Developing motor competency in youths: Perceptions and practices of Strength and Conditioning coaches

Alan M. Burton[1,2,3], Joey C. Eisenmann [1,4], Ian Cowburn[1], Rhodri S. Lloyd[5,6,7] &

Kevin Till[1,3]

Affiliations:

1. Carnegie School of Sport, Leeds Beckett University, Leeds, United Kingdom
2. Queen Ethelburga's Collegiate, York, UK
3. Leeds Rhinos Rugby League Club, Leeds, UK
4. University of Nebraska-Kearney, Kearney, NE, USA
5. Youth Physical Development Centre, Cardiff School of Sport, Cardiff Metropolitan University, Cardiff, UK
6. Sports Performance Research Institute New Zealand (SPRINZ), AUT University, Auckland, NZ
7. Centre for Sport Science and Human Performance, Waikato Institute of Technology, Hamilton, NZ

Corresponding author:

Name: Alan Burton
Address: Carnegie School of Sport, Leeds Beckett University,
Headingley Campus,
Church wood Avenue,
Leeds,
United Kingdom,
LS26 3QT
Email: a.m.burton@leedsbeckett.ac.uk

Word count: 4,611

Abstract

Motor competency is integral to the long-term athletic development of youths. Strength and conditioning (S&C) coaches are recommended to deliver motor competency

interventions, yet there are no studies investigating their perceptions and practices for developing motor competency in youths. Seventy-one S&C coaches (n=67 male; n=4 female) completed an initial and follow up questionnaire using a 5-point Likert scale, rating 1] the importance of developing competence, and 2] how frequently they developed competence across 90 motor competencies. Over 55% of S&C coaches reported a broad range of “important” (69/90) and ”frequently developed” (48/90) motor competencies. The most important motor competency was “deceleration” (4.9±0.3), whilst “hip hinge (bilateral)” was the most practised (4.4±0.5). Upper body pushing and pulling competencies were targeted more than S&C coaches perceived their importance, whilst agility (e.g., turning) competencies were targeted less than their importance. Linear mixed model analysis showed S&C coaches who delivered 3-4 sessions per week targeted 15-18% more motor competencies compared to ≤ 2 sessions per week. Overall, these findings have strong implications for developing motor competency within youths including the reflection of importance vs. practised competencies, coach education programmes, and consideration for how S&C coaches should seek to optimise motor competency development within youths.

Key Words

Long-term Athletic Development, Fundamental Movement Skills, Foundational Movement Skills, Athletic Motor Skill Competencies.

Introduction

A central focus of Long-Term Athletic Development is to habitually develop athleticism within youths. The term “youths” represents both children until the onset of puberty (generally aged 11 for girls and aged 13 for boys), and adolescents following the onset of puberty (generally aged between 12-18 for girls, and aged 14-18 years for boys) (Lloyd et al., 2015b; Towlson et al., 2020). Motor competency is an important component of athleticism for youths, and refers to one’s ability to perform goal-directed tasks which require controlled and coordinated movement of the human body (Cattuzzo et al., 2016; Hulteen et al., 2018; Robinson et al., 2015). Whitehead (2010)

suggests motor competency is multi-dimensional, consisting of simple (e.g., balance, coordination and flexibility), combined (e.g., agility requiring flexibility, balance and coordination) and complex (e.g., hand-eye coordination, needing orientation in space) movement capacities, which are all inter-related. Previous theory indicates that motor competency develops sequentially during early childhood, where stability skills (e.g., balance) develop prior to locomotive skills (e.g., running), followed by object control skills (e.g., catching) (Gallahue et al. 2012).

Across childhood, motor competency, physical fitness and perceived competence are suggested to interact to induce positive (i.e., increased physical activity and healthy weight status) or negative (i.e., decreased physical activity and unhealthy weight status) trajectories (Stodden et al., 2008). Various reviews support these trends, and highlight that motor competency is positively associated with physical activity level (Holfelder & Schott, 2014; Logan et al., 2015), musculoskeletal strength and endurance, cardiorespiratory endurance, and inversely associated with weight status throughout childhood (Cattuzzo et al., 2016; Lubans et al., 2010). Accordingly, limited motor competency foundations could be linked to a “proficiency barrier” (Seefeldt, 1980), whereby reduced competency during childhood transpires to reduced motor competency, physical activity levels and physical fitness in adolescents and adulthood (Stodden et al., 2009). Indeed, children with enhanced motor competency maintain their physical activity levels into adolescence (Barnett et al., 2009; Robinson et al., 2015). Conversely, less competent children show reduced fitness throughout their development (Hands & Larkin, 2006; Robinson et al., 2015; Schott et al., 2007). Therefore, developing and maintaining motor competency throughout childhood and

adolescence is a priority to enhance health, reduce injury risk, reduce obesity, increase athleticism, increase confidence and competence, and enhance physical activity (Cattuzzo et al., 2016; Hardy et al., 2012; Lloyd et al., 2015b; Robinson et al., 2015; Telama et al., 2005).

Recent recommendations state that planned and structured interventions are vital to develop motor competency across long-term athletic development (Lloyd et al., 2016), as practice, feedback and instruction are likely to facilitate positive motor competency outcomes (Clark & Metcalfe, 2002; Gallahue & Ozmun, 2006). Hence, various methods, ideas and approaches (e.g., fundamental movement skills [FMS] (Barnett et al., 2016); foundational movement skills (Hulteen et al., 2018); athletic motor skill competencies [AMSC] (Moody et al., 2013; Lloyd et al., 2015a)) have been proposed to assist practitioners design and implement interventions to develop athleticism within youths. Indeed, structured Strength and Conditioning (S&C) interventions have shown to improve motor competency in youths (Behringer & vom Heede, 2011; Pullen et al., 2020). However, whilst this research has demonstrated positive improvements, no studies have investigated the perceived importance and the practices of S&C coaches that are responsible for developing motor competency in youths. Such insights could help foster the sharing of best practice, enhance long-term athletic development pathways, and inform future coach development and research (Jones et al., 2017; Wells and Langdown, 2020) to help overcome diminishing motor competency levels within youths (Dobbs et al., 2020; Parsonage et al., 2014). Therefore, the purpose of this study was to evaluate and compare the perceptions (i.e., importance) and

practices (i.e., frequency of developing competencies) of S&C coaches responsible for developing motor competency within youths.

