuidade nessa amostra de jovens jogadores. De forma geral, há a necessidade de serem consideradas as interações entre o crescimento físico, a maturação biológica, capacidades funcionais e características comportamentais, especialmente entre jogadores na trajetória em busca da expertise. As jogadoras selecionadas para o nível de estado tiveram maior experiência acumulada, eram mais altas e com melhores desempenhos funcionais. Considerando os dados, treinadores(as) de jovens atletas do sexo feminino tenderam a valorizar (provavelmente sobrevalorizar) o tamanho e a funcionalidade ao selecionar/promover jogadoras, mesmo em idades precoces, possivelmente contribuindo para uma maior representação de garotas maturadas precocemente nos grupos etários mais baixos. Jogadoras dos níveis de clube e estado estavam altamente motivadas para a prática deliberada e para a realização. Apenas para a competitividade, jogadoras do nível de estado tiveram maiores valores tiveram maiores valores que jogadoras de nível de clube. As fontes de apreciação foram influenciadas pelo contexto (níveis competitivos) para competências auto referenciadas e competências referenciadas pelos outros. Programas de treinamento e competição estruturados em jovens jogadoras de basquetebol proporcionaram um ambiente estimulantes para o desenvolvimento do engajamento e comprometimento ao treino e alcance da excelência das jogadoras.

Considerações finais

Com um caminho não claro dos programas de treinamento acerca da trajetória para o esporte profissional, o basquetebol de jovens, especialmente no feminino, pode influenciar nas tendências de motivação para a realização e competitividade com o aumento da idade e do aumento da experiência acumulada no treinamento. As informações acerca do esporte de jovens são escassas e carecem de estudos empíricos considerando aspectos multifatoriais que possuem alguma influência no desenvolvimento de jovens atletas e sua progressão. Interpretações baseadas em análises unidimensionais podem ser mal interpretadas e favorecer de forma equivocada às tomadas de decisão de treinadores e outros agentes envolvidos no contexto do basquetebol de jovens. A utilização de modelos multinível e métodos bayesianos podem ser úteis em pesquisas na área de ciências do esporte, especialmente com jovens, dada a influência de aspectos relacionados ao crescimento e maturação, principais fatores de confusão na interpretação do desempenho de jovens atletas. Em relação aos dados apresentados, nossas estimativas destacaram uma grande representação de jogadores e jogadoras maturados precocemente. Aparentemente, pela influência do crescimento pubertário e das vantagens físicas de atletas que atingem a maturação precocemente, e o fato de os clubes selecionarem

jogadores para representação em competições formais, o sistema esportivo parece dar uma ênfase maior ao desempenho atual ao invés do potencial desempenho futuro dos atletas. Ao menos nos contextos observados, estratégias pedagógicas deveriam ser adotadas com o intuito de promover a participação de atletas com maturação tardia no treinamento e competição regulares e estruturados, considerando que o desenvolvimento em longo prazo poderia reduzir diferenças aparentes em idades iniciais. O acúmulo de experiência no treino influenciou diretamente em aspectos de motivação para a prática deliberada e desempenho funcional. Portanto, influenciando diretamente na interpretação de treinadores e outros agentes do contexto esportivo, influenciando a sua decisão acerca do atleta (i.e., exclusão ou promoção de nível). O ambiente esportivo pareceu influenciar nos aspectos comportamentais do atleta, enquanto os níveis de motivação e as fontes de apreciação se demonstrar adequadas ao nível de competição das atletas. O processo de seleção deve considerar os múltiplos fatores que influenciam no desenvolvimento dos jovens, em prol de favorecer que o potencial desempenho futuro seja favorecido em relação ao desempenho atual. Mesmo com uma grande variabilidade de características pessoais, físicas e comportamentais nos diferentes níveis de competição, os atletas pareceram apreciar o ambiente e o contexto ao qual estavam inseridos. Portanto, devemos tomar cuidado ao afirmar que os contextos competitivos podem influenciar negativamente no desenvolvimento dos jovens, sobretudo nos aspectos psicológicos.

Palavras-chave: jovens atletas; desenvolvimento de atletas; crescimento e desenvolvimento; métodos bayesianos.

ABSTRACT

Youth sports programs are commonly based on “elite academies” models, where those who are considered “talented” have access to better opportunities and facilities for their own development. It has been recognized that deliberate engagement in practice is one of the indispensable characteristics to expertise achievement in many domains, and it may be determinant to differ those who will have greater chances to achieve higher levels of performance. Given the high number of changes that occur in youth during their childhood and adolescence, these selection models may be overestimating some athletes by their personal characteristics. Especially in basketball, body size and functional capacities may favor some advantages in-game. Thus, biological maturation is a major confounding in the selection process. Coaches and sports stakeholders may be overvaluing early maturing players, besides considering different timing and tempo of growth for each athlete. This variability may influence athletes’ progression and engagement in formal sports practice. Moreover, psychological characteristics may be affected by this approach, and its relation to growth changes should be considered in youth sports. Therefore, coaches and researchers should consider multidimensional and holistic approaches in youth assessments. A multidimensional comprehension and adequate analysis treatment of the factors that influence young athletes’ development could favor better interventions from coaches and stakeholders. Due the lack of empirical evidences about young basketball players, this study aimed to (i) examine relative contributions of chronological age, accumulated experience in sports, physical and biological development (body size and maturity status), functional capacities (specific functional performance) and psychological and behavior (motivation and orientation) domains to youth progression or dropping out basketball programs; and to (ii) verify what are the determinants for coaches decision when selecting players to compete in a formal organizational selected state team. Two different samples compose this study. The first sample was composed of 57 male basketball players (10,5 to 15,5 years) engaged in formal training and competition measured during the competitive season. Using an interdisciplinary approach, we examined the baseline variation in biological maturity status, training experience, body size, functional capacities (Line Drill test and Yo-Yo Intermittent Recovery Level 1 test) and motivation for achievement, competitiveness and deliberate practice of youth basketball players according to their participation status in the sport two years after assessment. Two years later we ascertained whether players discontinued participation (dropout), or remained engaged within a structured basketball training program. Taller adolescent players were more likely to be selected/promoted in youth basketball regardless of their lower functional capacity. Achievement and competitiveness motivation (will to excel and competitiveness) were related to dropping out or persisting in this sample of youth basketball players. Overall, there is a need to consider the interaction between physical growth, biological maturation, functional capacities, and behavioral characteristics, specifically among players on the path to sport expertise. The second sample considered variation in accumulated basketball training experience, body size, functional performance, deliberate practice motivation, achievement and competitiveness motivation and sources of enjoyment among young female basketball players, partitioning the potential variation by individuals´ biological characteristics (menarche status) and contextual characteristics (competitive age group and competitive level, i.e. state, n = 30; club level, n = 84). We considered 114 adolescent

female basketball players (10,0 to 17,9 years). We used multilevel regression and poststratification estimations to examine variation by competitive level, accounting for age group and menarcheal status. The adolescent female basketball players selected for the state-level had more accumulated experience, were taller and with better functional performance. Conditional on the data, youth female coaches tend to value (probably overvalue) size and function when selecting/promoting players, even at early age groups, likely contributing to an overrepresentation of early maturing girls at early age groups. Players from club and state levels were similarly highly motivated for deliberate practice and achievement. Only for competitiveness, state-level players had higher values than club level players. The sources of enjoyment were influenced by context (competitive levels) for self-referenced competencies and others referenced competencies. Structured programs of training and competition in youth female basketball provide a nurturing environment for the development of players´ engagement and commitment to training and excellence attainment.

Keywords: youth sports. athletes' selection. multidimensional analysis.

FIGURE LIST

TABLE LIST

ABBREVIATIONS

ARB Associação Regional de Basquetebol

DM developmental models

DPMQ Deliberate Practice Motivation Questionnaire

FPB Federação Paulista de Basketball

FCB Federação Catarinense de Basketball

LD Line Drill test

PHV peak height velocity

PYD positive youth development

Yo-Yo IR1 Yo-Yo Intermittent Recovery test level 1

SUMMARY

1 INTRODUCTION

1.1 YOUTH SPORTS

The development of young athletes is a highly dynamic and complex problem, which is key for clubs, federations and governmental bodies. Youth sports research and applied contexts are mainly interested in talent identification and selection oriented for the attainment of sports expertise (1, 2), often typified as “elite academies” training and development systems focused on the development of high-performance athletes (3). In this context, it is assumed that young athletes' abilities and capabilities are fixed and can be identified and predicted at an early age (4, 5). This view of youth sports is often narrow-minded and based on unidimensional approaches. Hence, this context may reflect the reduced participation of youth in sports programs.

Consequently, most of youth sports developmental models follow implicitly or explicitly the “*Standard Model of Talent Development*”, favoring that just a few and selected players achieve the highest levels of sports performance, while many others leave sports program through time – indicating a metaphor of a pyramid, where the number of players engaged in formal sports system decreases with the increased of the competitive level (6). These models are based on several assumptions, including (a) the focus is solely on progressing those who are identified as talented; (b) progression from one to the next level involves the removal of large numbers of players; (c) formal measures identified as ideal are often in place to select and/or de-select players; (d) players who leave this specific route, likely won´t get in again; (e) early specialization is seen as necessary to achieve high performance; (f) it is assumed that early ability in early-stage indicates later success. Apparent acceptance and success of this model have been hindered by the sparsity of empirical studies, although it remains the *modus operandi* of young players' development in sports (3).

The great interest of existing developmental models in optimizing sport “talents” to the achievement of higher levels of performance has been questioned (7). Instead, the exclusive pretention of selecting players, Lloyd et al. (7) highlighted that there is a small number of youths who can expect to achieve an elite professional level. In contrast, there are many young players who opt to play a sport only on a recreational level, but they do not participate in organized sports or fail to accumulate the daily physical activity recommendations by leading health authorities. Therefore, even considering the actual scenario of a youth sports organization, there

are few models that clearly define training prescription directives for youth in different maturational stages, technical competencies and levels of training background.

In general, developmental models consider athletes from early ages and adolescence to adulthood (8-12). However, most of the developmental models do not take account of the multidimensional nature in the enhancement of psychomotor, personal, social, cognitive and creative abilities (11). The limitations of these models are the unidimensional consideration of growth and maturation development processes in different aspects of human characteristics and the scarce available longitudinal data tracking during children and adolescents athletes (13-15). A holistic approach and the comprehension of the multifaceted dimensions of athletes' development could maximize the chances of players remaining sports practice during a long-time period during their lives on different levels and purposes of playing, promoting better health conditions and practices.

In order to avoid possible biases in sport organization structures due to the inter-individual differences related to maturity status and growth, the bio-banding is an experimental approach that matches players based on their actual maturity status in comparison with their adult predicted height (16, 17). The limitation of these purposes is the background based on unidimensional approaches and assessment, and the scarce empirical evidence (7).

It has been argued that early engagement in formal structured training programs and specialization are determinant to achieve expertise and highest levels of performance and competition in some sports (18-21). Often, young athletes' developmental models assume the need for engagement in deliberate practice since early ages, entailing specialization in only one or few sports, with structured training and competition structures.

Deliberate practice is characterized by the accomplishment of several oriented tasks that demand cognitive and physical effort, fostering positive skill development and improving performance by reducing weaknesses in sport-specific influences of performance (7, 22-24). Studies have pointed out that deliberate practice's efforts require a high level of motivation and enjoyment of players, due to its massive routine and repetition basis (18, 19, 23, 25).

Because of the actual organization in youth sports, early specialization has had some attention in the debate. Besides the importance of the accumulated practice in specific sport practice for achievement of expertise in many dimensions, researchers have warned about some possible negative effects of early specialized training to young athletes; such as social limitations, dietary restriction, injury risks, potential dropping out and burnout due its demands

in long-term training programs, as result of high levels of stress (3, 26-36). Despite the importance of the comprehension of early specialization in youth sports, available data linking this topic and athletes' career outcomes are still scarce (30, 37). Retrospective studies highlighted that most athletes who achieved higher levels of performance in Canada attended more than one sports program during their childhood and adolescence. Mostly based on these analyses it has been proposed the framework of the *Developmental Model of Sports Participation* (8, 23, 38, 39). The limitation of this model, such as others, is the lack of empirical data with young athletes along with their entire career progression or dropping out an organized sports system (7), considering the multivariate determinants in each stage.

It has been noted recently that talent identification and selection among youth is likely misinterpreted when considering unidimensional approaches in performance (3). This is based on the assumption that talent is a genetically characteristic (*i.e.* a gift), hence sports systems are confounding potential future high-level athletes with variation between athletes during their individual timing and tempo of pubertal growth, maturation, and development (40). This likely reflects coaches' and stakeholders' beliefs and decision making in players' selection as such as governmental policies and economical efforts involved, producing a bias in published evidence-based information. Consequently, *talent identification* could be overvaluing current *performance identification* instead of looking for potential future high-level athletes (3).

Youth sports organizations are usually based on classification by chronological age, with reference date as a cutoff. The day players were born determines their age group, then the category they will keep engaged and compete. This classification, such as in other social systems focused on youth development (*e.g.* school, university, and music programs) (41), has been biased when it does not consider variability between-individuals, promoting the *relative age effect* (42). This phenomenon has been considered a consequence of the selection system, which favors those who are labeled as "talented" by their advantages in physical conditions (body dimensions), skills and competences (technical and cognitive domains) and accumulated sport-specific experience. It means that these players who apparently show better performance, most of times, older than their teammates and opponents, may be promoted and have access to better coaches and facilities, increasing the differences from others (43-48). Besides selection, healthy and safe conditions of practice and competition should be taken by coaches and stakeholders considering all these differences in players' categorization (49). Therefore, care should be taken when comparing youth performance (50, 51).

Notwithstanding, youth sports programs can provide a powerful context to promote positive environments due to youth interest and engagement in these programs. Therefore, considering individuals' capacity for adaptation and learning, there have been calls to promote the potential of positive youth development (PYD) (39, 52-57). PYD refers to the creation and expansion of personal assets comprising relationships and opportunities to develop competencies, abilities, and skills in cognitive, social, emotional and intellectual dimensions (55, 58-60). Assets need to be considered as the outcome of youth interactions with themselves and within their context (i.e. sports environment, coach, practitioners and managers) combining learning positive values, commitment, social competencies, positive identity, support, boundaries, expectations, empowerment and the constructive use of time, not considering only sport dimensions but various positive aspects for throughout life.

Youth sports programs and coaches during their intervention should take into account the differences between athletes' own characteristics and developmental stages in order to promote an adequate environment for participants to learn and develop themselves in physical, technical, intellectual, social, psychological and emotional aspects, respecting the time and limits athletes demand in each stage of their development.

1.2 INTERDISCIPLINARY/HOLISTIC APPROACH

Caution is warranted when predicting the potential high-performance in adult age, and to consider an interdisciplinary approach may be helpful in this challenge. Often coaches and practitioners are interpreting potential since early ages based on snapshots of current players´ performance. In fact, the time of engagement in deliberate practice has been considered as one of the predictors of expertise achievement in many fields, not exclusively in sports (19, 24, 61, 62). However, especially during pubertal growth, coaches and researches should consider the possible interactions between athletes' chronological age, biological maturation status and accumulated experience on body dimensions, functional performance, physical and physiological capacities and behaviors (29, 63). These interpretations demand adequate analytical approaches (40, 64-70).

Chronological age is often used in studies as a reference to growth and performance during adolescence. However, limited utility in the assessment of growth and maturation using this parameter is recognized, due to the large variability in somatic and biological maturation and performance among adolescents of the same chronological age, especially during pubertal

years (63, 71-74). Growth is understood as measurable changes in body size dimensions, while maturation refers to the timing and tempo these changes occur. Given the individuality in maturation timing and tempo of development, care should be taken when assessing young athletes. The order of apparent characteristics is not the same for any adolescent, then considering maturity status is a complex task in studies. Due to its difficult to measure, studies have purposed non-invasive methods of assessment that consider secondary characteristics of pubertal growth and development to measure skeletal, sexual and somatic maturation components. Skeletal development in hand and wrist by radiography; breast development and menarche in girls, penis and testes development in boys, and pubic hair in both sexes, comparing with population references; hormones, age at peak height velocity (PHV) through longitudinal follow-up, and; percentage of predicted adult stature estimated by equations that consider anthropometry measures are commonly used (63, 73, 75-77).

Especially in sports, these differences may influence athletes' development and opportunities of practice that may influence in his/her development and chances of achievement of higher levels of performance (1, 6). Basketball demands are multifaceted which involves short, intense and repeated episodes of activity requiring rapid changes of direction (78, 79). Particularly in basketball, biological maturation influences in body dimensions and sport-specific functional capacities. There is a need to account for the influence of maturation on athletic performance during the pubertal growth period (16, 65, 72, 80). Performance measurement and assessment of athletes' characteristics tend to influence athletes´ career progression, due growth-related changes may be overestimated in the selection process (81). Early maturing players may be overvalued by their advantages in-game situations (e.g. rebounding, fighting for space and shooting by longer distances) while late maturers may be excluded from sports programs progression by their biological characteristics (3, 4, 63, 69), even evidences show that after the PHV, discrepancies between athletes tend to be lower (65, 74).

Besides the importance of functional capacities and favorable performance for in-game situations, technical domain, physical capacities, social relations, and environmental factors are involved in the selection process, consequently to athlete development and progression (2, 45, 67, 80). The lack of consideration of the holistic and multifactorial nature process of athlete development has been reported as a key reason for inaccuracy and limited success in predicting future high-level athletes (1, 13, 15, 40, 64, 70, 82).

1.3 BEHAVIORAL CHARACTERISTICS

Given the importance of accumulated experience and time dispended in deliberate practice (*i.e.* tasks which the main goal is explicit to improve performance) to achieve expertise in many domains (24, 83), behavioral and environmental aspects seem to be determinant in athletes' development through childhood and adolescence until adulthood performance (18, 19, 84). The role of deliberate practice in skill acquisition and performance is consolidated as a basic requisite for high-performance individuals, and the need to consider the accumulated experience with other integrated variables is evident (61). Dispending time and effort to deliberate practice and focusing on challenge tasks requires the full engagement of athletes, focusing on weakness improvement and produce successful outcomes (21). Therefore, personal characteristics, such as mastery achievement orientation (85), competitiveness (18, 86), self-control (87), commitment (88), individual and collective perception of efficacy (89-92) and motivation (30, 40) have been described as deterrent for enjoyment and will to be engaged in sports (21).

Behavioral or psychosocial characteristics are directly related to personal behaviors and assets of development (82, 92-98). Especially in sports, it is recognized that psychological and emotional aspects influence athletic performance (89-92, 99). Team sports require interaction between-athletes and other people involved in different roles of an organization that is relevant to develop and achieve optimal performance. Individuals' abilities, competences, skills and performance aligned between athletes and their peers with the team's common goals may favor this achievement (100). It is reasonable that a positive environment that favors the contribution of athletes on community and social contexts they are engaged (*i.e.* school, family, religion and others), may promote great personal assets of development (55, 60).