Methods

Study design

For this study, a web-based questionnaire approach was adopted. Contrary to other approaches (e.g., face-to-face/telephone interviews, postal questionnaires), web-based questionnaires are simple to use, inexpensive, time efficient and minimise data entry errors (Sebo et al., 2017). Additionally, web-based questionnaires can be distributed internationally to enhance participant reach (Jones et al., 2008). Therefore, the initial and follow up questionnaires were distributed online to S&C coaches responsible for developing motor competency in elite (e.g., talent development) and non-elite (e.g., school) youth environments. The questionnaires were developed and administered using Qualtrics™ software (Qualtrics, Provo, USA) between April and June 2020.

Participants

Initially, potential participants were invited to participate and given access to the questionnaires through professional networks (e.g., LinkedIn), and publicly available emails, as per the methods of similar studies (e.g., Robertson et al., 2017). To increase potential reach, details of the study and the link to participate were circulated on social media (e.g., Twitter). To participate, S&C coaches required 1) a minimum of 3 years'

experience in youth environments (e.g., schools, sports clubs, and talent development pathways involving children and adolescents aged 18 or younger) based upon Drury et al. (2021); and 2) accreditation from a relevant governing body (e.g., United Kingdom Strength and Conditioning Association, National Strength and Conditioning Association, Australian Strength and Conditioning Association, British Association of Sport and Exercise Sciences) and/or a relevant post graduate qualification (e.g., MSc). Such details are synonymous with the minimum knowledge and experience requirements for entry level youth S&C coaching positions.

In total, 71 youth S&C coaches (n = 67 male; n = 4 female; experience = 8.2 ± 4.9 years; range = 3 – 26 years), from 13 countries, completed both questionnaires. Respondents stated their primary affiliation (n = 41 team sports; n = 8 individual sports; n = 19 school/multi-sports; n = 3 academia) and facilitated S&C programmes for several sports including: Athletics (n = 1), Baseball (n = 1), Basketball (n = 1), Cricket (n = 2), Freestyle snow sports (n = 1), Gaelic Athletic Association (GAA) hurling (n = 1), Gymnastics (n = 2), Ice hockey (n = 1), Judo (n = 1), Multiple sports (n = 19), Netball (n = 1), Rowing/Kayaking (n = 1), Rugby (union and league; n = 20), Soccer (n = 17), Short track speed skating (n = 1) and Swimming (n = 1). This study was conducted with formal ethical approval with participants providing consent.

Identifying and defining motor competencies

Before designing the initial questionnaire, the 1st author, who is MSc qualified and has knowledge and experience in youth S&C, identified and defined a list of motor

competencies. This list consisted of 58 competencies, which were based on literature relating to FMS (Giblin et al., 2014), foundational movement skills (Hulteen et al., 2018; Tompsett et al., 2014) and AMSC (Lloyd et al., 2015a). The defined motor competencies were presented to the 5th author, who is a professor of youth athletic development, for examination and critique. Based the 5th author's feedback, 19 definitions were edited and a further 18 competencies were defined and included. The revised list was reviewed again, and then confirmed via discussions between the 1st and 5th authors. In total, 76 motor competencies were identified and defined during this process (supplementary table 1), and presented to participants during section 2 of the initial questionnaire.

Within the initial questionnaire, participants provided suggested additions or changes to the initial list presented. Similar to other S&C practice research (e.g., Gee et al., 2011; Jones et al., 2017), these open-ended responses were analysed via content analysis, (Elo & Kyngäs, 2008) to identify and report common patterns within the data (i.e., suggested additional competencies and/or edits to definitions). The process involved identifying key phrases within responses that represented a motor competency, for example "I would add movement patterns related to crawling", "I would also find it essential to develop crawling derivatives", and "I would also suggest crawling" were identified as "crawling". Such phrases were compared to the initial list presented, and any equivalent phrases were discounted. The 1st author then reviewed the phrases that were truly different from those presented in the initial list, to identify and define additional motor competencies. The defined list of additional competencies were then reviewed and confirmed via discussions between the 1st and 5th authors to

enhance the validity of the follow up questionnaire. This process identified and defined 14 additional motor competencies, which were presented to participants in the follow up questionnaire.

Procedures

The initial questionnaire consisted of three sections. Section 1 requested demographic information relating to the participants primary affiliation, number of years' experience in youth S&C, and the age ranges of their athletes/individuals. The 76 defined motor competencies were presented to S&C coaches in section 2 of the initial questionnaire. Participants were first asked to rate the importance of developing competence in each movement in youth populations on a 5-point scale (1] "not important", 2] "little importance", 3] "somewhat important", 4] "important", 5] "very important") (Croasmun & Ostrom, 2011; Fernandes, & Randall, 1991). After rating all 76 competencies, an open-ended question asked participants if any edits were required, based on the initial list presented (e.g., highlight a competency that was not originally included; suggest edits to the definitions presented).

Section 3 of the initial questionnaire required participants to state their frequency of S&C delivery (i.e., "monthly", "fortnightly", "weekly", "2 x per week", "3 x per week", "4 x per week" or "> 4 x per week") and their average session duration (i.e., "0-30 mins", "31-45 mins", "46 mins – 59 mins", "1 – 1.5 hours" or "> 1.5 hours"). Following this, participants rated how frequently they developed each motor competency based on

their contact time with their youths on a 5-point Likert-scale (1] “never”, 2] “rarely”, 3] “sometimes”, 4] “often”, 5] “always”).

The follow up questionnaire was developed, based on the open-ended responses (14 additions: supplementary table 2) from section 2 of the initial questionnaire. Participants were required to rate the importance of, and how frequently they targeted each additional motor competency. In total, S&C coaches rated their perceived importance and coaching practices of 90 motor competencies.

Data analysis

Likert-scale responses were reported as means and standard deviations and percentage of total responses. Likert-scale responses were categorised as either “important” (“important” + “very important”) or “not important” (“not important + “little importance”) for perceptions, or “frequently developed” (“often” + “always”) or “not frequently developed” (“never” + “rarely”) for practices. To determine the magnitude of the percentages of total responses for each motor competency, qualitative terms were assigned as follows: Minority = <30 %; approximately a third = ~ 30 %; Approximately half = ~50 %; Majority = 55–74 %; Most = ≥75 %; All=100 % of respondents, as per previous research (Ford et al., 2020; Starling & Lambert, 2017).

To analyse the influence of session frequency and duration on S&C coaches’ practices, the percentage of motor competencies reported as “frequently developed”

(i.e., the percentage of competencies rated a 4 [“often”] or 5 [“always”]) was calculated for each participant. A linear mixed model then evaluated the influence of session frequency and duration on the number of competencies that S&C coaches frequently developed. Pairwise comparisons showed the magnitude of difference between groups with the F statistic, degrees of freedom, mean differences, p values reported. Effect sizes are reported as *d* ± 90% confidence intervals. Thresholds for effect sizes were set as follows: 0-0.19, trivial; 0.2-0.59, small; 0.6-1.19, moderate; > 1.2, large (Hopkins, 2000). Competencies were ranked by mean score to compare the differences between perceptions (i.e., importance) and practices (i.e., frequency of developing competence) for each motor competency.

Results

Perceived importance of developing motor competencies

Table 1 shows the 10 most, and 10 least important motor competencies reported by S&C coaches (see supplementary table 3 for a full overview of perceptions). Fifty-four (60%) of the 90 motor competencies were deemed important by most respondents (76-99%), with the majority (55-73%) highlighting a further 15 important motor competencies. The most important motor competencies consisted of “acceleration” (99%), “deceleration” (99%) and “hip hinge (bilateral)” (99%). The majority of S&C coaches rated “skating” (55%) and “Skiing” (62%) competencies as “not important”, while approximately half (45-53%) of the participants rated “galloping”, “vaulting” and “rowing machine” as “not important”. Five other competencies were rated “not important” by approximately a third (31-36%) of S&C coaches.

TABLE 1 HERE

Youth strength and conditioning coach's session frequency and duration

Figures 1a and 1b show the participants reported session frequency and average session duration, respectively. The most common session frequency was "2 x per week" (n = 20, 28%), while "46 – 59 minutes" (n = 26; 37%) was the most common duration.

FIGURE 1a & 1b HERE

Frequency of developing movement competencies with youths

Table 2 shows the 10 most, and 10 least frequently developed motor competencies by S&C coaches (see supplementary table 3 for full overview of practices). Most (76–96%) respondents indicated they "frequently developed" 24 motor competencies with their respective youths with the majority of coaches (55-73%) reporting they "frequently developed" a further 24 motor competencies. The most frequently developed competencies were "hip hinge (bilateral)" (96%), "lunge (horizontal)" (94%) and "squat (bilateral)" (93%). Most S&C coaches (82-99%) highlighted seven competencies that were "not frequently developed", while the majority (58-75%) highlighted a further 15 competencies that were "not frequently developed", within their programmes.

TABLE 2 HERE

Perceptions vs. practices

Table 3 illustrates the differences between S&C coaches' perceptions (i.e., importance) and practices (i.e., frequency of developing movement competencies) for motor competence development in youths (see supplementary table 4 for a full overview). The greatest differences in ranked mean scores between perceptions and practices were witnessed in "upper body horizontal pushing (unilateral/bilateral)" (importance rank = 36; frequency rank = 6; rank difference = ↑ 30), "upper body vertical pushing (unilateral/bilateral)" (importance rank = 32; frequency rank = 9; rank difference = ↑ 23), "reacceleration" (importance rank = 20; frequency rank = 50; rank difference = ↓ 30), and "turning" (importance rank = 7; frequency rank = 35; rank difference = ↓ 28). Five competencies did not change rank, with "skating" (importance rank = 89; frequency rank = 89) and "skiing" (importance rank = 90; frequency rank = 90) being rated the least important and least frequently developed motor competencies.

TABLE 3 HERE

Influence of session frequency and average session duration on youth strength and conditioning coaches' motor competency practices

A linear mixed model identified significant differences between session frequency and the percentage of motor competencies "frequently developed" ($F_{(4,53)}$ = 3.23, p = 0.019). Specifically, S&C coaches delivering sessions "3 x per week" could develop a

significantly greater percentage of motor competencies compared to those delivering sessions “weekly” (mean difference = 16.47%, p = 0.006; d = 1.05 ± 0.77) or “2 x per week” (mean difference = 14.80%, p = 0.008; d = 1.03 ± 0.70). Similarly, participants delivering sessions “4 x per week” could significantly develop more motor competencies than coaches delivering sessions “weekly” (mean difference = 17.73%; p = 0.002; d = 1.00 ± 0.68) and twice weekly (mean difference = 16.06%; p = 0.002; d = 0.93 ± 0.59). There were no significant differences between delivering sessions weekly or twice per week, no significant differences between delivering three or four sessions per week, and no differences between delivering sessions “> 4 x per week” and all session frequencies. Average session duration had no effect on the percentage of motor competencies that S&C coaches “frequently developed” ($F_{(4,53)}$ = 2.31, p = 0.70).