Growth-related changes from adolescence to adulthood marks a period of profound influence in terms of emotions, social life, psychology, and motivations. Different timing and tempo in biological maturation can impact athletes' development in sport, as much as into their personal life (21, 101-103). In the same way, sociocultural and contextual environment differences and their own characteristics must be considered when assessing youth athletes' development. The integration of genetic factors and environment athletes are engaged must be understood (32, 70, 82, 104-106).

Understanding young players selection in sports, contexts of practice and intervention, and athletes' progression during their development is important to (a) give coaches information that bases their selection decisions; (b) promote better quality of the athletes development environment in a long-term process, considering the influence of experience and time spent in deliberate practice; (c) integrate all sport stakeholders and researchers in order to develop an efficient and effectual athlete development system with shared goal and clear objectives; (d) scientists getting closer to high-performance sports field, since the ultimate assessment of the investment of resources comes from people who make decisions about athletes' progression, and not outside (3).

If the practice is oriented to improve performance, it is reasonable that victory in competition moments are considered important moments of the process. Even though, there are limited studies considering interactions of behavior characteristics with physical growth, function and experience in sports (67). Given the number of issues and influences of social relationships and engagement in oriented sports programs, understanding how these interactions occur and the influence in athletes' development in different dimensions is required to a better approach through interventions with athletes, families and stakeholders (26, 28, 102, 107).

1.4 PURPOSE

There is a lack of information about youth athletes' pathways, development and progression in sports considering the multivariate complexity of youth in sports. As the importance and social impact sports have, empirical results could help coaches, practitioners, administrators and public policies to collaborate with the more effective and positive promotion of sports. Therefore, this study purposes to use a multidimensional and interdisciplinary approach in youth basketball athletes' assessment, interpretation and discussion.

The main objective is to discuss how growth-related changes may influence athletes' development and how it may be misconstrued if coaches, practitioners, administrators and researchers do not consider behavioral aspects, personal, physical and physiological characteristics and accumulated experience in sports as integrated variables in youth pathways. We also aim to discuss and interpret athletes' selection and promotion process as a consequence of shallow interpretations into the sports system. We divided this purpose into two different moments to attend these perspectives.

The first study we considered a cross-sectional design, where athletes were assessed in body size, chronological age, maturity status, accumulated years of practice, functional performance and motivation dimensions. Two years after baseline, players were asked if they were engaged in structured and formal basketball training programs at the same level or above, or who had left basketball engagement. Its aim was to highlight what were the determinants of players who drop-out structured basketball training engagement after considering the variances between athletes' individual characteristics.

In the second study, in a cross-sectional design, our aim was to analyze what characteristics were determinant for young basketball players being selected to compete at a higher level they usually do. We considered young female basketball players from under-13, under-15 and under-17 age categories who competed in the state-level championship. From our sample, we grouped those players who were selected to the state team and those who were not selected during the respective year. We considered functional performance, behavioral characteristics, body size, maturity status and accumulated experience in structured basketball training and competition. The main goal was to highlight what determinants influence athletes' opportunities of competing at a higher level with selected coaches and facilities by the direct influence of state-level coaches.

We hope to contribute with actual literature with new empirical arguments to discuss young athletes' selection and development, and to highlight the need of considering different aspects while studying and intervening with youth in sports, particularly in basketball.

2 METHODOLOGICAL CONSIDERATIONS

This study is considering two independent samples of youth basketball players, assuming a multidimensional perspective, i.e. considering personal, biological, psychological, physical and physiological characteristics. Both samples were adopted given the constraints of the applied context to proceed with follow-up studies.

2.1 STUDY AND DESIGN SETTING

To address the trends of engagement or dropping-out sports system we considered a sample of 57 male basketball players aged 10,5 to 15,5 years, measured in 2015. We followed-up the playing status (i.e., remaining engaged in formal basketball or drop-out of sport). The players were engaged in a formal structured training program within a local club in Campinas and competed at the state level, supervised by *Federação Paulista de Basketball* (FPB). After two years, players were contacted again to follow up on their status in the sport, i.e. whether they remained engaged in basketball structured training and competition or abandoned basketball.

Assuming a cross-sectional sample of female basketball players aged 10,0 to 17,8 years engaged in structured training programs and competition, we will examine the determinants of selection between players who were selected by coaches to represent the state team and those who were not selected in under-13, under-15 and under-17 categories, supervised and organized by *Federação Catarinense de Basketball* (FCB). In a cross-sectional design, we will compare these athletes by a multidimensional perspective and try to discuss possible determinants for coaches' decisions when calling up youth basketball players.

2.2 DATA QUALITY

Anthropometry measures were performed by a single observer. Body mass was measured with a calibrated portable balance (Seca model 770, Hanover, MD, USA) to the nearest 0,1 kg. Stature was measured with a portable stadiometer (Seca model 206, Hanover, MD, USA) to the nearest 0,1 cm. Based on repeated-measures, stature reliability was verified and established with a perfect correlation between measures and a typical error of measurement 0,18 cm (95% confidence interval 0,12 to 0,40). Maturity status was inferred by the *maturity offset* protocol equation. Performance compared to those who were not retained in the youth basketball program. We recognize the limitations of the maturity offset equation to estimate

individual maturity status (40, 108). Cautious is needed when interpreting maturity status classification, but the between-player variability may be useful to compare each other.

Assessment of performance in the Line Drill test, i.e., time to cover a 140m shuttle run performance, was performed using video recording in part of the sample. The reliability of video recording for time measurement o was completed by comparison with photoelectric cells (65). Twenty-five measurements of time were made simultaneously from the baseline reference, using a gate of photoelectric cells (Speed Test 6.0 Standard, Cefise, Nova Odessa – SP, Brazil) and the video recorder. Agreement between methods showed no systematic or proportional bias (calibration equation: $Y = 0{,}034 + 0{,}997 \cdot X$), with a technical error of measurement 0,12 s (95% confidence interval 0,10 to 0,17) and a perfect correlation between methods. Thus, video analysis for time recording in the Line Drill test was assumed to be reliable and accurate.

The of the protocol Yo-Yo IR1 is based on repeated 2 x 20 m runs back and forth between the starting, changing of direction and finishing line at a progressively increased speed controlled by audio bleeps from a tape recorder (109). Participants have a ten-seconds of active rest between each turn, jogging in a distance of 2 × 5 m. Participants run until they are no longer able to maintain the required intensity; the test is considered complete when athletes fail twice to reach the last line in time. Covered distance is measured in meters. Replicate measured were performed on a subsample of eleven players twice within one week. As reported before (74), the coefficient of variation was 6.0% (95% CI 4.5–9.5%), which is within the range of reproducibility reported for the Yo-Yo IR1 (109).

The countermovement jump test was tested on a jump mat (Multisprint System, Hidrofit, Brazil), as reported elsewhere (74). Players started the test from an upright standing position. Then, they were instructed to begin the maximal vertical jump with a downward movement, immediately followed by a concentric upward movement. During the full test, hands were held on the hips. Each player performed three trials, and the best mark was retained for analysis. The coefficient of variation, based on replicate measures separated by 1 week in 18 players, was 6,9% (95% CI 5,1–10,5).

3 DETERMINANTS OF DROP-OUT IN YOUTH BASKETBALL: AN INTERDISCIPLINARY APPROACH[1]

3.1 INTRODUCTION

Talent identification, selection, and development are a major focus of youth sports programs. Within applied contexts, such as sports federations or professional clubs, there has been a generalization of providing youth sports programs using an "elite academies" model, focused on the development of high- athletes, where children and adolescents can develop in a highly targeted, athlete-centered environment built around early specialization (5). These youth sports programs generally assume that talent is a fixed capacity which consequently, can be identified and predicted early (4, 5). However, the paths to adult expertise in sports are both highly selective and nonlinear (1). Accordingly, the mechanisms that may predict future success or dropping out from organized sports are multifactorial and highly complex (13), especially in sports like basketball, where structured training systems start at early age (21).

Basketball performance is influenced by physical, physiological, and behavioral characteristics (40, 110, 111), perhaps even more so with young players (40). Body size and physiological performance are particularly valued in the selection process for youth basketball (112). Indeed, coaches may well be overvaluing these factors as available data in youth basketball, albeit scarce, shows an overrepresentation of early maturing boys (40, 113-115). Furthermore, studies tend to focus on selected characteristics of young players, considering unidisciplinary perspectives from either biological, psychological or behavioral variables (40). These studies also appear to favor those who remain in the sport, often labeled "elite youth players", rather than considering a more balanced and comprehensive data set from successes and failures across several interacting variables.

When considering young athletes, particularly during pubertal growth, coaches and researchers need to consider the possible interacting influence of chronological age, biological maturation and accumulated experience in the sport on body dimensions, functions, and behaviors (40). Maturation is a major confounding variable to interpret young players´ performance, given the numerous hormonal changes during puberty resulting in important physical, physiological and behavioral changes (116). Therefore, early prediction of adult

[1] SOARES, A.L.A.; KÓS, L.D.; PAES, R.R.; NASCIMENTO, J.V.; COLLINS, D.; GONÇALVES, C.E. and CARVALHO, H.M. Determinants of drop-out in youth basketball: an interdisciplinary approach. **Research in Sports Medicine**, 2019. doi: 10.1080/15438627.2019.1586708

performance from adolescent data is difficult and likely to be unreliable, although it remains the typical modus operandi in high-performance sport (5).

Behavioral dimensions have been sparsely considered in studies of young athletes (40, 67), where the focus is mostly based on biological and performance characteristics (117). Particularly in youth sports programs focused on the development of high-performance athletes, it is generally assumed that expertise development is positively associated with an accumulated amount of training hours and that the age of specialization is a particularly decisive moment to lift an athlete's skill level, readiness, and commitment (19, 21). Although psychological characteristics play a central role in the development of sport expertise (5), there are limited studies considering interactions of behavior characteristic with physical growth, function, and experience in youth sports (13, 67).

Reflecting on these various issues, we examined the baseline variation in biological maturity status, training experience, body size, functional capacities and motivation for achievement, competitiveness and deliberate practice of youth basketball players according to their participation status in the sport two years later. Specifically, we were interested in baseline differences between those who discontinued or continued to participate in the sport.

3.2 METHODS

Experimental approach to the problem

The present study considers 57 male basketball players aged 10,5 to 15,5 years, measured in 2015. When measured, players were engaged in formal training and competition within a local club in Campinas metropolitan region and competed at the state level supervised by *Federação Paulista de Basketball (FPB)*. Players were part of the under-11 and under-12 teams that trained six hours per week, and the under-13 to under-15 teams that trained 8 hours per week. No participant was suffering from lower extremity musculoskeletal injury at the time of testing or during 6 months before testing.

All players were contacted again in 2017 to follow up on their current status in the sport, i.e. whether they remained engaged in basketball structured training and competition or abandoned basketball. Hence, two groups of playing status were defined: *drop-outs*, players who discontinued (abandoned) basketball; and *persisters*, players who remained engaged in basketball structured training and competition, at least at same the level of the baseline measurement.

The study was approved by the *Research Ethics Committee of the University of Campinas*. Participation in this study was voluntary; players and their parents or legal guardians provided informed written consent.

Procedures

Details about procedures and reliability estimates are presented elsewhere (40), as the present study re-examines the data at baseline, considering the players within status at follow-up two years later.

Briefly, we considered anthropometry measures, taken by a single and experienced observer following standardized procedures, including stature, sitting height, body mass, and the triceps, subscapular, suprailiac and medial calf skinfolds, which were summed as a measure of relative body fat distribution. Intra-observer technical errors of measurement were 0,25 cm for stature, 0,38 cm for sitting height, 0,42 kg for body mass, and 0,68–0,91 mm for skinfolds.

Chronological age was calculated to the nearest 0,1 year by subtracting birth date from the date of testing. We used the maturity offset protocol (77) to derive age at peak height velocity (PHV). Prediction of time before or after PHV considers chronological age, stature, body mass, sitting height and estimated leg length (stature minus sitting stature). The assumptions and limitations of the offset equation applied to the sample of the present research project were recognized elsewhere (40).

We used two protocols of functional capacity for basketball: a short-term maximal effort protocol, the Line Drill test (118) and an intermittent endurance test, the Yo-Yo Intermittent Recovery Level 1 test (Yo-Yo IR1) (109). Each functional performance variable was standardized to a z-score; z-scores were reversed for the Line drill performance; as lower times indicate better performance. The respective z-scores were summed to provide composite functional performance indicators for each player.

To evaluate psychobehavioural factors, we used the Work and Family Orientation Questionnaire (86) and the Deliberate Practice Motivation Questionnaire (19). The former has 19 items, rated on a 5-point Likert scale (1 = completely disagree to 5 = completely agree), and assesses four dimensions of achievement: personal unconcern, work, mastery and competitiveness. We only used the last three subscales in the present study, consistent with previous observations with similar samples of youth basketball (21, 40). The Deliberate Practice Motivation Questionnaire (DPMQ), originally designed for chess (19), was adapted for

basketball, translated and validated to Portuguese (21). Two dimensions of deliberate practice are considered: will to compete and will to excel. The questionnaire is composed of 18 items, similarly rated on a 5-point Likert scale. The adapted Portuguese version showed good reliability in previous data in youth basketball from the same age range of the present study (21).

Finally, years of experience in formal basketball training and age when players first took part in organized basketball practice were obtained by interviews of the players and confirmed with their coaches and parents.

Statistical analysis

Modeling approach. We used a multilevel linear regression model, in this case, a null model, which is the simplest two-level model that includes only the random parameters, to measure the proportion of total variance which fell between players grouped by playing status two years after initial observation players (i.e., intraclass coefficient). As expected based on previous observations in youth male basketball (40, 114, 115, 119), we observed substantial nesting on the dependent variables by age groups (Table 5). Thus, we assumed players (level-1) nested by age group category (level-2) in the following steps of the analysis.

A series of multilevel linear regression models were fitted to explore whether body dimensions, functional capacities, achievement motivation dimensions and motivation for deliberate practice varied for players grouped by playing status two years after initial observation (dummy variable: drop-outs coded as 0; persisters coded as 1). We accounted for age by alignment with estimated age at PHV (maturity offset) and aggregation between age group at level-2.

We used allometric scaling to partition the influence of body size on the interpretation of functional capacities. Through analysis of the validity of allometric models, based on residual analysis, we only considered Yo-Yo IR1 performance scaled for body mass. Finally, for computational convenience and for interpretation when variables have different scales (120), we used z-score transformations on both dependent and independent variables.

Priors. Variables standardization allowed us to use weakly informative prior distributions for population-level, normal priors (0,10), and for group-level effects, Cauchy priors (0,2). As such, we intend that results reflected the knowledge available from the original data.

Model-checking and inference. We used posterior predictive checks to confirm that we did not omit relevant interactions (121). We used the widely applicable information criteria to compare models and to ensure we did not overfit our data (120, 121).

Computation. For each model, we ran a chain for 2,000 iterations with a warm-up length of 1,000 iterations. The models were implemented with Bayesian methods via Markov Chain Monte Carlo (MCMC) simulation and using Hamiltonian Monte Carlo and its extension, the No-U-Turn Sampler, using Stan (122) and obtained using "brms" package (123), available as a package in the R statistical language.

3.3 RESULTS

Baseline characteristics of drop-outs and persisters and the comparison between groups are summarized in Table 1. Positive intraclass coefficients indicate the need to consider aggregation at level-2, hence estimates based on single-level regressions become inaccurate (121). There was substantial aggregation by playing status two years after the initial observation. This related to chronological age, maturity status, age at the start of basketball training, years of training experience, functional performance score and motivation for achievement, competitiveness and deliberate practice.

Players considered in the present study ranged from under-11 to under-15 yearly competitive age groups. The substantial age-related variation between age groups was present (Table 5). Thus, we accounted for variation between players grouped at level-2 within the Bayesian multilevel models to compare baseline characteristics of drop-outs and persisters. Comparisons of body dimension between drop-outs and persisters are summarized in Table 2, partitioning the influence of both maturity status and years of training in basketball, and aggregation at level-2 for an age group. Players who persisted playing basketball were taller, heavier and somewhat larger. As expected, the substantial influence of somatic maturity status was present, regardless of playing status two years later.

Functional performance characteristics of young players who dropped-out or persisted in basketball two years after the measurements are summarized in Table 3. These data partition the influence of both maturity status and years of training in basketball, and aggregation at level-2 for age group partitioning. There was no variation between persisters and drop-outs for Line Drill performance. Also, accounting for differences by playing status two years later and age group variation as a level-2 unit, no influence of maturity status or training experience was

apparent. Notably, however, drop-outs had better Yo-Yo IR1 performance, even when the influence of body mass was partitioned using allometric scaling. This scaling removed the influence of maturity status on intermittent endurance performance, independent of playing status two years later and age group variation, as a level-2 unit. Also, a positive influence of experience on intermittent endurance was observed, independent of playing status two years later. When we considered the score of functional capacities, which ranks players with better performance in both tests, persisters were better on overall performance compared to dropouts. Also, more advanced maturity status and years of experience were positively related to the score of functional capacities, when accounting for playing status two years later and age group variation, as a level-2 unit.

Achievement motivation and motivation for deliberate practice characteristics of young players who dropped-out or persisted in basketball two years after the measurements are summarized in Table 4. These data partition the influence of both maturity status and years of training in basketball, and aggregation at level-2 for age group partitioning. Overall, both groups of players showed high scores for the dimensions of the Work and Family Orientation Questionnaire. All players had high scores for work, independent of playing status two years later, maturity status, experience or aggregation at level-2 for the age group. As for mastery, there was a positive influence on the scores of maturity status and years of experience in basketball, regardless of playing status two years later, accounting for aggregation for age group at level-2. Perhaps unsurprisingly, persisters had higher scores of competitiveness compared to dropouts, independent of maturity status and years of experience in basketball. The Deliberate Practice Motivation Questionnaire scores were high in the present basketball sample. For will to excel, persisters had higher scores than drop-outs, independent of maturity status. Also, years of experience in basketball had a positive influence, accounting for variation in playing status two years later. The scores of will to compete were high for all players when accounting for variation in all variables and levels in the model.

Table 1. Descriptive statistics (posterior mean and 90% credible intervals) for players within status at follow-up two years later and corresponding intraclass coefficients.