Discussion

The development of motor competency is important for health and performance (Lloyd et al., 2016) but limited research has evaluated the perceptions and practices of practitioners responsible for developing motor competency in youths. Therefore, this study aimed to evaluate and compare the perceptions and practices of youth S&C coaches. Findings indicated that S&C coaches valued the importance of, and frequently developed, a broad range of motor competencies with their youths. However, differences were apparent between S&C coaches’ perceptions and practices, with participants rating greater importance to linear speed and agility competencies (e.g., reacceleration, turning), whilst targeting more resistance training

competencies (e.g., upper body pushing and pulling) in their coaching practices. Further, coaches who delivered 3 or 4 sessions per week targeted between 15-18% more motor competencies, compared to coaches who delivered 2 or less sessions per week.

Strength and conditioning coaches perceived it important to develop a broad range of motor competencies relating to speed (e.g., “acceleration”), resistance training (e.g., “hip hinge [bilateral]”), agility (e.g., “turning”) and plyometrics (e.g., “jumping [vertical]”) activities. However, common FMS (e.g., “galloping”, “2-handed striking”, “cartwheel”) and foundational movement skills (e.g., “cycling”, “swimming”) were reported as the least important motor competencies to develop. Reporting lower importance to traditional FMS or foundational competencies may have implications for a youth’s motor competency as they develop. For example, previous studies have identified that 51% of adolescent rugby union players lack proficient sprint mechanics (Parsonage et al., 2014), and young male cricketers lack squatting proficiency across all stages of maturity (Dobbs et al., 2020). Therefore, considering the findings of the present study, it is plausible that S&C coaches are overlooking the importance of developing FMS and foundational competencies, which could lead to reduced motor proficiency at latter stages of development.

Although S&C coaches may be overlooking FMS and foundational motor competencies, likely explanations exist. Firstly, it is unclear what coaches learn throughout their formal education (e.g., university) relating to motor competency

development, because the curriculum contents of institutions are rarely published. Furthermore, it appears that national S&C accreditation curriculums focus on resistance training principles over motor competence development (e.g., National Strength and Conditioning Association, 2020; United Kingdom Strength and Conditioning Association, n.d.). If university curricula align with national accreditation curricula, it may be plausible that S&C coaches develop and express knowledge/skills related to resistance training over motor competency development in youths. If so, this may partially explain why coaches value the importance of resistance training competencies over FMS and foundational competencies. Second, perceived importance could be related to other coaches' practices within a multi-disciplinary team. For example, research involving a sports-based multi-disciplinary team suggests that operational monitoring (i.e., monitoring day to day processes), and reflections of observations could influence decision-making related to injury prevention (Tee & Rongen, 2020). Specifically, these observations may change the focus of subsequent training sessions. In the context of developing motor competency, it's plausible that if S&C coaches observe another coach frequently focusing on certain competencies (e.g., agility) within their sessions, the S&C coach may spend less time developing those competencies, thus identifying them as less important.

When ranking motor competencies in order from most to least important, the top five competencies were: "deceleration", "acceleration", "sprinting", "hip hinge (bilateral)" and "landing (bilateral)". This suggests coaches may value the importance of enhancing sports performance (Rumpf et al., 2012) and injury risk reduction (Rössler et al., 2014; Steib et al., 2017) within their programmes as these competencies align

to existing research. However, when comparing perceptions to practices, the most important competencies (except “hip hinge [bilateral]”) ranked lower (ranked difference: “deceleration”, ↓ 20; “acceleration”, ↓ 11, “sprinting”, ↓ 13; “landing [bilateral]”, ↓ 9) than some more recognised resistance training (e.g., frequency rank: “squat [bilateral]” = 2; “upper body vertical pulling [unilateral/bilateral]” = 4; “upper body horizontal pushing [unilateral/bilateral]” = 6) and plyometric competencies (e.g., frequency rank: “jumping [vertical]” = 5; “jumping [horizontal]” = 7). This indicates that coaches focused more on developing traditional resistance training competencies (especially within the upper body), that may not be as important as initially perceived, to prepare youth for the demands of sport (Lloyd et al., 2016). These findings therefore represent a potential disconnect between S&C coaches’ perceptions and practices when developing motor competency in youths, which signifies that coaches don’t target what they perceive is important. Such findings may be indicative of complex decision-making processes in S&C, which are influenced by various contextual factors including an organization’s values, other individuals (e.g., players, other coaches, club officials, support staff, and parents), accepted practices and traditions, physical constraints (e.g., facilities), and resources (Till et al., 2019). For example, respondents in this study may target more resistance training competencies as their sessions (depending on facilities and resources) are more gym based. Nevertheless, a deeper understanding is required to fully understand why S&C coaches report a disconnect between perceptions and practices. Coaches should reflect on their practices to ensure these are appropriate for their athlete’s/individual’s needs.

The most commonly reported session frequency and duration was 2 sessions per week, lasting 46-59 minutes. Results showed that session frequency, but not duration, influenced the percentage of competencies “frequently developed” by S&C coaches. Respondents delivering 3 or 4 sessions per week “frequently developed” 15-18% more competencies than those who delivered sessions twice weekly or less. These findings could be explained by coaching efficacy theory, which suggests a coaches’ perceived ability could influence their behaviours (Bandura, 1977; Bandura, 1986; Feltz et al., 1999). For example, respondents in the present study stated they frequently developed ”hip hinge (bilateral)” (mean response = 4.45 ± 0.58), “squat (bilateral)” (mean response = 4.39 ± 0.62) and “jumping (vertical)” (mean response = 4.30 ± 0.68) competencies, over “sprinting” (mean response = 4.18 ± 0.92). Although (in adults) specific sprinting methods are the ideal method to enhance sprint performance (Rumpf et al., 2016), combined plyometric and resistance training interventions can improve speed in adolescent males (ES = -1.33 ± 0.47; percentage change = -5.79 ± 2.54%) (Rumpf et al. 2012). Consequently, coaches delivering fewer sessions may focus on competencies which they are more confident at coaching (e.g., resistance training and plyometric competencies), regardless of what constitutes “ideal practice”. Furthermore, coaches with a greater session frequency may have more flexibility enabling them to experiment, build confidence, and expand the repertoire of motor competencies which they frequently develop. Therefore, S&C coaches should seek other opportunities outside of scheduled sessions, to target a broader range of motor competencies.

To maximise opportunities to develop a broader range of motor competencies within sessions, S&C coaches may focus on various transferable competencies rather than individual skills. Here, the AMSC approach could be appropriate as most athletic tasks typically involve numerous AMSC combinations (e.g., rapid change of direction efforts during tennis requires lower limb force production/load attenuation, along with core bracing/antirotation). Developing strength and coordination is essential for motor competency because all forms of movement require some degree of force production and absorption (Lloyd et al., 2019; Radnor et al., 2020). Therefore, coaches should develop quality and function within each AMSC, using varying levels of session structure depending on the coaching environment and maturity stage of youths (Radnor et al., 2020).

Outside of S&C sessions, the concept of “microdosing” could maximise the number of competencies developed across long-term athletic development. Microdosing, involves frequently performing exercises at a low volume, but high frequency (Read et al., 2020). In relation to motor competency, microdosing could occur as frequently as a coaches programme allows, providing stimulus to various competencies that are important, but less frequently developed (Read et al., 2020). However, during the circumpubertal period of adolescence, some youths may be susceptible to adolescent awkwardness (i.e., a temporary reduction in sensorimotor function; (Quatman-Yates et al., 2012)). Therefore S&C coaches should longitudinally track motor competence, using technique and outcome based assessments (Hulteen, Barnett et al., 2020; Hulteen, True et al., 2020), and regularly review their interventions to facilitate the individualised development of important but un-targeted competencies (Lloyd et al.,

2016). To facilitate microdosing of less targeted competencies, coaches could utilise the RAMPAGE (i.e., raise, activate, mobilise, prepare, activity, games, evaluate) coaching session framework (Till et al., 2020). Specifically, the “RAMP” element represents a structured warm-up , where coaches could target various locomotive, object control, strength, stability, mobility, plyometric and speed competencies (Till et al., 2020). Within sessions, coaches can then use the “activity”, “games” and “evaluate” sections to frequently target AMSC and sport specific skills, whilst continually reflecting on practices (Till et al., 2020).

Although this is the first study to examine the perceptions and practices of S&C coaches responsible for developing motor competency in youths, it is not without limitations. Firstly, it is not possible to fully explain participants responses to each motor competency. Other studies examining the perceptions and practices of professional golfers (Wells & Langdown, 2020) and elite Rugby Union S&C coaches (Jones et al., 2017) included deeper qualitative processes, and therefore added clarity to their findings. Thus, utilising qualitative methods (e.g., more open ended questions or focus groups) in the present study could have provided additional context to explain quantitative scores (Robertson et al., 2017). Nevertheless, this study provides coaches with practical recommendations to increase the repertoire of motor competencies which are develop within their long-term athletic development programmes. Secondly, this study investigated S&C coaches perceived importance and coaching practices related to the youths that they coach. This approach therefore does not consider how S&C coaches’ perceptions and practices may change depending on the different stages of biological maturity. This is an important

consideration as coaching practices should differ depending on biological and psychosocial maturity (Lloyd & Oliver 2012; Lloyd et al., 2015b). Yet, this study provides a comprehensive examination of how S&C coaches perceptions differ to coaching practices, which has implications for future coach development. Thirdly, it is clear that a very low number of female S&C coaches were involved in this study, and may represent a gender gap within the industry. Indeed, this limits the ability to compare perceptions and practices between male and female S&C coaches, which could provide intriguing findings. However, this is an interesting future research direction in a relatively new and novel research topic.

Conclusion

This study evaluates and compares the perceptions and practices of S&C coaches responsible for developing motor competency in youths. Coaches perceive it important to develop a broad range of competencies (e.g., speed, resistance training, agility, plyometrics) which is replicated in their coaching practice delivery. Findings reflect a preference towards developing resistance training competencies (e.g., ranked mean scores for developing upper body motor competencies were 18-30 places higher than perceived importance), to prepare youths for sport and more intensive S&C programmes at following stages in their training careers. This suggests coaches should reflect on their practices to ensure they are delivering competencies related to their athletes/individual's needs. Session frequency but not session duration significantly influenced the number of motor competencies developed by coaches, with those who delivered 3-4 sessions per week developing 15%-18% more

competencies than those who delivered sessions twice weekly or less. This suggests that coaches with less contact time should seek additional opportunities (outside of scheduled sessions) to target motor competencies which receive less focus. Other practitioners responsible for developing motor competency in youths can use the extensive list of movements provided to evaluate their own coaching strategies. Additionally, coaches and researchers can design motor competency interventions considering the large range of competencies presented. Future research should evaluate how youth S&C coaches' perceptions and practices change depending on maturity status, and should involve deeper qualitative approaches to provide greater context to this important area for enhancing performance and health in youths.

Practical applications

There are several practical applications related to the results of this study. Firstly, findings suggest that S&C coaches should reflect on their coaching practices, to ensure that targeted competencies reflect their athletes/individual's needs. This should involve evaluating important competencies relating to their youths' stage of development, comparing these competencies to those frequently developed, and identifying how to develop competencies that require more focus within their programmes. Additionally, S&C coaches with reduced session frequency should seek other opportunities to develop more motor competencies in their programmes. Here, a two-fold approach could be used by 1] utilising the AMSC approach to develop motor competency within S&C sessions (Radnor et al., 2020), and 2] micro-dosing other

important competencies outside of S&C sessions as part of a motor competency focused warmup (e.g., RAMPAGE; Till et al., 2020).

Acknowledgements

The authors would like to thank all the participants involved throughout this study.

Declaration of Interest

The authors report no conflict of interest.

References

Bandura, A. (1977) *Social Learning Theory*. Englewood Cliffs, N.J.: Prentice Hall.