	All sample (n=57)	Drop-outs (n=22)	Persisters (n=35)	Intraclass coefficient
Chronological age (yrs)	13,2 (12,8 to 13,6)	13,4 (12,7 to 14,0)	13,1 (12,6 to 16,6)	0,12 (0,00 to 0,50)
Maturity offset (yrs)	-0,34 (-0,78 to 0,08)	-0,34 (-1,04 to 0,36)	-0,35 (-0,91 to 0,21)	0,09 (0,00 to 0,45)
Age at the start of basketball training (yrs)	10,1 (9,5 to 10,6)	10,9 (10,1 to 11,7)	9,6 (8,9 to 10,2)	0,23 (0,01 to 0,57)
Years of experience (yrs)	3,1 (2,5 to 3,7)	2,5 (1,6 to 3,6)	3,5 (2,8 to 4,2)	0,13 (0,00 to 0,44)
Stature (cm)	167,9 (164,0 to 171,8)	166,3 (160,0 to 172,7)	168,9 (163,8 to 173,9)	0,00 (0,00 to 0,02)
Body mass (kg)	60,2 (55,8 to 64,8)	56,8 (49,6 to 64,0)	62,4 (56,7 to 68,2)	0,00 (0,00 to 0,02)
Sitting height (cm)	83,5 (81,6 to 85,5)	83,1 (80,0 to 86,3)	83,8 (81,3 to 86,3)	0,01 (0,00 to 0,7)
Sum of skinfolds (mm)	59,0 (53,6 to 64,4)	52,5 (44,0 to 60,9)	63,2 (56,4 to 70,0)	0,00 (0,00 to 0,02)
Line Drill test (s)	34,79 (34,07 to 35,52)	34,84 (33,67 to 36,03)	34,76 (33,82 to 35,70)	0,05 (0,00 to 0,28)
Yo-Yo IR1 (m)	578,2 (515,4 to 641,1)	628,2 (527,5 to 728,9)	546,9 (467,0 to 626,7)	0,00 (0,00 to 0,00)
Scaled Yo-Yo IR1 ($m.kg^{0,61}$)	48,5 (44,0 to 53,0)	54,7 (47,7 to 61,8)	44,6 (38,9 to 50,2)	0,00 (0,00 to 0,03)
Performance composite score (z-score)	0,00 (-0,45 to 0,45)	0,19 (-0,55 to 0,93)	-0,12 (-0,71 to 0,46)	0,24 (0,00 to 0,69)
Achievement motivation				
Work (1-5)	4,47 (4,32 to 4,60)	4,42 (4,21 to 4,64)	4,49 (4,31 to 4,66)	0,86 (0,00 to 0,87)
Mastery (1-5)	4,17 (3,99 to 4,35)	4,08 (3,79 to 4,37)	4,23 (4,00 to 4,46)	0,31 (0,00 to 0,81)
Competitiveness (1-5)	3,64 (3,44 to 3,83)	3,37 (3,07 to 3,67)	3,80 (3,57 to 4,04)	0,45 (0,01 to 0,85)
Deliberate practice motivation				
Will to excel (1-5)	4,21 (4,00 to 4,42)	3,85 (3,53 to 4,17)	4,43 (4,18 to 4,69)	0,48 (0,03 to 0,83)
Will to compete (1-5)	4,34 (4,19 to 4,49)	4,31 (4,06 to 4,55)	4,36 (4,16 to 4,56)	0,32 (0,00 to 0,84)

Table 2. Comparison between persisters and dropouts for body size, accounting for between player associated variation in training experience and maturity status, and aggregation by age group at level-2 using Bayesian multilevel models.

	Stature	Body mass	Sitting height	Sum of skinfolds
Population-level effects (90% credible interval)				
Intercept	-0,12 (-0,45 to 0,18)	-0,18 (-0,56 to 0,26)	-0,06 (-0,61 to 0,53)	-0,41 (-1,45 to 0,60)
Persisters/drop-out category*	0,16 (-0,02 to 0,35)	0,30 (0,09 to 0,51)	0,04 (-0,04 to 0,12)	0,51 (0,09 to 0,92)
Maturity offset	1,09 (0,90 to 1,29)	1,14 (0,85 to 1,45)	1,42 (1,32 to 1,53)	0,58 (-0,12 to 1,25)
Years of experience	-0,10 (-0,19 to -0,01)	0,02 (-0,10 to 0,14)	-0,04 (-0,08 to 0,01)	-0,00 (-0,24 to 0,23)
Group level estimates (90% credible interval)				
Level 2, between age group effects				
Intercept standard deviation	0,35 (0,08 to 0,78)	0,50 (0,06 to 1,18)	0,75 (0,35 to 0,41)	1,17 (0,18 to 2,46)
Level-1 standard deviation	0,36 (0,30 to 0,40)	0,44 (0,37 to 0,53)	0,17 (0,14 to 0,20)	0,90 (0,76 to 1,08)

* Persisters/drop-out category: dummy category with dropout coded 0, persisters coded 1; hence intercept is the estimate for the drop-outs and Persisters/drop-out category estimate represents the difference magnitude for the persisters players.

Table 3. Comparison between persisters and dropouts for functional capacities, accounting for between player variation in training experience and maturity status, and aggregation by age group at level-2 using Bayesian multilevel models.

	Line Drill test	Yo-Yo IR1	Scaled Yo-Yo IR1	Performance composite score
Population-level effects (90% credible interval)				
Intercept	-0,02 (-0,57 to 0,50)	0,31 (-0,08 to 0,76)	0,44 (-0,02 to 0,92)	0,22 (-0,20 to 0,63)
Persisters/drop-out category*	0,01 (-0,44 to 0,44)	-0,49 (-0,87 to -0,14)	-0,72 (-1,17 to -0,30)	-0,31 (-0,70 to 0,09)
Maturity offset	-0,30 (-0,61 to 0,10)	0,49 (0,18 to 0,78)	0,12 (-0,31 to 0,44)	0,48 (0,12 to 0,77)
Years of experience	-0,08 (-0,31 to 0,17)	0,21 (0,01 to 0,39)	0,22 (-0,01 to 0,45)	0,18 (-0,05 to 0,40)
Group level estimates (90% credible interval)				
Level 2, between age group effects				
Intercept standard deviation	0,52 (0,08 to 1,27)	0,36 (0,04 to 0,89)	0,239(0,03 to 1,07)	0,34 (0,04 to 0,92)
Level-1 standard deviation	0,89 (0,75 to 1,06)	0,73 (0,63 to 0,86)	0,92 (0,77 to 1,09)	0,77 (0,65 to 0,91)

*Persisters/drop-out category: dummy category with dropout coded 0, persisters coded 1; hence intercept is the estimate for the drop-outs and Persisters/drop-out category estimate represents the difference magnitude for the persisters players.

Table 4. Comparison between persisters and dropouts for achievement motivation and deliberate practice motivation, accounting for between player variation in training experience and maturity status, and aggregation by age group at level-2 using Bayesian multilevel methods.

	Achievement motivation			*Deliberate practice motivation*	
	Work	Mastery	Competitiveness	Will to Excel	Will to compete
Population-level effects (90% credible interval)					
Intercept	-0,07 (-0,52 to 0,40)	-0,02 (-0,39 to 0,38)	-0,32 (-0,74 to 0,11)	-0,37 (-0,95 to 0,19)	-0,05 (-0,58 to 0,45)
Persisters/drop-out category*	0,13 (-0,36 to 0,64)	0,07 (-0,37 to 0,51)	0,53 (0,06 to 0,98)	0,59 (0,12 to 1,06)	0,08 (-0,42 to 0,59)
Maturity offset	0,12 (-0,21 to 0,47)	0,23 (-0,04 to 0,51)	-0,04 (-0,38 to 0,26)	-0,12 (-0,54 to 0,22)	0,16 (-0,19 to 0,52)
Years of experience	0,01 (-0,27 to 0,28)	0,36 (0,11 to 0,58)	0,13 (-0,14 to 0,39)	0,25 (0,02 to 0,51)	0,09 (-0,19 to 0,38)
Group level estimates (90% credible interval)					
Level 2, between age group effects					
Intercept standard deviation	0,29 (0,02 to 0,40)	0,23 (0,01 to 0,69)	0,24 (0,01 to 0,72)	0,48 (0,06 to 1,23)	0,42 (0,05 to 1,09)
Level-1 standard deviation	1,05 (0,89 to 1,23)	0,91 (0,77 to 1,06)	1,01 (0,86 to 1,20)	0,91 (0,78 to 1,08)	1,01 (0,84 to 1,20)

* Persisters/drop-out category: dummy category with dropout coded 0, persisters coded 1; hence intercept is the estimate for the drop-outs and Persisters/drop-out category estimate represents the difference magnitude for the persisters players.

3.4 DISCUSSION

In this study, we used an interdisciplinary approach to examine the baseline variation in biological maturity status, training experience, body size, functional capacities and motivation for achievement, competitiveness and deliberate practice of youth basketball players according to their participation status in the sport two years later (i.e. discontinued their participation in the sport, drop-out; or continued to participate in the sport, persisters). Drop-outs were slightly older but had less accumulated training experience than those who remained in the training programs two years after the initial observation. Considering variation between players for chronological age, maturity status and training experience, those retained in the youth basketball training programs had higher body dimensions and worse functional capacity but notably, had higher values for competitiveness (achievement motivation), will to excel and will to compete (deliberate practice motivation) compared to those who dropped out. Overall, coaches appear to have selected those who were taller, heavier and motivated to compete and excel, even if they had worse functional performance compared to those who were not retained in the youth basketball program.

We acknowledge the limitations of the maturity offset equation to estimate individual maturity status (40, 108). However, the range of predicted ages at PHV and uncertainty estimates by age group (see Table 5) were within the ranges for age at PHV derived from longitudinal studies which modeled individual stature data for young athletes (75, 124), as well as the longitudinal studies where the maturity offset protocol was used (77). Cautiously, we may infer that the players in the present sample, on average, were “on time” in maturation, but substantial between-player variability was present (Table 1). Hence, the need to appropriately account for variation on predicted age at PHV when interpreting body size, functional capacities and motivation for achievement, competitiveness and deliberate practice. Considering the athletes by playing status two years after observation, persisters were slightly advanced in maturity status.

Concerns about the risks and potential impacts of early specialization in youth sports have been raised (27, 125). However, the current practices in youth sports programs often referred to as “elite academies” are generally focused on early specialization (5, 27). As stated earlier, this approach is based on several assumptions, such as talent is a fixed capacity that can be identified early, or beliefs about talent (e.g., talent as a gift) (5). On the other hand, the perspective is also supportedby the argument that expertise attainment needs a deliberate

engagement (126) in practice during the specialization years, spending time wisely and always focusing on tasks that challenge the current performance (21). In the present study, persisters started their formal training in basketball earlier. Consequently, they had more accumulated experience than their dropout peers two years after observation. Similar observations were reported in youth soccer (67). Therefore, although the body of evidence is sparse, it appears to confirm that young athletes starting early in organized training may have advantages in the selection process in youth team sports.

When comparing body dimensions of players by playing status two years after observation, there were no apparent differences for body dimensions (see Table 1). However, as reported earlier (40), there was substantial variation in body dimension associated with contrasting maturity status (Table 2). Hence, we re-modeled body dimensions by playing status, aligning for maturity-associated and chronological age-variations in the sample. The results of the Bayesian multilevel revealed that taller and heavier players were likely to be retained two years after the observations (see Table 2). These findings are consistent with the limited observations in youth basketball. For example, in a sample of 84 Portuguese players aged 12 to 15 years, retained players (n = 52) were also taller and heavier than dropouts (n = 32) two years after observations (13).

Results also highlight the need to be cautious when interpreting the functional performance of adolescent basketball players. A naive interpretation of the comparisons between drop-out and persisters (i.e., without considering variations in age, maturity status, and training experience – Table 1) would suggest that persisters were better on Line-drill performance than drop-out players whilst, on overall performance composite score, drop-outs were better than persisters. Also, this simple picture would suggest that there were no differences in intermittent endurance performance between players by playing status. However, after aligning the influence of age, maturity indicator and training experience in the Bayesian multilevel models the initial interpretations differ. Consequently, dropouts showed higher intermittent endurance performance, even when allometric scaling was performed, and substantially better overall functional performance. Also, the differences in the Line drill performance between players by playing status were explained by age-related variation (note the substantial group-level estimate for age group effects and the large uncertainty estimates for maturity offset and years of experience at population-level effects). The preceding observations

add to the need for appropriate analytical approaches to examine the interactions between age, maturity status and years of experience in sport with performance.

Consistent with the observations with a Portuguese youth basketball sample (13), persisters appear to have lower levels of functional capacity during pubertal years compared to those who are not retained in basketball. Of course, these interpretations are limited to the data available and lack the prospective of repeated measures across pubertal years. For example, it has been noted in a longitudinal study in youth soccer that the rate of changes within a competitive season should also be considered to interpret the functional capacities of young players (127).

These concerns notwithstanding, it is likely that the present sample already reflects a highly selected group of young basketball players. This may contribute to the high scores observed for both achievement and competitiveness motivation, and deliberate practice motivation in the present study. A naive interpretation (Table 1) would suggest that players that persisted in youth basketball training programs had substantially higher values in all dimensions of motivation in both questionnaires used. However, considering the substantial influence of chronological age and years of experience in basketball, but not maturity status, persisters were more motivated for excel and for competitiveness, and similarly high in the other dimensions compared to dropouts. These results are consistent with observations where will to excel was the main predictor identified to classify under-16 players by competitive level in both male (21) and female (103) youth basketball. The results add to the calls for further consideration of behavioral characteristics in the study of young athletes' development and progression in sport (40, 67, 94).

Finally, the present study is limited by its sample size and may reflect characteristics of the context of the study, warranting caution when generalizing interpretations. Also, we were not able to track information about growth, performance and behavioral characteristics after the baseline observation. Nevertheless, the present data add valuable insights for the study of youth basketball selection and progression, particularly considering a multidimensional approach, particularly given the increase in t call for interdisciplinary studies in sports research (40, 128).

In summary, we used an interdisciplinary approach to examine whether variation in biological maturity status, training experience, body size, functional capacities and motivation for achievement, competitiveness and deliberate practice of youth basketball explained differences between players according to their participation status in the sport two years after

the assessment. The present study highlights the need to consider Bayesian multilevel modeling to deal with the interactions among physical growth, biological maturity status, functional capacities, and behavioral characteristics; specifically, among players on the path to sport expertise. On a simpler level, it became apparent that taller adolescent players are more likely to be selected/promoted in youth basketball, regardless of their lower functional capacity, particularly intermittent endurance. Finally, achievement and competitiveness motivation is apparently linked to the process of dropping out or persisting in this sample of youth basketball players. The need to consider the complex interactive pattern between variables is perhaps the clearest applied implication of the study.

Table 5. Descriptive statistics (posterior mean and 90% credible intervals) for adolescent basketball players by age group team at study baseline.

	Under 11 (n=12)	Under 12 (n=14)	Under 13 (n=10)	Under 14 (n=11)	Under 15 (n=10)	Intraclass coefficient
Chronological age (yrs)	11,2 (11,0 to 11,4)	12,3 (12,2 to 12,5)	13,3(13,1 to 13,6)	14,4 (14,2 to 14,6)	15,4 (15,1 to 15,6)	0,98 (0,93 to 1,00)
Maturity offset (yrs)	-2,34 (-2,69 to -1,99)	-1,32 (-1,65 to -1,00)	-0,31 (-0,70 to 0,07)	1,06 (0,69 to 1,43)	1,83 (1,44 to 2,21)	0,94 (0,82 to 0,99)
Age at the start of basketball training (yrs)	9,7 (8,5 to 10,8)	9,6 (8,5 to 10,6)	10,0 (8,8 to 11,3)	10,3 (9,1 to 11,5)	11,1 (9,9 to 12,3)	0,09 (0,00 to 0,45)
Years of experience (yrs)	1,5 (0,4 to 2,6)	2,7 (1,7 to 3,8)	3,3 (2,1 to 4,0)	4,1 (2,9 to 5,3)	4,3 (3,0 to 5,5)	0,33 (0,02 to 0,71)
Stature (cm)	150,6 (145,8 to 155,5)	160,0 (155,5 to 164,5)	170,4 (165,0 to 175,7)	182,5 (177,4 to 187,5)	181,1 (175,8 to 186,4)	0,76 (0,55 to 0,90)
Body mass (kg)	45,6 (38,9 to 52,3)	50,6 (44,3 to 56,8)	58,8 (51,4 to 66,1)	74,4 (67,4 to 81,4)	77,5 (70,1 to 84,8)	0,66 (0,39 to 0,82)
Sitting height (cm)	75,2 (72,8 to 77,6)	79,8 (77,6 to 82,0)	84,0 (81,4 to 86,5)	89,8 (87,3 to 92,3)	91,6 (89,0 to 94,2)	0,80 (0,58 to 0,92)
Sum of skinfolds (mm)	69,2 (57,8 to 80,5)	64,6 (54,1 to 75,1)	49,6 (37,2 to 62,1)	56,5 (44,6 to 68,3)	51,4 (39,0 to 63,9)	0,14 (0,00 to 0,43)
Line Drill test (s)	37,6 (36,3 to 38,9)	35,2 (33,9 to 36,4)	33,5 (32,0 to 34,9)	33,7 (32,3 to 35,1)	33,5 (32,0 to 35,0)	0,54 (0,17 to 0,83)
Yo-Yo IR1 (m)	373,3 (270,6 to 476,1)	468,6 (373,5 to 563,7)	564,0 (451,5 to 676,5)	803,6 (696,3 to 910,9)	744,0 (631,5 to 856,5)	0,58 (0,31 to 0,80)
Scaled Yo-Yo IR1 ($m.kg^{0,61}$)	38,2 (29,0 to 47,5)	45,3 (36,7 to 53,9)	47,7 (37,6 to 57,9)	59,6 (49,9 to 69,3)	53,8 (43,7 to 64,0)	0,22 (0,01 to 0,55)
Performance composite score (z-score)	0,15 (-0,42 to 0,72)	-0,33 (-0,85 to 0,19)	-0,55 (-1,17 to 0,08)	0,54 (-0,05 to 1,14)	0,22 (-0,40 to 0,85)	0,21 (0,00 to 0,62)
Achievement motivation						
Work (1-5)	4,41 (4,11 to 4,71)	4,35 (4,08 to 4,63)	4,60 (4,27 to 4,93)	4,41 (4,09 to 4,72)	4,61 (4,27 to 4,94)	0,06 (0,00 to 0,37)
Mastery (1-5)	4,81 (3,44 to 4,18)	4,07 (3,72 to 4,42)	4,20 (4,79 to 4,60)	4,27 (3,88 to 4,66)	4,60 (4,20 to 5,00)	0,22 (0,00 to 0,67)
Competitiveness (1-5)	3,55 (3,11 to 3,99)	3,64 (3,24 to 4,05)	3,65 (3,17 to 4,13)	3,73 (3,27 to 4,18)	3,63 (3,15 to 4,11)	0,04 (0,00 to 0,28)
Deliberate practice motivation						
Will to excel (1-5)	3,79 (3,35 to 4,23)	4,35 (3,94 to 4,76)	4,27 (3,79 to 4,76)	4,65 (4,18 to 5,00)	3,98 (3,48 to 4,46)	0,00 (0,00 to 0,59)
Will to compete (1-5)	3,98 (3,66 to 4,30)	4,48 (4,18 to 4,77)	4,53 (4,18 to 4,87)	4,31 (3,98 to 4,64)	4,43 (4,08 to 4,77)	0,16 (0,00 to 0,58)

4 PERFORMANCE, MOTIVATION, AND ENJOYMENT IN YOUNG FEMALE BASKETBALL PLAYERS: AN INTERDISCIPLINARY APPROACH[2]

4.1 INTRODUCTION

A key question for researchers, coaches and governing bodies is "what is it that characterizes those who succeed?" (129). This question is frequently addressed in the early stages of the development of children and adolescents engaged in organized training programs deliberately focused on training and development in that sport. It is often considered that specialization years are a decisive moment to lift an athlete's skill level, readiness and commitment (18, 21). However, this perspective tends to be exclusive and is applied to only a minority of the participants in youth sports structured programs.