Bandura, A. (1986) *Social Foundations of Thought and Action: A Social Cognitive Theory*. Englewood Cliffs, N.J, USA: Prentice Hall.

Barnett, L. M., van Beurden, E., Morgan, P. J., Brooks, L. O. & Beard, J. R. (2009) Childhood Motor Skill Proficiency as a Predictor of Adolescent Physical Activity. *Journal of Adolescent Health*, 44 (3), pp. 252–259.

Behringer, M. & vom Heede, A. (2011) Effects of Strength Training on Motor Performance Skills in Children and Adolescents: A Meta-Analysis. *Pediatric Exercise Science*, 23, pp. 186–206.

Cattuzzo, M. T., dos Santos Henrique, R., Ré, A. H. N., de Oliveira, I. S., Melo, B. M., de Sousa Moura, M., de Araújo, R. C. & Stodden, D. (2016) Motor Competence and Health Related Physical Fitness in Youth: A Systematic Review. *Journal of Science and Medicine in Sport*, 19 (2), pp. 123–129.

Clark, J. E. & Metcalfe, J. S. (2002) The Mountain of Motor Development: A Metaphor. In: Clarke, J. E. & Humphrey, J. H. ed., *Motor development: research and reviews*. vol. 2. Reston, VA: National Association for Sport and Physical Education, pp. 163–190.

Croasmun, J. T. & Ostrom, L. (2011) Using Likert-Type Scales in the Social Sciences. *Journal of Adult Education*, 40 (1), pp. 19–22.

Dobbs, I. J., Oliver, J. L., Wong, M. A., Moore, I. S. & Lloyd, R. S. (2020) Movement Competency and Measures of Isometric and Dynamic Strength and Power in Boys of Different Maturity Status. *Scandinavian Journal of Medicine & Science in Sports*, 30 (11) November, pp. 2143–2153.

Drury, B., Clarke, H., Moran, J., Fernandes, J. F. T., Henry, G. & Behm, D. G. (2021) Eccentric Resistance Training in Youth: A Survey of Perceptions and Current Practices by Strength and Conditioning Coaches. *Journal of Functional Morphology and Kinesiology*, 6 (1), p. 21.

Elo, S. & Kyngäs, H. (2008) The Qualitative Content Analysis Process. *Journal of Advanced Nursing*, 62 (1), pp. 107–115.

Feltz, D. L., Chase, M. A., Moritz, S. E. & Sullivan, P. J. (1999) A Conceptual Model of Coaching Efficacy: Preliminary Investigation and Instrument Development. *Journal of Educational Psychology*, 91 (4), pp. 765–775.

Fernandes, M. & Randall, D. (1991) The Social Desirability Response Bias in Ethics Research. *Journal of Business Ethics*, 10 (11), pp. 805–807.

Gallahue, D. L. & Ozmun, J. C. (2006) *Understanding Motor Development: Infants, Children, Adolescents, Adults*. Boston, MA: McGraw-Hill.

Gallahue, D. L., Ozmun, J. C. & Goodway, J. D. (2012) *Understanding Motor Development: Infants, Children, Adolescents, Adults.* New York, NY: McGraw-Hill.

Gee, T. I., Olsen, P. D., Berger, N. J., Golby, J. & Thompson, K. G. (2011) Strength and Conditioning Practices in Rowing. *Journal of Strength and Conditioning Research*, 25 (3), pp. 668–682.

Giblin, S., Collins, D. & Button, C. (2014) Physical Literacy: Importance, Assessment and Future Directions. *Sports Medicine*, 44 (9), pp. 1177–1184.

Hands, B. & Larkin, D. (2006) Physical Fitness Differences in Children with and without Motor Learning Difficulties. *European Journal of Special Needs Education*, 21 (4), pp. 447–456.

Hardy, L. L., Reinten-Reynolds, T., Espinel, P., Zask, A. & Okely, A. D. (2012) Prevalence and Correlates of Low Fundamental Movement Skill Competency in Children. *Pediatrics*, 130 (2), pp. e390–e398.

Hopkins, W. G. (2000) Measures of Reliability in Sports Medicine and Science. *Sports Med*, 30 (1), pp. 1–15.

Hulteen, R. M., Barnett, L. M., True, L., Lander, N. J., del Pozo Cruz, B. & Lonsdale, C. (2020) Validity and Reliability Evidence for Motor Competence Assessments in Children and Adolescents: A Systematic Review. *Journal of Sports Sciences*, 38 (15), pp. 1717–1798.

Hulteen, R. M., Morgan, P. J., Barnett, L. M., Stodden, D. F. & Lubans, D. R. (2018) Development of Foundational Movement Skills: A Conceptual Model for Physical Activity Across the Lifespan. *Sports Medicine*, 48 (7), pp. 1533–1540.

Hulteen, R. M., True, L. & Pfeiffer, K. A. (2020) Differences in Associations of Product- and Process-Oriented Motor Competence Assessments with Physical Activity in Children. *Journal of Sports Sciences*, 38 (4), pp. 375–382.

Jones, S., Murphy, F., Edwards, M. & James, J. (2008) Doing Things Differently: Advantages and Disadvantages of Web Questionnaires. *Nurse Researcher*, 15 (4), pp. 15–26.

Jones, T., Smith, A., MacNaughton, L. & French, D. (2017) Variances In Strength And Conditioning Practice In Elite Rugby Union Between The Northern And Southern Hemispheres. *Journal of Strength and Conditioning Research*, 31 (12), pp. 3358–3371.

Lloyd, R. S., Cronin, J. B., Faigenbaum, A. D., Haff, G. G., Howard, R., Kraemer, W. J., Micheli, L. J., Myer, G. D. & Oliver, J. L. (2016) National Strength and Conditioning Association Position Statement on Long-Term Athletic

Development. *Journal of Strength and Conditioning Research*, 30 (6), pp. 1491–1509.