It is generally assumed that the expertise attainment in sport is positively related to the accumulated number of hours of practice (18, 21, 22). Hence, the decision to persist engaged in youth sports organized programs is likely founded on a clear orientation towards competitive success and on a strong will to become an expert player, ready to practice at the standards of volume and intensity required by expert performance (21). Given that young athletes are first of all adolescents, it may be reasonable to assume that achievement orientations and the will to become experts through deliberate practice may vary between players in contrasting competitive playing levels. Also, enjoyment in sports practice among young athletes may play a significant role in their engagement in practice to improve performance.

As organized youth sports entail a very structured selection process, early prediction of future outcomes and adult expertise attainment potential is aimed (5), and decisions are mostly based on physiological test performance (116). However, the performance development of children and adolescent athletes is potentially influenced by a myriad of factors, including variability in growth and biological maturation or the complex environmental factors that may mislead the accuracy and specificity of most traditional physiological tests (116). To examine variation between young players by their level of competition, research generally assumes unidisciplinary perspectives from either biological, psychological or behavioral variables, which is a clearly flawed approach (130). Interdisciplinary approaches are rarely adopted to

[2] SOARES, A.L.A.; LEONARDI, T.J.; SILVA, J.; NASCIMENTO, J.V.; PAES, R.R.; GONÇALVES, C.E.; CARVALHO, H.M. Performance, motivation, and enjoyment in young female basketball players: an interdisciplinary approach. **Journal of Sports Sciences** *(Accepted in February 10, 2020)*.

interpret young athletes´ development, despite the longtime calls applied to talent identification and development (131), and research in sports science (132, 133).

Even more when considering youth basketball, determinants of performance are multifactorial. It has been well documented about the importance of body size on playing positions and performance (112). Basketball movement patterns involve high-intensity short-term activities, and intermittent in nature, such as sprinting, jumping or cutting (134, 135). The physiological demands require both activities aerobic in nature (135, 136), but also placing important energy demands on anaerobic metabolism. On the other hand, any sports context involves interpersonal interactions within it, as constrained by the organizational structure of the training and competition (137). Hence, an interdisciplinary approach considering size, functional performance and behavioral attributes (and biological maturation in young athletes) will allow for a deeper understanding of players´ performance development and the path to expertise in basketball.

Available information with young athletes' development is mostly based on male populations, despite generalized girls' participation in organized sports (131). Particularly with female adolescent basketball players, the limited data available considers mainly anthropometric and physiological attributes (138, 139). In this study we assumed an interdisciplinary approach to examine young female athletes' functional and behavioral characteristics, accounting for variation by age group, menarcheal status, and competitive level.

Finally, research questions and designs (e.g., limited sample size within a team or competitive level) (140), frequent small true between-individual variation at different levels (e.g., between individual differences in maturity status or training experience within a narrow age group or team of adolescent players) are often overlooked in sports science. The analysis and interpretation in sports science research are often dealt with traditional single-level approaches and using frequentist methods, albeit its limitations being been noted is several scientific areas (141). As previously noted (130), multilevel regression modeling provides a flexible and robust alternative that intuitively considers the hierarchical data structure (142). Moreover, estimations of small group's characteristics within a higher level of observations may be improved upon the consideration of all data available. For this, better estimates may be derived using poststratification based on the multilevel regression models (142, 143), where information is partially pooled across similar groups, providing then aggregate estimations for a target population (142), with limited or even non-existent data (144). From a Bayesian

perspective, model fit comprises samples from the joint posterior density of the parameters (145). The interpretations use probabilistic of these parameters to simulate predictions and assess the quality of the model fit to data (145). For multilevel model estimations, we used Markov chain Monte Carlo (MCMC), which is generally superior to maximal likelihood methods (146).

In the present study, we examined the variation in years of accumulated training experience, body dimensions, functional performance, deliberate practice motivation, achievement and competitiveness motivation, and sources of enjoyment among young female basketball players within and between age groups, menarcheal status and competitive levels among the female adolescent basketball, partitioning the potential variation by individuals´ biological characteristics (menarche status) and contextual characteristics (competitive age group and competitive level). Furthermore, in the present study, we illustrate the use of multilevel regression and poststratification to estimate the variation in outcomes of interest accounting for cross-classified nesting, which is often the case in an applied youth sports context, i.e. within and between variation by age groups, menarcheal status, and competitive levels.

4.2 METHODS

Study design and sample

This study was based on a cross-sectional design. A total sample of 114 adolescent female basketball players aged, on average, 14,3 (SD = 1,8) years, with a range between 10,0 to 17,9 years, was considered. The players were classified by competitive level as club- (n = 84) and state-level (n = 30) selected by coaches to compete in the state teams. The latter competed with their respective clubs during the season at a regional level competition and were included among state selections in the 2018 competitive season (it should be noted that competitive seasons in Brazil typically run between March until November). Player´s selection for the state level teams was performed by the respective state-level team coaches. Club level players were from under 13, under 15 and under 17 teams from clubs that competed at regional level competition supervised by either the *Associação Regional de Basquetebol* (ARB) – institutional body supervisor of the local competition, filiated to *Federação Paulista de Basketball* (FPB); and by the *Federação Catarinense de Basketball* (Basketball Federation of Santa Catarina). Both federations organize their own state level competition, and represent both

structured and organized competitive system with substantial engagement of female young players. At the time of the study, all players trained regularly (~300–360 min/wk) over a 9-month season (March to November). No player was injured at the time of testing or self-reported to have any moderate or more severe lower-limb injury (i.e. more than 7 days elapsing from the date of injury to the date of the player's return to full participation in team training and availability for competitive gameplay) during 6 months before the testing.

The study was approved by the Research Ethics Committee of the Federal University of Santa Catarina and by the Research Ethics Committee of the University of Campinas. Participants were informed about the nature of the study, that participation was voluntary and that they could withdraw from the study at any time. Players and their parents or legal guardians provided written informed consent.

Procedures

Chronological age was calculated to the nearest 0,1 years by subtracting a birth date from the date of testing. Menarcheal status was obtained through self-reported age at menarche, via interview performed by the coaches (female coaches in all cases). Distance to age at menarche was calculated to the nearest 0.1 years by subtracting menarche date from the date of testing. Players were grouped into three groups of menarcheal status: early (n=27), average (n=8) and late (n=12). Reference age at menarche (mean = 12,89 years, 95% CI: 12,68 to 13,09 years) for Brazil population was estimated based on data from five studies, summarizing data recorded from 1972 to 1992 (147), using Bayesian multilevel modeling to perform a meta-analysis. Players classified as having early or late maturation were those whose age at menarche was minus or plus one year from the mean of age at menarche for the Brazilian population. To the best of our knowledge the reference data, even if somewhat outdated, is the available data for the regions of the present sample. Hence, caution is warranted given the secular trend of declining age at menarche (148), likely associated with the potential influences of environmental sources on age at menarche, such as nutritional status, ethnicity, family size, socio-economic background, among others. (149-151).

Years of experience in formal basketball training and age when players first took part in organized basketball practices were obtained by interview of the players and confirmed with their coaches and parents.

Stature was measured with a portable stadiometer (Seca model 206, Hanover, MD, USA) to the nearest 0,1 cm. Body mass was measured with a calibrated portable balance (Seca model 770, Hanover, MD, USA) to the nearest 0,1 kg. Reliability estimates for the observer are published elsewhere (152).

To examine functional performance we used the vertical jump with countermovement (153), a short-term maximal running protocol, the Line drill (LD) test (154, 155) and an intermittent endurance test, the Yo-Yo Intermittent Recovery Level 1 test (Yo-Yo IR1) (156). We considered the sum of the z-scores as an estimate of overall performance, i.e., functional performance index (lower-limb explosive strength, agility, and anaerobic power, and intermittent endurance). Note that z-scores were reversed for the LD performance; as lower times indicate better performance. The vertical jump with countermovement was tested on a jump mat (Multisprint System, Hidrofit, Brazil). Players started from an upright standing position and were instructed to begin the jump with a downward movement, which was immediately followed by a concentric upward movement, resulting in a maximal vertical jump. During jumping, hands were held on the hips during all phases of the jumping. Vertical jump was recorded in centimeters. In the LD protocol players ran 140 m as fast as possible in the form of four consecutive shuttle sprints of 5.8, 14.0, 22.2 and 28.0 m within a regulation basketball court. Players began the test one meter behind the baseline of the basketball court, where a pair of photoelectric cells (Multisprint System, Hidrofit, Brazil) was aligned with the baseline. Time was recorded in seconds. The Yo-Yo IR1 protocol is based on repeated 2 x 20-m runs back and forth between the starting, turning, and the finishing line at a progressively increased speed controlled by audio bleeps from a tape recorder. The athletes have a 10-s active rest period between each bout, jogging at a distance of 2 x 5-m. Players ran until they were no longer able to maintain the required speed; the test was completed when athletes failed twice to reach the finishing line in time. The covered distance was measured in meters. Tests were performed in two sessions separated by at least 48 hours, where the first session included the vertical jump and LD test, and the second session the Yo-Yo IR1. A standardized warm-up was taken by all athletes before testing. Details about the functional performance procedures and reliability estimates are available elsewhere (130, 152, 157, 158).

Psychobehavioural factors were assessed using the Work and Family Orientation Questionnaire (86), the Deliberate Practice Motivation Questionnaire (19), and the Sources of Enjoyment in Youth Sports (159). The Work and Family Orientation Questionnaire is

composed of 19 items, rated on a 5-point Likert scale (1=completely disagree to 5=completely agree), assessing four dimensions of achievement: personal unconcern, work, mastery, and competitiveness. For the present study, we only used the last three subscales in the present study, consistent with previous observations with similar samples of youth basketball (21, 130, 152). The Deliberate Practice Motivation Questionnaire was originally designed for chess (18, 19). The questionnaire is composed of 18 items, similarly rated on a 5-point Likert scale, considering two dimensions of deliberate practice: will to compete and will to excel. We used an adapted version for basketball, translated and validated to Portuguese (21). The reliability of the adapted Portuguese version has been reported with data in youth basketball from the same age range of the present study elsewhere (21). The Portuguese version (160) of the Sources of Enjoyment in Youth Sport Questionnaire (159) was used in this study. The questionnaire has 28 items and examines five dimensions: self-referenced competencies, others-referenced competencies, effort expenditure, affiliation with peers and positive parental involvement. Each questionnaire item is rated on a 5-point Likert scale (1=completely disagree to 5=completely agree). The questionnaire showed good reliability (160).

Data analysis

Modeling approach. We used multilevel regression and poststratification (142) estimation to examine variation by competitive level and age group for chronological age, anthropometric dimensions, age at menarche, functional performance, motivation for achievement and competitiveness and sources of enjoyment in youth sports among the Brazilian female basketball players. The outcome of each player was estimated as a function of her individual characteristics, i.e. age group, menarcheal status, and competitive level (for player *i*, with indexes *j*, *k,* and *l* for age group, menarcheal status, and competitive level, respectively):

$$\boldsymbol{y_i = \beta^0 + \alpha^{age\ group}_{j[i]} + \alpha^{menarcheal\ status}_{k[i]} + \alpha^{competitive\ level}_{l[i]}}$$

The terms after the intercept are modeled as group effects (also referred to as random effects) drawn from normal distributions with variances to be estimated from the data:

$$\boldsymbol{\alpha^{age\ group}_{j[i]} \sim N\ (0, \sigma^2_{age\ group})}, \text{ for } j = 1, 2, 3$$

$$\boldsymbol{\alpha^{menarcheal\ status}_{k[i]} \sim N\ (0, \sigma^2_{menarcheal\ status})}, \text{ for } k = 1, 2, 3$$

$$\boldsymbol{\alpha^{competitive\ level}_{l[i]} \sim N\ (0, \sigma^2_{competitive\ level})}, \text{ for } l = 1, 2.$$

Considering the influence of body mass and training experience on functional performance (40, 65, 161), we added body mass and years of training experience as a population-level effect when modeling functional performance outcomes. As for psychobehavioural outcomes, added years of training experience as a population-level effect. In these cases, we standardized all variables in the models for computational and interpretative convenience.

Prior distributions. We used non-informative priors for population-level effects and weakly informative prior distributions for group-level, normal priors (0,2). The choice of priors was made to allow the models to converge. We also intended for the results to reflect the knowledge available on the data.

Model-checking and computation. We used posterior predictive checks to compare models estimates with observed data, to ensure we had not overfitted our data (162). For each model, we run two chains for 2,000 iterations with a warm-up length of 1,000 iterations. Bayesian estimations were implemented via R statistical language (163), with "brms" package (123) which call Stan (122).

4.3 RESULTS

Descriptive statistics of young Brazilian female basketball players are summarized in Table 7. Fourteen players had not attained menarche at the time of observation. There was no substantial variation in the outcome variables by menarcheal status. Hence, we report estimates based on models considering aggregation by age group and competitive level. Poststratified estimates and 95% credible intervals for young female players considering both competitive level and age groups are summarized in Table 6. An advantage of Bayesian methods lies in the possibility of direct probabilistic comparisons of the posterior estimates and respective credible intervals.

Conditional on the data, the posterior estimates showed no substantial differences for chronological age and distance to menarche, considering players by competitive level in each age group. For accumulated training experience in basketball, state-level players had higher experience in all age groups. For body size, state-level players were slightly higher than club level players, about 5 cm across all age groups. No substantial variation was observed between competitive levels across the age groups.

Conditional on the data, it was apparent that state-level female players showed better performance for vertical jump, Line Drill test, Yo-Yo IR1 performance and overall performance score than club level players. Considering age variation between players (Table 6), standardized differences between players by competitive level were at least large (see Figure 1). However, when body mass and training experience were accounted for, standardized differences by competitive level become trivial. Particularly, years of experience had a substantial positive relation with Line drill performance (population-level estimate = -0,37, 95% CI: -0,59 to -0,15; note that a negative exponent indicates a better time performance). As for jump, intermittent endurance and overall performance score, standardized differences between players by competitive level were at least large remained large and, in particular, independent of years of training experience. Furthermore, body mass had a negative substantial association with vertical jump (population-level estimate = -0,38, 95% CI: -0,66 to -0,11), Yo-Yo IR1 performance (population-level estimate = -0,24, 95% CI: -0,43 to -0,06) and overall performance score (population-level estimate = -0,26, 95% CI: -0,45 to -0,06).

As for the Deliberate Practice Motivation Questionnaire dimensions, there was a slight trend of decrease in the scores with the increase in age groups in both competitive levels, but there was no substantial variation between players by competitive level. As for Work and Family Orientation Questionnaire dimensions, only for competitiveness dimension was observed a trend of higher scores for players of state level, across all age groups. Also, this effect for competitiveness was independent of years of experience in basketball. Years of experience in basketball had a negative association with will to compete score (population-level estimate = -0,29, 95% CI: -0,56 to -0,04), from Deliberate Practice Motivation Questionnaire, and the work score (population-level estimate = -0,27, 95% CI: -0,52 to -0,03), from the Work and Family Orientation Questionnaire score.

As for Sources of Enjoyment in Youth Sports, all players presented a trend of high scores in all dimensions. There was no substantial influence of players' menarcheal status, competitive age-group, and accumulated training experience, except for other-referenced competences, on dimensions of sources of enjoyment. For other-referenced competences, more experienced players from the state-level had higher scores compared with less experienced and from club level players. On the other hand, club level players had substantially higher scores for self-referenced competences than state-level players.

Table 6. Posterior estimations of young female basketball players by competitive level and age group.

	Club level			State-level		
	under 13	under 15	under 17	under 13	under 15	under 17
Chronological age, yrs	12,6 (12,5 to 12,8)	14,9 (14,6 to 15,1)	16,8 (16,4 to 17,1)	13,1 (12,8 to 13,5)	15,4 (15,1 to 15,7)	17,3 (16,9 to 17,6)
Distance to age at menarche, yrs[a]	0,04 (0,63 to 0,71)	2,07 (1,39 to 2,75)	4,75 (3,69 to 5,81)	0,38 (0,50 to 1,39)	2,40 (1,54 to 3,35)	5,08 (4,07 to 6,06)
Year of experience in basketball, years	2,17 (1,57 to 2,17)	4,22 (3,47 to 4,94)	5,30 (4,28 to 6,37)	5,54 (4,54 to 6,55)	7,59 (6,60 to 8,52)	8,67 (7,62 to 9,70)
Stature, cm	159,8 (157,7 to 161,9)	165,2 (162,5 to 167,5)	163,4 (160,4 to 166,6)	166,0 (162,7 to 169,6)	171,4 (168,1 to 174,6)	169,5 (166,1 to 173,0)
Body mass, kg	50,8 (51,1 to 57,3)	60,5 (57,1 to 64,2)	60,3 (55,6 to 65,6)	59,2 (54,1 to 64,5)	65,5 (60,9 to 70,2)	65,3 (60,3 to 70,5)
Countermovement jump, cm	23,7 (22,1 to 25,2)	24,7 (23,0 to 26,6)	24,9 (22,8 to 27,4)	26,5 (23,9 to 29,0)	27,6 (25,0 to 30,0)	27,7 (25,2 to 30,4)
Line drill test, s	36,61 (36,02 to 37,13)	35,00 (34,28 to 35,67)	34,99 (33,92 36,09)	35,53 (34,51 to 36,54)	33,88 (32,96 to 34,79)	33,91 (32,94 to 34,95)
Yo-yo IR1, m	477,6 (423,3 to 531,4)	536,9 (474,9 to 600,3)	577,9 (490,5 to 671,6)	561,4 (468,4 to 654,3)	620,8 (540,4 to 702,8)	661,9 (571,9 to 759,4)
Performance score, z-score	-1,13 (-1,76 to -0,49)	0,10 (-0,68 to 0,88)	0,32 (-0,71 to 1,35)	0,33 (-0,72 to 1,41)	1,58 (0,61 to 2,49)	1,78 (0,75 to 2,80)
Deliberate Practice Motivation						
Will to excel, 1-5	4,21 (3,94 to 4,47)	3,61 (3,32 to 3,88)	3,58 (3,17 to 3,82)	4,38 (3,99 to 4,78)	3,78 (3,42 to 4,14)	3,74 (3,33 to 4,16)
Will to compete, 1-5	4,43 (4,24 to 4,64)	4,09 (3,89 to 4,29)	4,03 (3,75 to 4,31)	4,46 (4,17 to 4,75)	4,11 (3,85 to 4,36)	4,06 (3,75 to 4,36)
Achievement and competitiveness motivation						
Mastery, 1-5	4,06 (3,89 to 4,24)	4,00 (3,80 to 4,19)	4,12 (3,87 to 4,35)	4,12 (3,87 to 4,38)	4,05 (3,79 to 4,31)	4,13 (3,86 to 4,42)
Work, 1-5	4,36 (4,18 to 4,53)	4,26 (4,06 to 4,45)	4,19 (3,92 to 4,44)	4,26 (3,97 to 4,53)	4,15 (3,89 to 4,40)	4,09 (3,78 to 4,37)
Competitiveness, 1-5	3,42 (3,19 to 3,62)	3,55 (3,33 to 3,78)	3,61 (3,33 to 3,94)	3,74 (3,41 to 4,06)	3,87 (3,55 to 4,20)	3,93 (3,60 to 4,28)
Sources of enjoyments in youth sports						
Self-referenced competencies, 1-5	4,54 (4,35 to 4,73)	4,59 (4,37 to 4,83)	4,60 (4,30 to 4,94)	3,93 (3,61 to 4,22)	3,98 (3,69 to 4,29)	3,99 (3,69 to 4,29)
Others-referenced competencies, 1-5	3,43 (3,19 to 3,67)	3,39 (3,11 to 3,67)	3,38 (3,38 to 3,74)	4,12 (3,75 to 4,48)	4,08 (3,73 to 4,43)	4,06 (3,67 to 4,42)
Effort expenditure, 1-5	4,73 (4,60 to 4,86)	4,68 (4,51 to 4,82)	4,71 (4,49 to 4,93)	4,82 (4,65 to 5,02)	4,77 (4,59 to 4,96)	4,81 (4,61 to 5,02)
Affiliation with peers, 1-5	4,48 (4,28 to 4,68)	4,41 (4,16 to 4,63)	4,39 (4,02 to 4,68)	4,39 (4,02 to 5,02)	4,62 (4,34 to 4,91)	4,60 (4,34 to 4,91)
Positive parental involvement, 1-5	4,57 (4,36 to 4,78)	4,39 (4,13 to 4,62)	4,37 (3,98 to 4,70)	4,71 (4,42 to 5,03)	4,53 (4,23 to 4,81)	4,51 (4,19 to 4,81)

[a] It was not possible to retain age at menarche at the time in 14 of the players that had not attained menarche at the observation date.

Table 7. Characteristics of the total sample of young female basketball players.

	All sample (n = 114) [a]	Club level (n = 84)	State level (n = 30)
Chronological age, yrs	14,5 (14,3 to 14,6)	14,2 (14,0 to 14,3)	15,4 (15,1 to 15,7)
Age at menarche attainment, yrs	11,8 (11,5 to 12,1)	11,8 (11,7 to 11,9)	12,0 (11,7 to 12,2)
Distance to age at menarche, yrs	2,85 (2,67 to 3,03)	2,64 (2,43 to 2,86)	3,35 (2,99 to 3,69)
Year of experience in basketball, yrs	4,5 (4,2 to 4,8)	3,5 (3,2 to 3,8)	7,4 (7,0 to 7,9)
Stature, cm	164,1 (163,4 to 164,9)	162,3 (161,5 to 163,1)	169,3 (168,0 to 170,7)
Body mass, kg	59,1 (58,2 to 60,2)	57,4 (56,3 to 58,7)	64,0 (61,9 to 66,0)
Countermovement jump, cm	25,6 (25,2 to 26,0)	24,9 (24,5 to 25, 4)	27,5 (26,7 to 28,2)
Line drill, s	35,42 (35,16 to 35,67)	35,30 (35,50 to 36,11)	34,30 (33,79 to 34,39)
Yo-yo IR1, m	541,5 (523,0 to 561,5)	512,6 (462,2 to 534,8)	619,8 (584,2 to 654,1)
Performance score, z-score	0,33 (-2,23 to 2,92)	-0,48 (-0,97 to 0,03)	1,27 (0,42 to 2,07)
Deliberate practice motivation			
Will to excel, 1-5	3,90 (3,72 to 4,08)	3,88 (3,68 to 4,06)	3,95 (3,65 to 4,27)
Will to compete, 1-5	4,23 (4,11 to 4,36)	4,23 (4,10 to 4,38)	4,21 (3,98 to 4,44)
Achievement and competitiveness motivation			
Mastery, 1-5	4,06 (3,90 to 4,17)	4,04 (3,90 to 4,17)	4,09 (3,90 to 4,31)
Work, 1-5	4,27 (4,14 to 4,39)	4,30 (4,16 to 4,45)	4,17 (3,91 to 4,39)
Competitiveness, 1-5	3,58 (3,44 to 3,72)	3,49 (3,32 to 3,64)	3,86 (3,57 to 4,12)
Sources of enjoyments in youth sports			
Self-referenced competencies, 1-5	4,36 (4,12 to 4,51)	4,56 (4,40 to 4,73)	3,97 (3,73 to 4,20)
Others-referenced competencies, 1-5	3,74 (1,81 to 5,89)	3,41 (3,20 to 3,61)	4,08 (3,77 to 4,38)
Effort expenditure, 1-5	4,51 (4,36 to 4,65)	4,45 (4,27 to 4,62)	4,63 (4,41 to 4,87)
Affiliation with peers, 1-5	4,74 (4,65 to 4,83)	4,70 (4,59 to 4,81)	4,81 (4,66 to 4,97)
Positive parental involvement, 1-5	4,52 (4,38 to 4,66)	4,48 (4,33 to 4,79)	4,56 (4,34 to 4,79)

[a] It was not possible to retain age at menarche at the time in 14 of the players that had not attained menarche at the observation date.

Posterior estimates and uncertainty (95% and 50% credible intervals) were plotted by competitive level, accounting for variation by age group, for maturity indicator and training experience (Figure 1), body size (Figure 2), functional performance (Figure 3), Deliberate Practice Motivation Questionnaire dimensions (Figure 4), Work and Family Orientation Questionnaire dimensions (Figure 5) and Sources of Enjoyment for Youth Sports (Figure 6). Given the direct probabilistic comparisons of the posterior estimates and respective credible interval, and conditional on the data, players selected for state-level had more accumulated experience in basketball, were taller (likely also slightly heavier) and with better functional performance, with higher scores for competitiveness compared to club level players, and

referenced their competence against their peers. On the other hand, players from club level showed higher values of self-referenced competencies compared to state-level players.

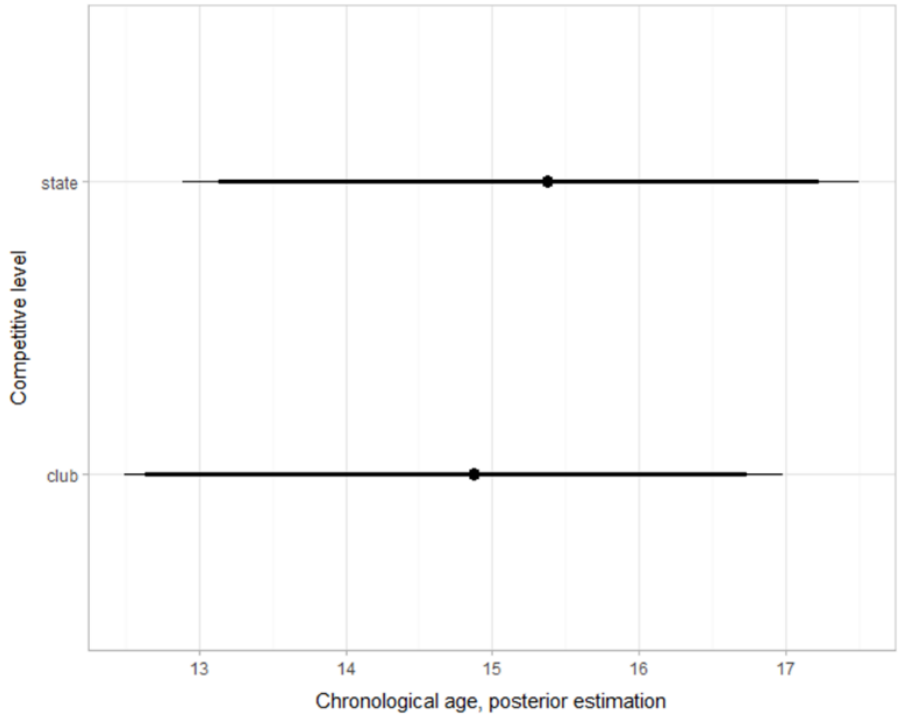

Figure 1. Posterior estimations for age by competitive level, considering variation between age groups

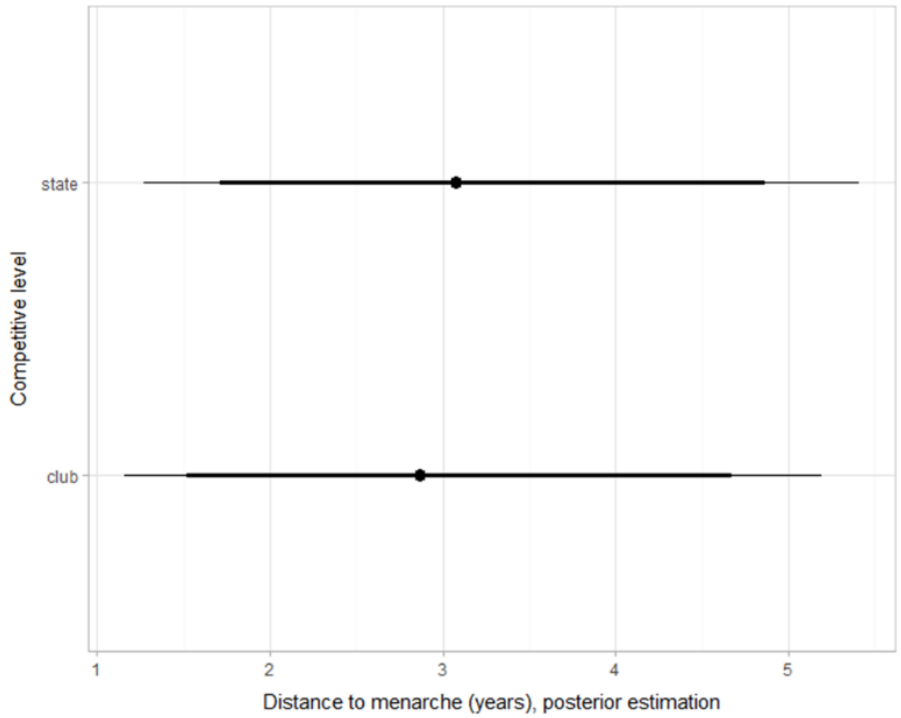

Figure 2. Posterior estimations distance to menarche by competitive level, considering variation between age groups

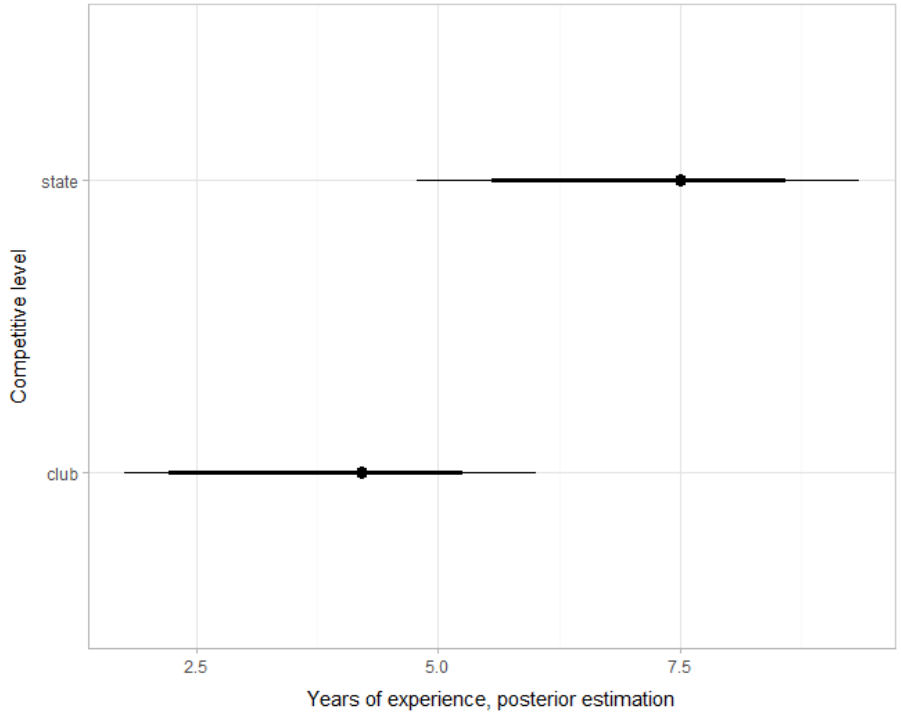

Figure 3. Posterior estimations for years of training experience by competitive level, considering variation between age groups

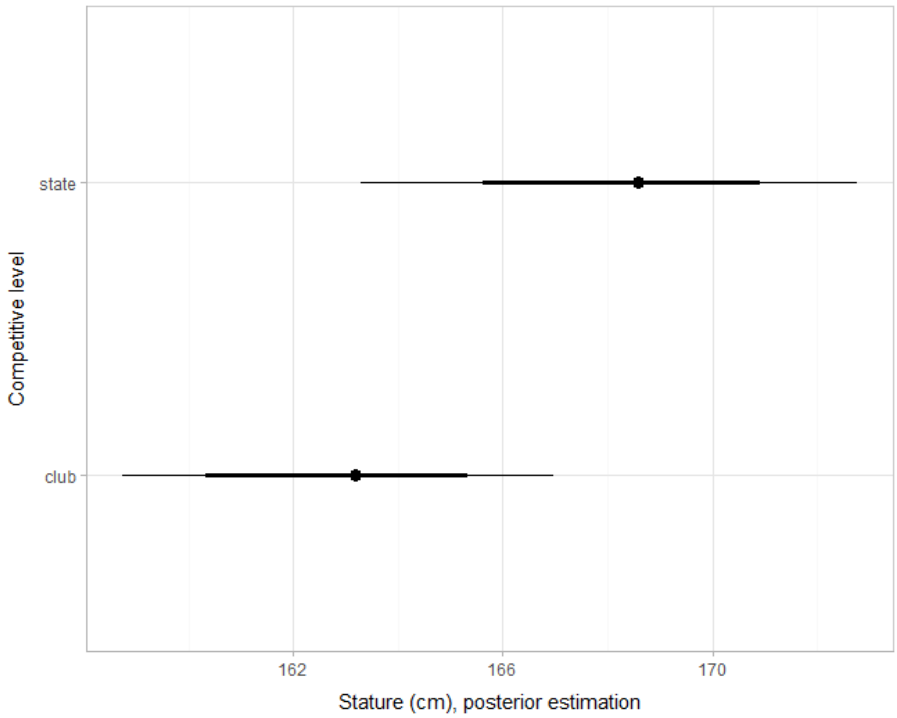

Figure 4. Posterior estimations for stature by competitive level, considering variation between age groups

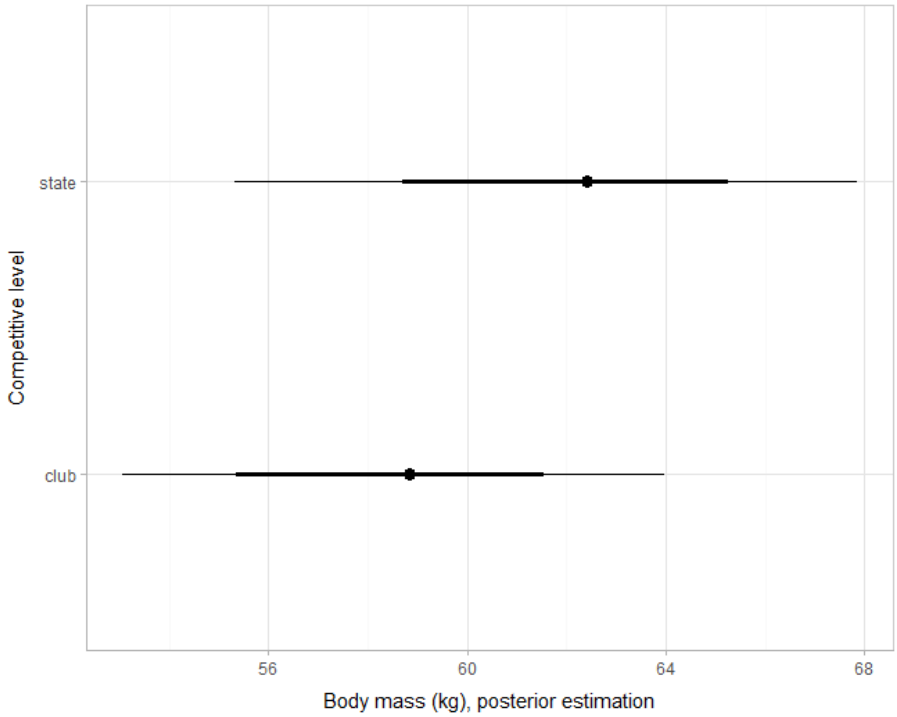

Figure 5. Posterior estimations for body mass by competitive level, considering variation between age groups