Lloyd, R. S., Moeskops, S. & Granacher, U. (2019) Motor Skill Training for Young Athletes. In: Lloyd, R. S. & Oliver, J. L. ed., *Strength and Conditioning for Young Athletes: Science and Application*. New York, NY: Routledge.

Lloyd, R. S. & Oliver, J. L. (2012) The Youth Physical Development Model: A New Approach to Long-Term Athletic Development. *Strength and Conditioning Journal*, 34 (3), pp. 61–72.

Lloyd, R. S., Oliver, J. L., Faigenbaum, A. D., Howard, R., De Ste Croix, M. B. A., Williams, C. A., Best, T. M., Alvar, B. A., Micheli, L. J., Phillip Thomas, D., Hatfield, D. L., Cronin, J. B. & Myer, G. D. (2015a) Long Term Athletic Development, Part 2: Barriers to Success and Potential Solutions. *Journal of Strength and Conditioning Research*, 29 (5), pp. 1451–1464.

Lloyd, R. S., Oliver, J. L., Faigenbaum, A. D., Howard, R., De Ste Croix, M. B. A., Williams, C. A., Best, T. M., Alvar, B. A., Micheli, L. J., Phillip Thomas, D., Hatfield, D. L., Cronin, J. B. & Myer, G. D. (2015b) Long-Term Athletic Development - Part 1: A Pathway for All Youth. *Journal of Strength and Conditioning Research*, 29 (5), pp. 1439–1450.

National Strength and Conditioning Association (2020) NSCA Certification Handbook [Online]. National Strength and Conditioning Association. Available from: <https://www.nsca.com/globalassets/certification/certification-pdfs/certification-handbook.pdf> [Accessed 17 December 2020].

Parsonage, J. R., Williams, R. S., Rainer, P., McKeown, I. & Williams, M. D. (2014) Assessment of Conditioning-Specific Movement Tasks and Physical Fitness Measures in Talent Identified Under 16-Year-Old Rugby Union Players: *Journal of Strength and Conditioning Research*, 28 (6) June, pp. 1497–1506.

Pullen, B. J., Oliver, J. L., Lloyd, R. S. & Knight, C. J. (2020) The Effects of Strength and Conditioning in Physical Education on Athletic Motor Skill Competencies and Psychological Attributes of Secondary School Children: A Pilot Study. *Sports*, 8 (10) October, p. 138.

Quatman-Yates, C. C., Quatman, C. E., Meszaros, A. J., Paterno, M. V. & Hewett, T. E. (2012) A Systematic Review of Sensorimotor Function during Adolescence: A Developmental Stage of Increased Motor Awkwardness? *British Journal of Sports Medicine*, 46 (9), pp. 649–655.

Radnor, J. M., Moeskops, S., Morris, S. J., Mathews, T. A., Kumar, N. T. A., Pullen, B. J., Meyers, R. W., Pedley, J. S., Gould, Z. I., Oliver, J. L. & Lloyd, R. S. (2020) Developing Athletic Motor Skill Competencies in Youth. *Strength and Conditioning Journal*, 42 (6), pp. 54–70.

Read, P. J., Oliver, J. L. & Lloyd, R. S. (2020) Seven Pillars of Prevention: Effective Strategies for Strength and Conditioning Coaches to Reduce Injury Risk and Improve Performance in Young Athletes. *Strength & Conditioning Journal*, 42 (6), pp. 120–128.

Robertson, S., Kremer, P., Aisbett, B., Tran, J. & Cerin, E. (2017) Consensus on Measurement Properties and Feasibility of Performance Tests for the Exercise and Sport Sciences: A Delphi Study. *Sports Medicine - Open*, 3 (2), pp. 1–10.

Robinson, L. E., Stodden, D. F., Barnett, L. M., Lopes, V. P., Logan, S. W., Rodrigues, L. P. & D'Hondt, E. (2015) Motor Competence and Its Effect on Positive Developmental Trajectories of Health. *Sports Medicine*, 45 (9), pp. 1273–1284.

Rössler, R., Donath, L., Verhagen, E., Junge, A., Schweizer, T. & Faude, O. (2014) Exercise-Based Injury Prevention in Child and Adolescent Sport: A Systematic Review and Meta-Analysis. *Sports Medicine*, 44 (12), pp. 1733–1748.

Rumpf, M. C., Cronin, J. B., Pinder, S. D., Oliver, J. & Hughes, M. (2012) Effect of Different Training Methods on Running Sprint Times in Male Youth. *Pediatric Exercise Science*, 24 (2), pp. 170–186.

Rumpf, M. C., Lockie, R. G., Cronin, J. B. & Jalilvand, F. (2016) Effect of Different Sprint Training Methods on Sprint Performance Over Various Distances: A Brief Review. *Journal of Strength and Conditioning Research*, 30 (6), pp. 1767–1785.

Schott, N., Alof, V., Hultsch, D. & Meermann, D. (2007) Physical Fitness in Children With Developmental Coordination Disorder. *Research Quarterly for Exercise and Sport*, 78 (5), pp. 438–450.

Sebo, P., Maisonneuve, H., Cerutti, B., Fournier, J. P., Senn, N. & Haller, D. M. (2017) Rates, Delays, and Completeness of General Practitioners' Responses to a Postal Versus Web-Based Survey: A Randomized Trial. *Journal of Medical Internet Research*, 19 (3), p. e83.

Seefeldt, V. (1980) Developmental Motor Patterns: Implications for Elementary School Physical Fitness. In: Nadeau, C. H., Halliwell, W. R., Newell, K. C. & Roberts,

G. C. ed., *Psychology of motor behavior and sport*. Champaign: Human Kinetics, pp. 314–323.

Steib, S., Rahlf, A. L., Pfeifer, K. & Zech, A. (2017) Dose-Response Relationship of Neuromuscular Training for Injury Prevention in Youth Athletes: A Meta-Analysis. *Frontiers in Physiology*, 8, p. 920.