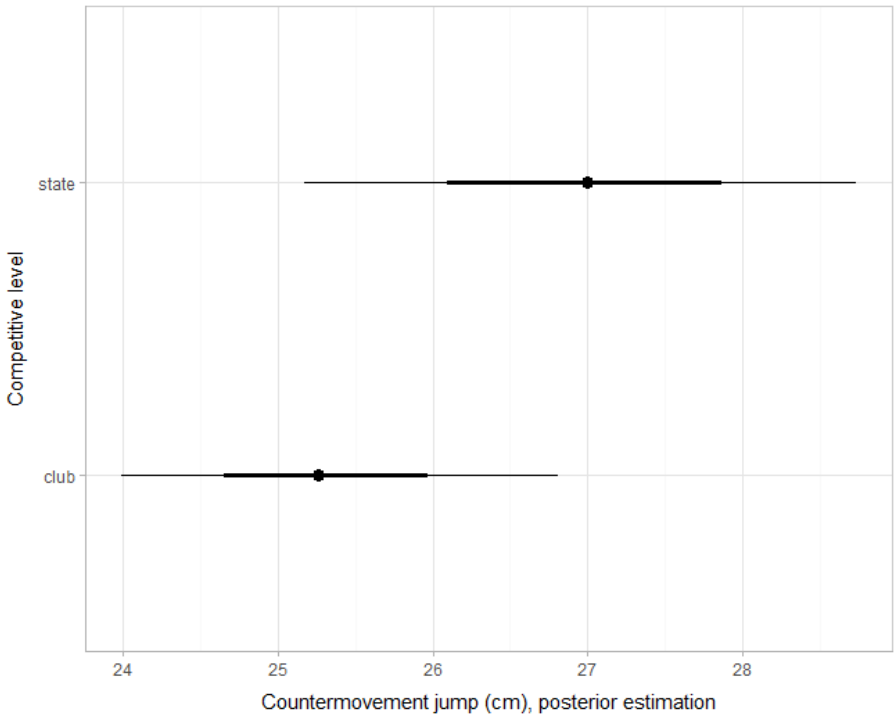

Figure 6. Posterior estimations for countermovement jump by competitive level, considering variation between age groups

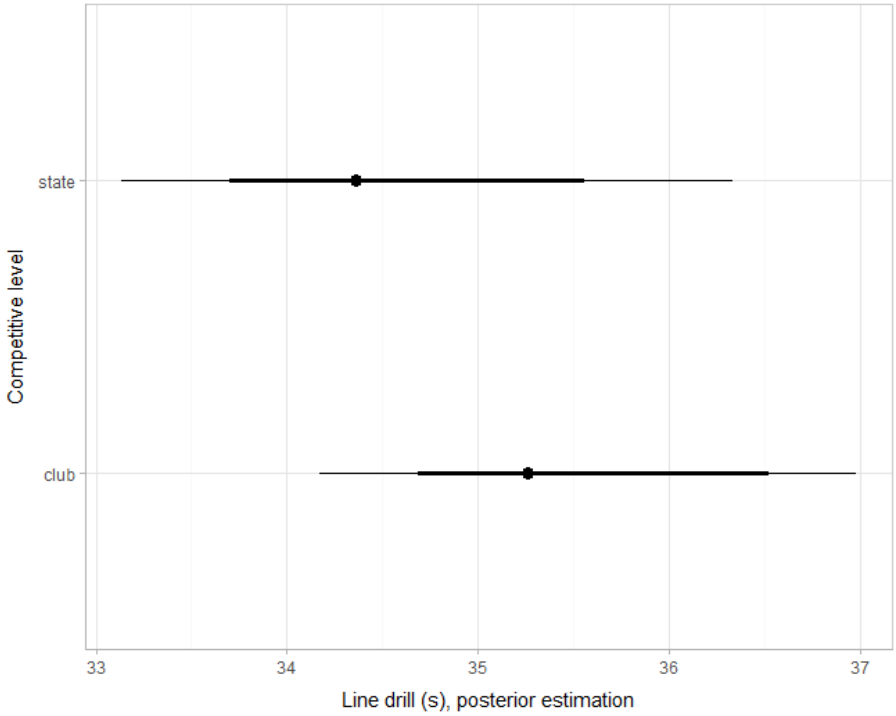

Figure 7. Posterior estimations for Line Drill test by competitive level, considering variation between age groups

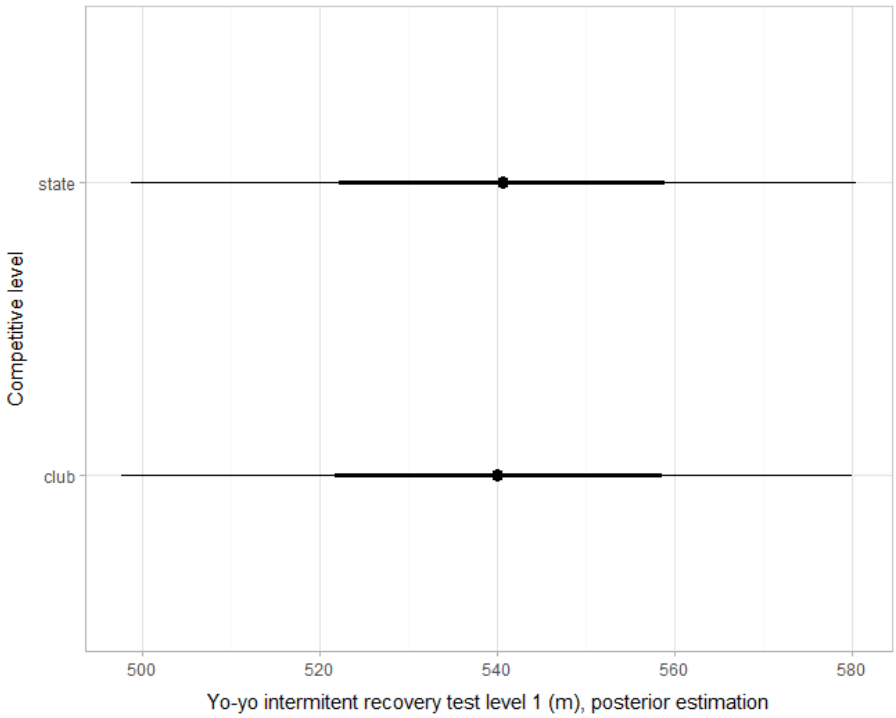

Figure 8. Posterior estimations for Yo-Yo IR1 by competitive level, considering variation between age groups

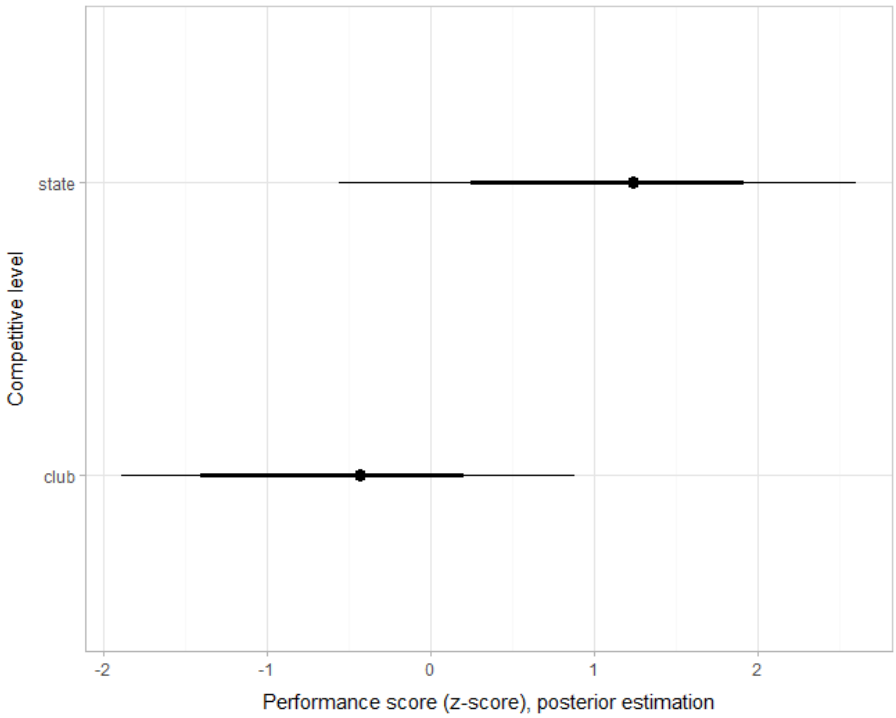

Figure 9. Posterior estimations for Line Drill test by competitive level, considering variation between age groups

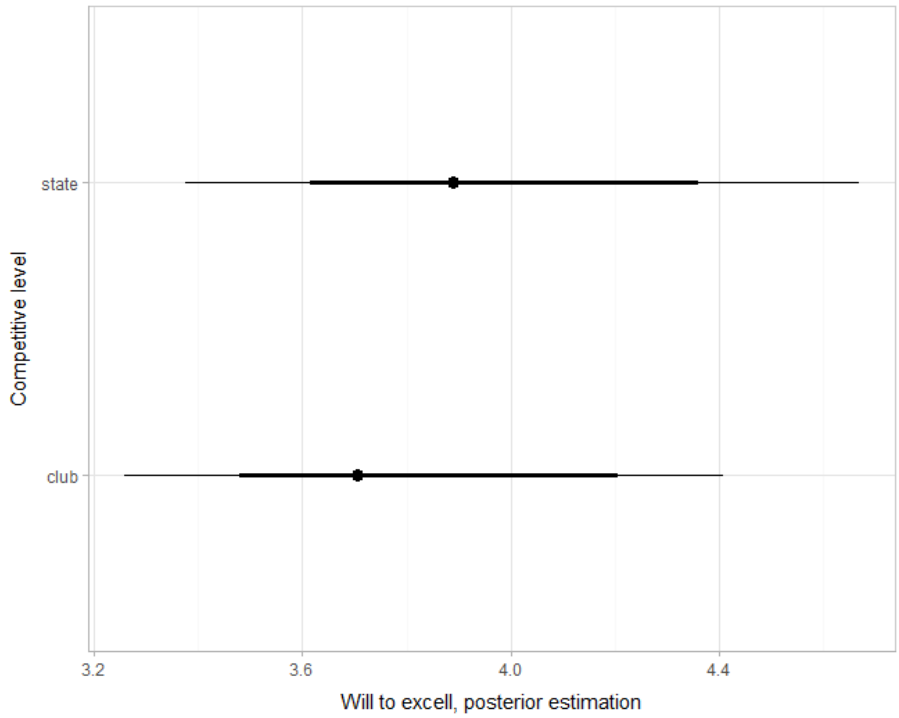

Figure 10. Posterior estimations for Will to excel scores by competitive level, considering variation between age groups

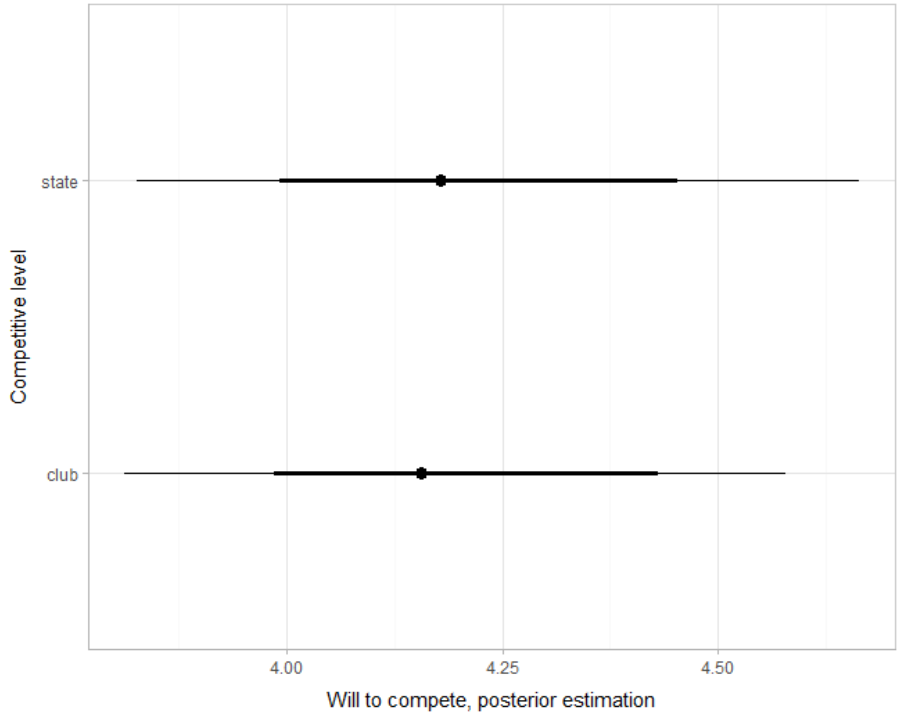

Figure 11. Posterior estimations for Will to compete scores by competitive level, considering variation between age groups

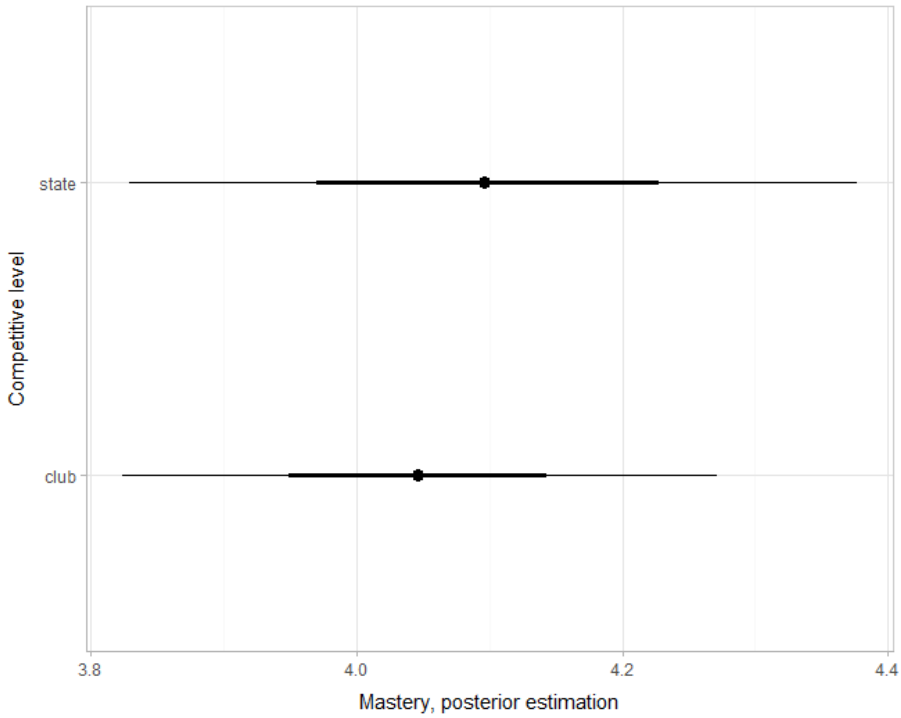

Figure 12. Posterior estimations for mastery scores by competitive level, considering variation between age groups.

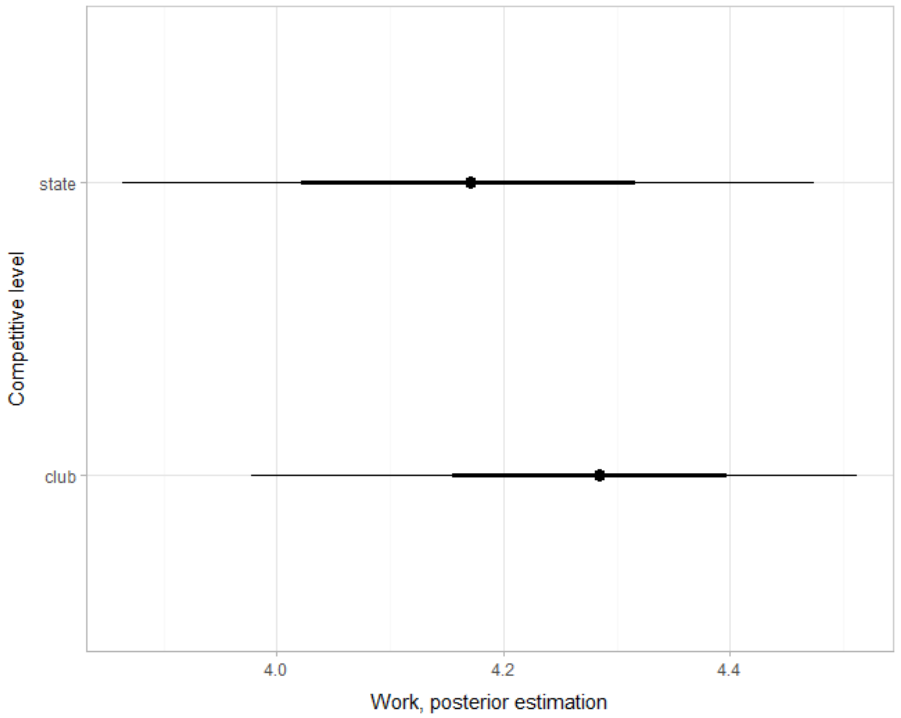

Figure 13. Posterior estimations for work scores by competitive level, considering variation between age groups

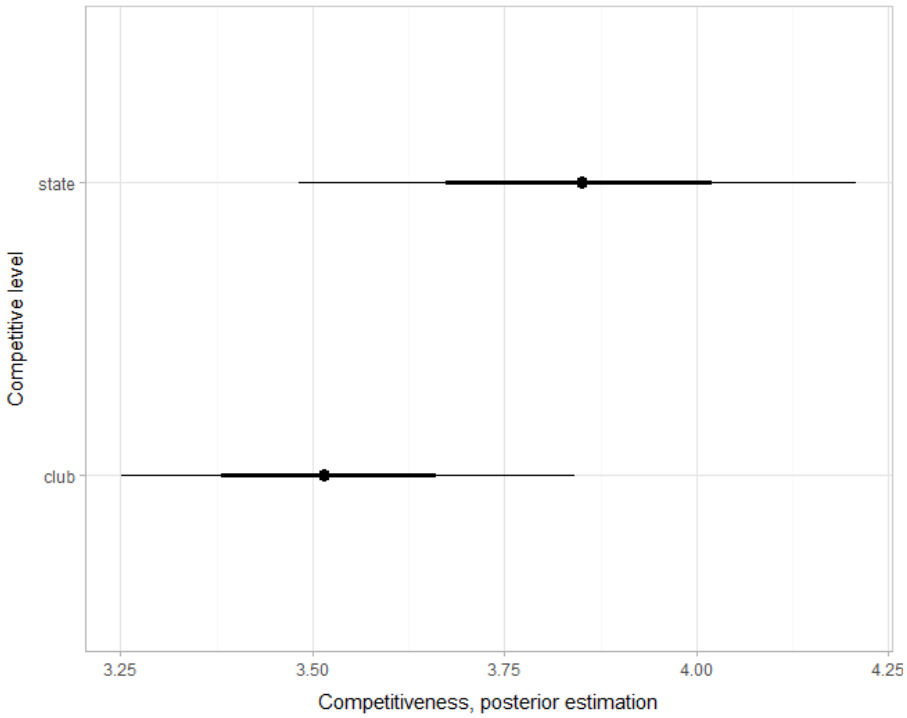

Figure 14. Posterior estimations for competitiveness scores by competitive level, considering variation between age groups

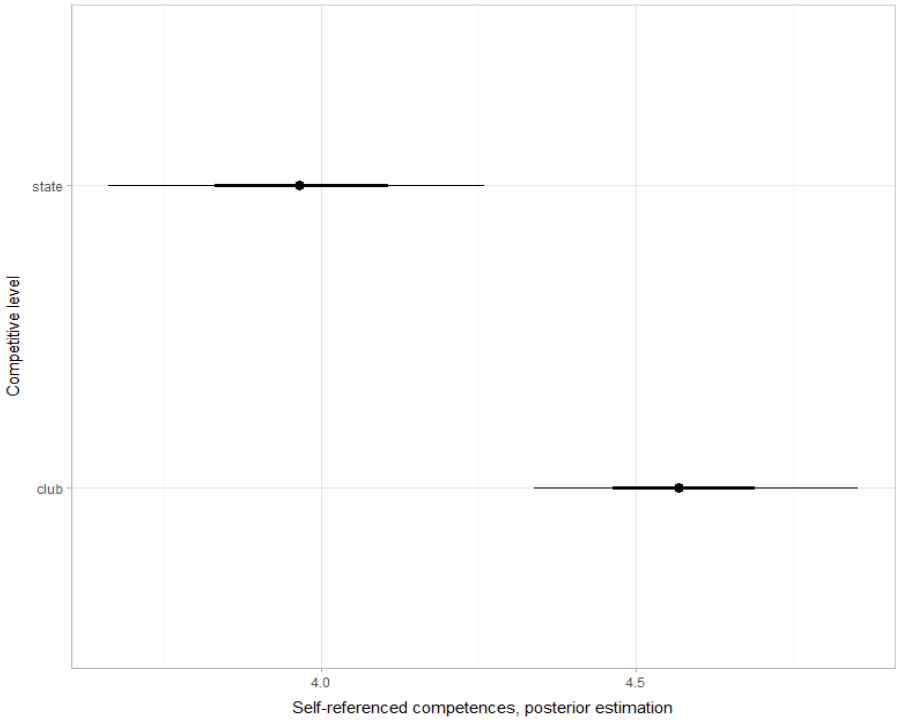

Figure 15. Posterior estimations for self-referenced competences scores by competitive level, considering variation between age groups

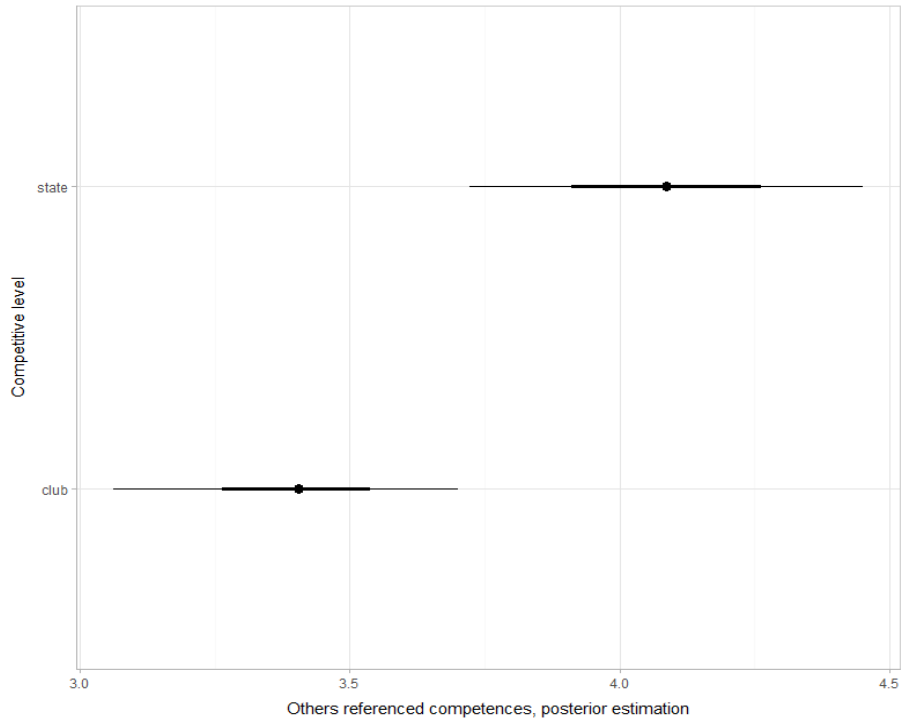

Figure 16. Posterior estimations for others referenced competences scores by competitive level, considering variation between age groups

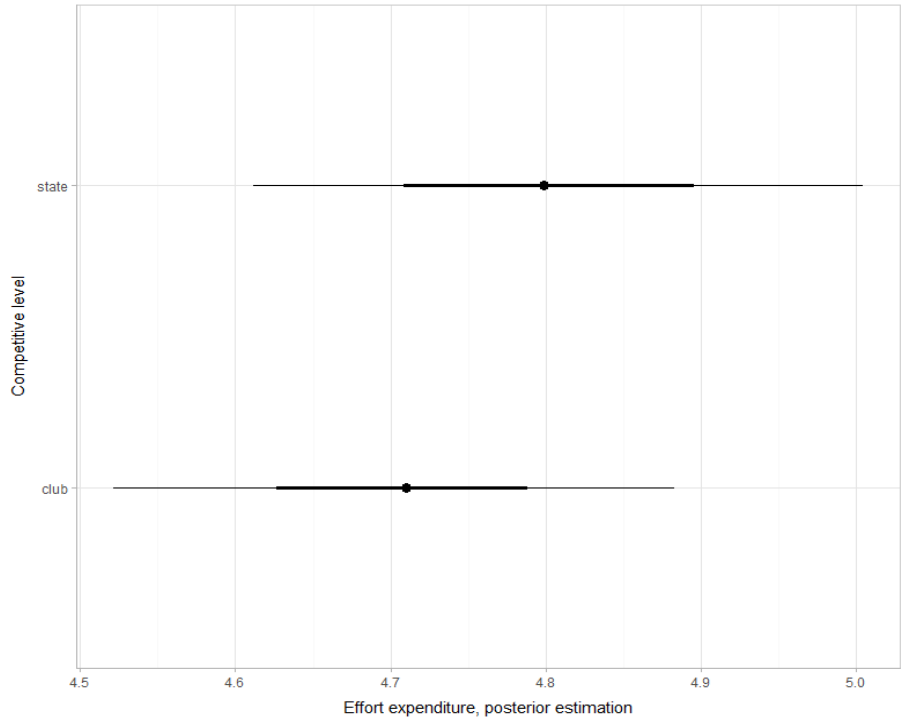

Figure 17. Posterior estimations for effort expenditure scores by competitive level, considering variation between age groups

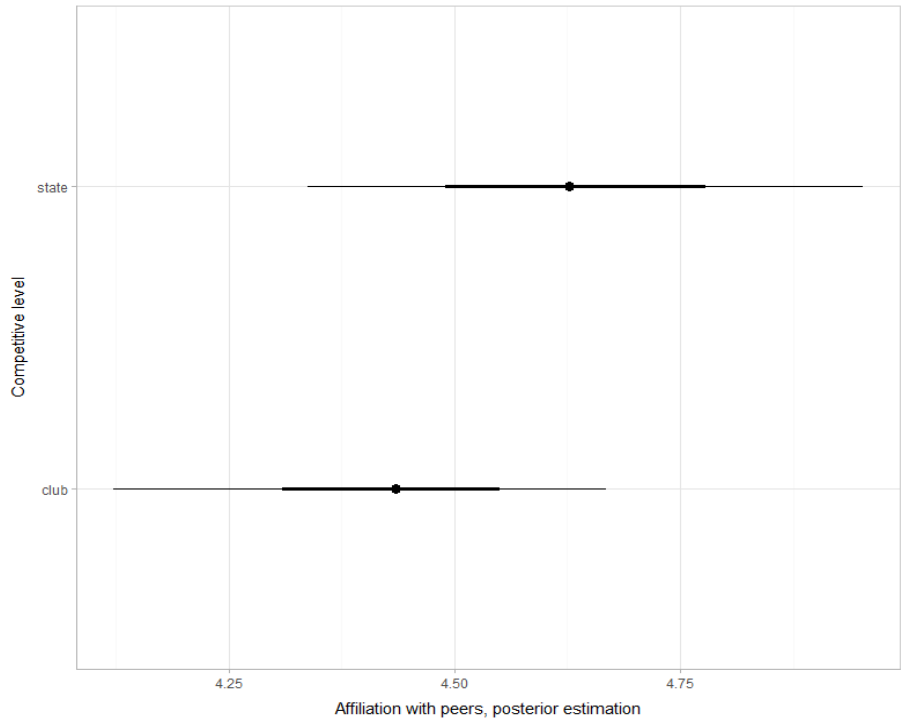

Figure 18. Posterior estimations for affiliation with peers scores by competitive level, considering variation between age groups

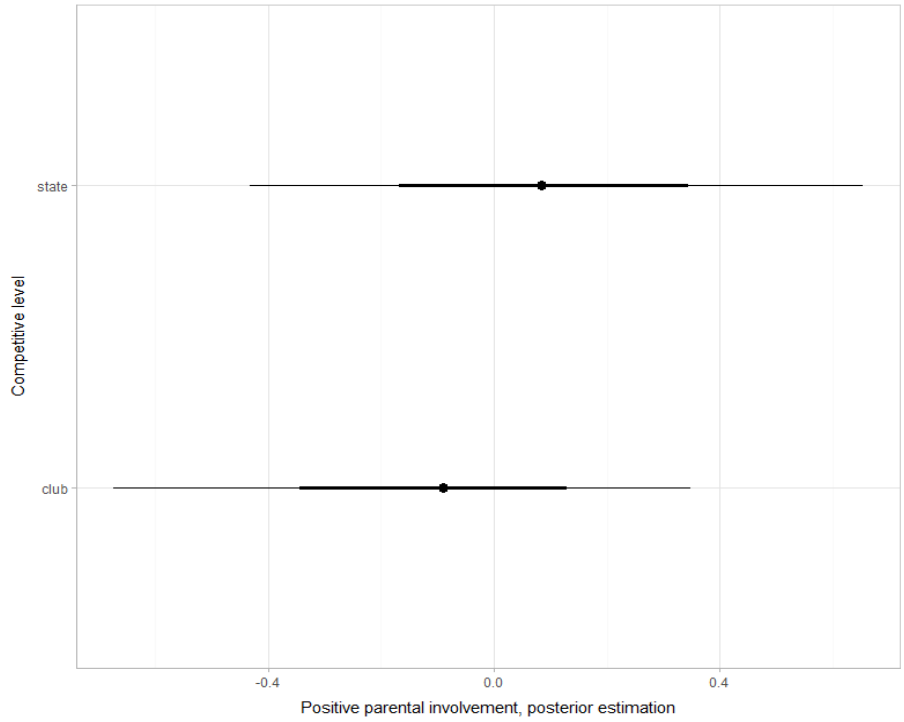

Figure 19. Posterior estimations for positive parental involvement scores by competitive level, considering variation between age groups

4.4 DISCUSSION

There is limited interdisciplinary research considering youth sports development despite its great interest in sport sciences, even more considering female players (131). Furthermore, there is an overemphasis on selection and talent development when considering young athletes. Hence, our use of competitive level as a discriminant factor is instrumental, must be regarded as a tool aiming to illustrate the selective bias that can influence coaches' decisions and the continuity of participation in sport.

In the present study, we focused on variation in accumulated basketball training experience, body size, functional performance, deliberate practice motivation, achievement and competitiveness motivation and sources of enjoyment in youth women's basketball, partitioning for individual biological (maturity status) and sport-specific accumulated experience variation, as well as contextual variation (competitive age groups and competitive level). Hence, we used Bayesian multilevel modeling to account for individual and contextual sources of variation. Within the present poll of club level female adolescent players, those selected for state-level teams had more accumulated training experience, were taller and heavier, and had better physiological performance, particularly in jump and Line drill test. There were no differences between players by competitive level for menarcheal status within age groups. As for psychological skills, particularly motivation for deliberate practice and achievement, we observed that the young female basketball players had high motivation values, regardless of their competitive level. An important finding was that the competitiveness dimension observed in state-level players showed higher scores compared to their club level peers. Although the young female basketball players in the present sample had high values in all dimensions of enjoyment in sports, playing in different competitive levels appears to exert a contrasting influence on how players evaluate their competence. While club level players value self-referenced competencies more, state-level players value more others-referenced competencies, i.e., how they compare their skill or performance with others.

Body dimensions of the adolescent female basketball players, on average, were comparable with age-specific 75th to 95th percentiles for stature, and comparable with age-specific 50th to 75th percentiles for body mass of US reference data (164). However, when matched with basketball samples, even the taller players selected for the higher competitive level and the older age groups (under-15 and under-17) teams in the present study had lower values for stature, on average, compared to adolescent female players from state and national

level in Australia (119), or with players attaining amateur level (165), professional level at adult level (166), or elite adult level considering as reference data from the Women's World Basketball Championships, held in Australia in 1994 (167).

Adding to the previous observations, age at menarche in the present sample was, on average, 11,8 (95% CI: 11,5 to 12,1 years). Hence, attained the age at menarche in the present sample was earlier than observations based on Brazilian data (65, 147) and worldwide observations (168). Consistent with previous observations that included part of the sample in the present study (65, 74), the female basketball players considered in the study were, on average, advanced in maturity status. However, there was no substantial variation by competitive level in the players´ age at menarche (see Table 7). These results suggest that the overrepresentation of early maturing girls in competitive basketball at the early ages of selection is independent of the competitive level.

Due the scarce data available in female youth basketball, specially considering growth-related changes and youth development, comparative data are limited. Our observations were also consistent with recent data in female Portuguese basketball, showing a trend of overrepresentations of early maturing girls within the teams selected to represent regional teams at the national championship (169). However, caution is warranted in the interpretation of the Portuguese data, as acknowledged by the authors, as maturity status estimations were based on the maturity offset protocol, which has limited validity (73). The present data suggest that early maturing, bigger girls may be advantaged to be retained within youth basketball programs. At least in the context of our observation, basketball coaches should consider training strategies to allow late-maturing girls to remain engaged in sport. Particularly for stature, a late-maturing girl may have a greater potential to attain higher adult stature (170).

On the other hand, young female players selected to represent the state teams had more accumulated experience. Conditional on the data, the more advanced "sports age" was also relevant to explain differences between players by competitive level across all age groups observed. Also, more experienced female players had better functional performance, independent of their competitive level. These observations were consistent with previous cross-sectional and longitudinal data (65, 74). Hence, the results imply that early specialization in female youth basketball may provide an advantage for functional capacities development. Adding to probable size advantages of early maturing girls, emphasis on early performance may be a contributing factor for the overrepresentation of early maturing girls across the observed

age groups. Particularly at early age groups, coaches should be cautious interpreting players´ performance (i.e., excluding or promoting), given the influence of accumulated training stimulus on functional performance combined with pronounced increases in functional performance during pubertal growth (74).

Partitioning the influence of training experience on functional performance, the female players selected for the state team had better functional performance, in particular, maximal short-term performance (i.e., vertical jump and Line-drill test). These observations were consistent with the limited data available considering functional performance with female adolescent basketball players. It has been noted that female adolescent players from the national level had better short-term outputs compared with state-level players within the Basketball Australia's State and National programs (119). Allowing for differences in procedures, it was also noted among contrasting levels of female under-14 players that players from the best ranked regional teams in the annual *Portuguese Festival of Youth Basketball* had better overall functional performance (169). However, the limited data available did not account for the confounding influence of maturity status and training experience on functional performance.

Youth sports developmental models often consider psychological dispositions and mental skills, besides motivation characteristics (171). Given the importance of accumulated training experience on the functional performance of young athletes, and likely influence on sport selection, the deliberate practice framework is generally assumed in the context of youth sports programs in team sports, such as basketball. Hence, personality-related dispositions and skills such as motivation characteristics, achievement and competitiveness motivation or deliberate practice motivation may provide important insights about the dispositions to be engaged and committed to a long and rocky road of more specialized and demanding practice for aspiring elites.

Conditional on the data, the Brazilian adolescent female basketball players showed high scores across the dimensions of deliberate practice motivation and achievement and competitiveness motivation. However, state-level players only had substantially higher values for competitiveness dimension compared to club level players, across all age groups. These observations contrast with the comparable data considering under-16 female Portuguese players from the national training centers of the Portuguese Basketball Federation, and from clubs competing at a national level (21). In the Portuguese sample, players from the Portuguese Federation training centers centers had substantially higher scores for almost all dimensions of

deliberate practice motivation and achievement and competitiveness motivation compared to players from clubs competing at the national level. These divergences might reflect the contextual differences between youth and adult basketball between the observed countries. Within the Portuguese context, a path to achieve professional adult basketball for both players from high-performance centers of the Portuguese Basketball Federation training centers and the national level players was available and proposed for players. In contrast, a path to achieve a professional adult level in female Brazilian basketball remains less clear nowadays for the young female players in the present sample. This may explain the trend of lower scores in all motivation dimensions, as age groups were older, independent of accumulated experience. The young athletes could potentially perceive the limited opportunities to remain engaged in competitive female basketball.

Overall the female adolescent basketball players in the present sample perceived their experience in organized basketball structured practice as enjoyable. As noted in another context of sports practice (22), the present observations do not fit well with the deliberate practice framework, mostly based on musicians' expertise (24). Interestingly, it appears that there is a contrast in the players´ enjoyment source for referenced competence related to the different competitive levels environments. Also, there was a relation between accumulated years of experienced and other-referenced competences. These observations suggest that coaches should be aware that with the increase in training experience and competitive level female adolescent, players may find more enjoyable to compare themselves against their peers and be valued by their improved performance or ability against their peers.

Conditional on the data, the Brazilian youth female basketball contexts appear to provide a nurturing environment for players´ development. Overall, the female adolescent players were highly motivated for deliberate practice, achievement, and competitiveness, and perceived their experience in structured basketball practice sports as highly enjoyable. These observations considering psychological dispositions of adolescent female basketball players are of particular relevance given the recent calls promoting bio-banding as a new paradigm for youth sports and training. Our data highlight the need for caution when assuming that youth sports training and competitive environments have a negative influence on young players´ psychological dispositions, and consequently potentially leading to dropout.

4.5 CONCLUSION

Assuming an interdisciplinary perspective, it was apparent in the present sample that adolescent female basketball players selected for higher competitive levels had more accumulated experience, were taller and with better functional performance. All players were similarly highly motivated for deliberate practice and to achievement and perceived their experience in structured youth basketball as highly enjoyable. Overall, the present data highlight the relation between functional performance and psychological dispositions of adolescent female basketball players with biological characteristics and contexts of practice (e.g., accumulated training experience or different competitive levels). The context of structured youth female basketball potentially provides a positive environment for players´ engagement and commitment to training and excellence attainment. Conditional on the data, youth female coaches tend to value (probably overvalue) size and function when selecting/promoting players, even at early age groups. Hence, coaches should refine their pedagogical strategies, accounting for the importance of the interactions among physical growth and biological maturity status, functional performance, and psychological characteristics, particularly among female adolescent athletes.

5 GENERAL DISCUSSION

Brazilian basketball is mainly organized in clubs and associations, where those players who are engaged in their programs and able to access their training facilities tend to be pre-selected to represent formal competitive teams. On the other hand, youth basketball is commonly proposed to develop young players to compose professional level teams or to promote sports practice in socially disadvantaged contexts. The limited number of national-level clubs and the dearth of professional-level basketball contexts offers limited opportunities for new players to achieve higher levels, especially for female basketball players. Therefore, with an unclear path for progression to achieve professional adult basketball, players may tend to decrease their motivation for achievement and competitiveness as their chronological age and training experience increase.

The available data in youth sports lacks empirical studies considering the multifactorial aspects that have some kind of influence on young athletes' development and progression. Most of the purposed developmental models are based in unidimensional approaches, favoring the potential of one aspect despite its relationship and integration with others. These simple interpretations may cause misunderstandings in youth sports organizations due to its superficial significance of variables in youngs development. On the other hand, available data considering young athletes are often interpreted based on traditional analytical approaches (i.e., single-level regression based models). Multilevel modeling provides a flexible and powerful approach that overcomes the limitations and restrictive assumptions of traditional single level regression models. Also, there is an intense ongoing discussion about the limits of frequentists inference (null hyphotesis testing), and how its limitations and missuse has contributed to the recently recognized statistical crisis in science. Also, in sport sciences the discussion is ongoing, mainly due to the proliferation in sport sciences studies of an alternative to null hypothesis testing and p-values, i.e., the magnitude based-inference. Recently the flaws of the approaches have been demonstrated and its use has been strongly recommended. Alternatively, Bayesian methods may be helpful in sport science research, especially in youth. Bayesian methods allow for intuitivly make direct probabilistic comparisons of the posterior estimates and respective credible intervals. Altogether, Bayesian multilevel modeling allows us to consider the multivariate influence of different timing and tempo of confounding factors as growth, maturation, psycho-behavioral components, training context and sports experience,

potentially providing deeper insights for coaches and stakeholders to embrace their pedagogical intervention in youth training programs.

Conditional to our data, our estimations highlight an overrepresentation of early maturers for male and female young basketball players. Pubertal growth timing and tempo may influence athletes' physical development. As taller and bigger players, they must have better performance scores at that time, which by no mean indicate or predict future potential performance. Apparently, the youth basketball system selects players from early ages to represent clubs in formal competitions promoted by state-level official federations, showing an overemphasis on the early performance of adolescent players. This overestimation may be a contributing factor to cause the overrepresentation of early maturers and the promotion of early performers. At least in the context of our observation, youth basketball coaches should consider training strategies and opportunities to allow late-maturing players to remain engaged in sport. As long-term development could decrease the apparent differences in early ages.

Our findings showed that more accumulated experience in basketball training (i.e. early specialization) was an advantage for young players to keep engaged in a training program or to be promoted to state-level selection. Caution should be taken by coaches and stakeholders when interpreting players' performance (i.e., excluding or promoting), given the influence of accumulated training stimulus on functional performance combined with pronounced increases in functional performance during pubertal growth. Years of training experience also showed an influence in motivation for deliberate practice, achievement and competitiveness dimensions. It seems that the training environment and the time youth spent engaged in its activities influence their behavioral and psychological development. Hence, adolescent athletes are likely shapen by their sport environment.

As for future athletes' development, it is accepted that if athletes keep engaged in formal training structures for a long time, they will be able to achieve higher levels of performance. It is reasonable that high levels of motivation to accomplish time and effort demanding tasks may determine potential achievement and excel. Apparently, as higher the motivation scores, better is the chance to progress in a basketball career. High levels of motivation were showed by athletes considered in both studies. However, our data highlights that persisters were more motivated in competitiveness and will to excel dimensions (see section 3). This trend was also apparent for the adolescent female players. Perhaps, this is one characteristic that coaches recognize and influence their decisions.

The athletes who were selected to represent the state-level team were compared with those who played only in club-level competitions (see section 4). The selection process is mostly determined by the coaches of some of the clubs that participated in state competition for each age group. Apparently, coaches selected players who had better characteristics to perform at that moment. Nevertheless, there was no apparent variation between state-level and club-level players for chronological age and in maturity status, but state-level players were taller, heavier, more experienced and had better functional performance scores. This corroborates the argument that coaches mainly interpret and decide about their young atletes based on snapshots of narrow and likely performance related information.

Overall, female adolescent basketball players in the present study perceived their experience in organized basketball structured practice as enjoyable. Interestingly, it appears that there is a contrast in athletes' enjoyment source for referenced competence related to competitive level engagement by competitive context. State-level players showed higher enjoyment for others referenced competences, while club-level players showed a higher level of self-referenced competencies enjoyment. In general, it highlights the need for caution when assuming that youth sports training and competitive environments have negative influences on young players' psychological dispositions, and consequently other risks.

Assuming the limitations of the assessment of performance in basketball, especially the unavailability of in-game situations analysis, we could find good information about youth sports. Using a multidimensional approach, data could provide a better interpretation of the determinants of Brazilian young basketball players' progression and promotion. Our data suggest that youth basketball organization tend to value early performance and has just a shallow interpretation of young athletes potential future achievement level. Besides the influence of competition at an early age, the environment athletes are engaged seems to influence their perceptions, motivation for deliberate practice, achievement, competitiveness and enjoyment. Considering the influence of coaches, peers, parents, managers and other stakeholders, could provide valuable information to discuss youth sports in further studies.

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APPENDIX A – Termo de Consentimento Livre e Esclarecido (participants)

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO – VULNERÁVEIS
Termo de Assentimento para crianças e adolescentes

Percurso do jovem atleta até a excelência esportiva: análise multidimensional
Nome do pesquisador responsável: Prof. Dr. Humberto Carvalho

Você, mediante sua autorização e do seu representante legal, está sendo convidado(a)a participar como voluntário (a) de um estudo. Este documento, chamado Termo de Consentimento Livre e Esclarecido (TCLE), visa assegurar seus direitos como participante e é elaborado em duas vias, uma que deverá ficar com você e outra com o pesquisador.

Por favor, leia com atenção e calma, aproveitando para esclarecer suas dúvidas. Se houver perguntas antes ou mesmo depois de assiná-lo, você poderá esclarecê-las com o pesquisador. Se preferir, pode levar para casa e consultar seus familiares ou outras pessoas antes de decidir sobre a sua participação. Se você não quiser participar ou retirar sua autorização, a qualquer momento, não haverá nenhum tipo de penalização ou prejuízo.

Justificativa e objetivos:

A pesquisa dedica-se ao estudo do crescimento, maturação biológica e aptidão física no jovem atleta. De uma forma resumida, pretende-se caracterizar o quanto os jovens atletas estão aptos para aquilo que são hoje as exigências de formação esportiva, em particular do volume de treino e competição. Para alcançar esse objetivo, entendemos que a sua participação ser uma importante contribuição.

Procedimentos:

Participando do estudo, você está sendo convidado (a) a:responder um questionário, com questões sobre a importância da prática do esporte no seu dia a dia. O questionário será respondido durante o horário de treinamento, sendo acompanhado (a) pelos professores/treinadores do Clube/Núcleo e pelo pesquisador. O questionário será respondido apenas uma (1) vez, com duração estimada de 15 minutos.

Entre as variáveis em estudo, interessa-nos determinar a aptidão anaeróbia e aeróbia que será determinada através de uma corrida de 140 metros na quadra de basquetebol, uma prova de doze corridas repetidas de 20 metros com vinte segundos de intervalo entre cada corrida, corrida vai-e-vem de 20 metros com e sem intervalos de recuperação, sem que sejam efetuadas qualquer coleta de sangue ou outras coletas invasivas. Adicionalmente, estimaremos a estatura adulta predita também com base no conhecimento da estatura do pai e da mãe biológicos

Você poderá, a qualquer momento, decidir não responder alguma questão ou desistir de participar em qualquer momento da pesquisa.

Desconfortos e riscos:

Você **não** deve participar deste estudo se achar que não foi devidamente esclarecido quanto aos objetivos e da forma em que irá participar. Todas as situações de desconfortos e riscos foram analisadas, e não foi encontrado nada que possa comprometer a sua participação. As provas de aptidão física poderão provocar exaustão e fadiga temporária aos participantes, similar aos momentos mais intensos que os participantes vivenciam no treinamento ou jogo. Na coleta de dados, as instruções preparatórias, acompanhamento durante e após as provas pelos pesquisadores procurará minimizar as situações de desconforto que possam ocorrer em conseqüência das provas da presente pesquisa. Adicionalmente, na ocorrência de qualquer desconforto que não tenha sido previsto nesse documento, serão adotadas providências para minimizá-los. A não autorização em nada afetará a sua relação como atleta com o clube.

Benefícios:

O estudo produzirá informação sobre o estado de crescimento e desempenho físico (vantagens) que serão devolvidas ao professor/treinador da equipe. Você, seu responsável e seu professor/treinador terão acesso aos resultados e ao conhecimento gerado a partir do estudo.

Sigilo e privacidade:

Você e seu responsável têm a garantia de que a identidade será mantida em sigilo e nenhuma informação será dada a outras pessoas que não façam parte da equipe de pesquisadores. Na divulgação dos resultados desse estudo, seu nome e do seu responsável não serão citados.

Ressarcimento:

Não será oferecido nenhum tipo de ressarcimento de despesas (transporte, alimentação, hospedagem, dentre outros) para participação no estudo.

Contato:

Em caso de dúvidas sobre o estudo, você poderá entrar em contato com os pesquisadores Humberto Carvalho (Pesquisador Responsável) e Roberto Rodrigues Paes (Pesquisador), através dos seguintes contatos: Faculdade de Educação Física, Universidade Estadual de Campinas (FEF-UNICAMP), Grupo de Estudo em Pedagogia do Esporte -Avenida Érico Veríssimo, 701, Cidade Universitária Zeferino Vaz, Barão Geraldo, CEP 13.083-851, Campinas, SP; Telefones: 19-3521-6600 (fixo); E-mail: hmoreiracarvalho@gmail.com; robertopaes@fef.unicamp.br; asoares_fef012@hotmail.com. Em caso de denúncias ou reclamações sobre sua participação e sobre questões éticas do estudo, você pode entrar em contato com a secretaria do Comitê de Ética em Pesquisa (CEP) da UNICAMP: Rua: Tessália Vieira de Camargo, 126; CEP 13083-887 Campinas – SP; telefone (19) 3521-8936; fax (19) 3521-7187; e-mail: cep@fcm.unicamp.br

Consentimento livre e esclarecido:

Após discutir com meu (minha) responsável legal sobre a participação no estudo, ter sido esclarecido sobre a natureza da pesquisa, seus objetivos, métodos, benefícios previstos, potenciais riscos e o incômodo que esta possa acarretar, autorizo participar:

Nome do(a) participante: _____

Nome do Responsável:_____

_____Data: ____/_____/_____.

(Assinatura Participante)

Responsabilidade do Pesquisador:

Asseguro ter cumprido as exigências da resolução 466/2012 CNS/MS e complementares na elaboração do protocolo e na obtenção deste Termo de Consentimento Livre e Esclarecido. Asseguro, também, ter explicado e fornecido uma cópia deste documento ao participante. Informo que o estudo foi aprovado pelo CEP perante o qual o projeto foi apresentado e pela CONEP, quando pertinente. Comprometo-me a utilizar o material e os dados obtidos nesta pesquisa exclusivamente para as finalidades previstas neste documento ou conforme o consentimento dado pelo participante.

Data: ____/_____/_____.

(Prof. Dr. Humberto Jorge Gonçalves Moreira de Carvalho – Pesquisador Responsável)

APPENDIX B – Termo de Consetimento Livre e Esclarecido (legal responsible)

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO – VULNERÁVEIS

Percurso do jovem atleta até a excelência esportiva: análise multidimensional
Nome do pesquisador responsável: Prof. Dr. Humberto Carvalho

O (a) seu (a) filho (a), através de você, como responsável legal, está sendo convidado(a) participar como voluntário (a) de um estudo. Este documento, chamado Termo de Consentimento Livre e Esclarecido (TCLE), visa assegurar seus direitos e do (a) seu (a) filho (a) como participante e é elaborado em duas vias, uma que deverá ficar com você e outra com o pesquisador.

Por favor, leia com atenção e calma, aproveitando para esclarecer suas dúvidas. Se houver perguntas antes ou mesmo depois de assiná-lo, você poderá esclarecê-las com o pesquisador. Se preferir, pode levar para casa e consultar seus familiares ou outras pessoas antes de decidir sobre a participação do (a) seu (a) filho (a). Se você não quiser que seu (a) filho (a) participe ou retirar sua autorização, a qualquer momento, não haverá nenhum tipo de penalização ou prejuízo.

Justificativa e objetivos:

A pesquisa dedica-se ao estudo do estado de crescimento, maturação biológica e aptidão física no jovem atleta. De uma forma resumida, pretende-se caracterizar o quanto os jovens atletas estão aptos para aquilo que são hoje as exigências de formação esportiva, em particular do volume de treino e competição. Para alcançar esse objetivo, entendemos que a participação do (a) seu (a) filho (a) poderá trazer importante contribuição.

Procedimentos:

Participando do estudo o (a) seu (a) filho (a) está sendo convidado (a) a: responder um questionário, com questões sobre a importância da prática do esporte no seu dia a dia. O questionário será respondido durante o horário de treinamento, sendo acompanhado (a) pelos professores/treinadores do Clube/Núcleo e pelo pesquisador. O questionário será respondido apenas uma (1) vez, com duração estimada de 15 minutos.

Entre as variáveis em estudo, interessa-nos determinar a aptidão anaeróbia e aeróbia que será determinada através de uma corrida de 140 metros na quadra de basquetebol, uma prova de doze corridas repetidas de 20 metros com vinte segundos de intervalo entre cada corrida, corrida vai-e-vem de 20 metros com e sem intervalos de recuperação, sem que sejam efetuadas qualquer coleta de sangue ou outras coletas invasivas. Adicionalmente, estimaremos a estatura adulta predita também com base no conhecimento da estatura do pai e da mãe biológicos.

O (a) seu (a) filho (a) poderá, a qualquer momento, decidir não responder alguma questão ou desistir de participar em qualquer momento da pesquisa.

Desconfortos e riscos:

Você e seu(a) filho(a) **não** devem participar deste estudo se achar que não foram devidamente esclarecidos quanto aos objetivos e da forma em que irá participar. Todas as situações de desconfortos e riscos foram analisadas, e não foi encontrado nada que possa comprometer a participar do (a) seu (a) filho (a). As provas de aptidão física poderão provocar exaustão e fadiga aguda transiente aos participantes, similar aos momentos mais intensos que os participantes vivenciam no treinamento ou jogo. O desenho de recolha de dados, instruções preparatórias, acompanhamento durante e após as provas pelos pesquisadores procurará minimizar as situações de desconforto que possam ocorrer em consequência das provas da presente pesquisa. Adicionalmente, na ocorrência de qualquer desconforto que não tenha sido previsto nesse documento, serão adotadas providências para minimiza-los. A não autorização em nada afetará a relação do atleta com o clube.

Benefícios:

O estudo produzirá informação sobre o estado de crescimento e desempenho físico (vantagens) que serão devolvidas ao professor/treinador da equipe. Você, seu (a) filho (a) e todos os demais participantes, terão acesso aos resultados e ao conhecimento gerado a partir do estudo.

Sigilo e privacidade:

Você e seu (a) filho (a) tem a garantia de que a identidade será mantida em sigilo e nenhuma informação será dada a outras pessoas que não façam parte da equipe de pesquisadores. Na divulgação dos resultados desse estudo, seu nome e do (a) seu (a) filho (a) não serão citados.

Ressarcimento:

Não será oferecido nenhum tipo de ressarcimento de despesas (transporte, alimentação, hospedagem, dentre outros) para participação no estudo.

Contato:

Em caso de dúvidas sobre o estudo, você poderá entrar em contato com os pesquisadores Humberto Carvalho (Pesquisador Responsável) e Roberto Rodrigues Paes (Pesquisador), através dos seguintes contatos: Faculdade de Educação Física, Universidade Estadual de Campinas (FEF-UNICAMP), Grupo de Estudo em Pedagogia do Esporte -Avenida Érico Veríssimo, 701, Cidade Universitária Zeferino Vaz, Barão Geraldo, CEP 13.083-851, Campinas, SP; Telefones: 19-3521-6600 (fixo); E-mail: hmoreiracarvalho@gmail.com; robertopaes@fef.unicamp.br; asoares_fef012@hotmail.com . Em caso de denúncias ou reclamações sobre sua participação e sobre questões éticas do estudo, você pode entrar em contato com a secretaria do Comitê de Ética em Pesquisa (CEP) da UNICAMP: Rua: Tessália Vieira de Camargo, 126; CEP 13083-887 Campinas – SP; telefone (19) 3521-8936; fax (19) 3521-7187; e-mail: cep@fcm.unicamp.br

Consentimento livre e esclarecido:

Após discutir com meu (minha) filho (a) sobre a participação no estudo, ter sido esclarecido sobre a natureza da pesquisa, seus objetivos, métodos, benefícios previstos, potenciais riscos e o incômodo que esta possa acarretar, autorizo a participação:

Nome do(a) participante: _____

Nome do Responsável:_____

_____Data: ____/_____/_____.

(Assinatura de seu responsável LEGAL)

Responsabilidade do Pesquisador:

Asseguro ter cumprido as exigências da resolução 466/2012 CNS/MS e complementares na elaboração do protocolo e na obtenção deste Termo de Consentimento Livre e Esclarecido. Asseguro, também, ter explicado e fornecido uma cópia deste documento ao participante. Informo que o estudo foi aprovado pelo CEP perante o qual o projeto foi apresentado e pela CONEP, quando pertinente. Comprometo-me a utilizar o material e os dados obtidos nesta pesquisa exclusivamente para as finalidades previstas neste documento ou conforme o consentimento dado pelo participante.

Data: ____/_____/_____.

(Prof. Dr. Humberto Jorge Gonçalves Moreira de Carvalho – Pesquisador Responsável)