Stodden, D. F., Goodway, J. D., Langendorfer, S. J., Roberton, M. A., Rudisill, M. E., Garcia, C. & Garcia, L. E. (2008) A Developmental Perspective on the Role of Motor Skill Competence in Physical Activity: An Emergent Relationship. *Quest*, 60 (2), pp. 290–306.

Stodden, D., Langendorfer, S. & Roberton, M. A. (2009) The Association Between Motor Skill Competence and Physical Fitness in Young Adults. *Research Quarterly for Exercise and Sport*, 80 (2), pp. 223–229.

Tee, J. & Rongen, F. (2020) 'How' a Multidisciplinary Team Worked Effectively to Reduce Injury in a Professional Sport Environment - Pre-Print. *SportRχiv* [Online]. Available from: <https://osf.io/7qh4c> [Accessed 15 January 2021].

Telama, R., Yang, X., Viikari, J., Välimäki, I., Wanne, O. & Raitakari, O. (2005) Physical Activity from Childhood to Adulthood: A 21-Year Tracking Study. *American Journal of Preventive Medicine*, 28 (5), pp. 267–273.

Till, K., Eisenmann, J., Emmonds, S., Jones, B., Mitchell, T., Cowburn, I., Tee, J., Holmes, N. & Lloyd, R. S. (2020) A Coaching Session Framework to Facilitate Long-Term Athletic Development. *Strength & Conditioning Journal*, Publish Ahead of Print May, pp. 1–13.

Till, K., Muir, B., Abraham, A., Piggott, D. & Tee, J. (2019) A Framework for Decision-Making Within Strength and Conditioning Coaching. *Strength and Conditioning Journal*, 41 (1), pp. 14–26.

Tompsett, C., Burkett, B. & McKean, M. R. (2014) Development of Physical Literacy and Movement Competency: A Literature Review. *Journal of Fitness Research*, 3 (2), pp. 53–74.

Towlson, C., Salter, J., Ade, J. D., Enright, K., Harper, L. D., Page, R. M. & Malone, J. J. (2020) Maturity-Associated Considerations for Training Load, Injury Risk, and Physical Performance in Youth Soccer: One Size Does Not Fit All. *Journal of Sport and Health Science* [Online]. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S2095254620301198> [Accessed 10 May 2021].

United Kingdom Strength and Conditioning Association (n.d.) UKSCA Competency Document [Online]. United Kingdom Strength and Conditioning Association. Available from: <https://www.uksca.org.uk/assets/pdfs/ASCCdocs/ASCCcompetencyDocument.pdf> [Accessed 17 December 2020].

Wells, J. E. T. & Langdown, B. L. (2020) Sports Science for Golf: A Survey of High-Skilled Golfers' "Perceptions" and "Practices". *Journal of Sports Sciences*, 38 (8), pp. 918–927.

Whitehead, M. (2010) *Physical Literacy: Throughout the Lifecourse*. London: Routledge.

Tables (with captions)

Table 1. An overview of the 10 most, and 10 least important motor competencies to develop based on percentage of response frequency.

Movement	Not Important (% scoring a 1 or 2)	Important (% scoring a 4 or 5)
Most important		
Acceleration	0	99
Deceleration	0	99
Hip hinge (bilateral)	0	99
Sprinting	1	97
Turning	1	97
Landing (bilateral)	0	96
Landing (unilateral)	0	96
Cutting	0	94
Hip hinge (unilateral)	1	94
Jumping (Vertical)	0	94
Least important		
Hurdling	36	35
Cycling	31	32
Jogging	33	30
Cartwheel	32	28
Handstand	34	27
Galloping	45	25
Vaulting	51	17
Rowing machine	53	15
Skating	55	8
Skiing	62	3

* Percentages do not add up to 100 % due to rounding and excluding the percentage of response frequencies that did not fit the groupings for perceptions (i.e., excludes percentage of responses scoring a 3, "somewhat important").

Table 2. An overview of the 10 most, and 10 least frequently developed motor competencies based on percentage of response frequency.

Movement	Not frequently developed (% scoring a 1 or 2)	Frequently developed (% scoring a 4 or 5)
Frequently developed		
Hip hinge (bilateral)	0	96
Lunge (horizontal)	1	94
Squat (bilateral)	0	93
Upper body vertical pulling (unilateral/bilateral)	3	92
Jumping (Vertical)	1	90
Jumping (horizontal)	3	90
Upper body horizontal pushing (Unilateral/bilateral)	3	90
Hip hinge (unilateral)	1	89
Hip mobility	0	89
Upper body horizontal pulling (unilateral/bilateral)	3	89
Not frequently developed		
Climbing	83	8
Handstand	68	8
Vaulting	85	8
Rowing machine	70	8
Swimming	77	7
2 handed striking	85	7
1 handed striking	82	7
Cartwheel	70	7
Skating	92	7
Skiing	99	1

* Percentages do not add up to 100 % due to rounding and excluding the percentage of response frequencies that did not fit the groupings for practices (i.e., excludes percentage of responses scoring a 3, "sometimes").

Table 3. Greatest mean score rank changes between perceived importance and coaching practices (i.e., frequency of developing motor competencies).

Movement	Perceived Importance of developing each motor competency			Frequency of developing each motor competency			Rank difference
	Mean	SD	Rank	Mean	SD	Rank	
Greatest rank increase							
Upper body horizontal pushing (Unilateral/bilateral)	4.30	0.74	36	4.30	0.72	6	↑ 30
Upper body vertical pushing (unilateral/bilateral)	4.32	0.71	32	4.27	0.81	9	↑ 23
Upper body horizontal pulling (unilateral/bilateral)	4.34	0.75	29	4.27	0.74	8	↑ 21
Knee hinge (unilateral/bilateral)	4.20	0.86	47	3.92	0.84	26	↑ 21
Anti-lateral flexion	3.80	0.82	62	3.55	0.94	42	↑ 20
Olympic lifting derivatives	3.44	0.94	74	3.35	1.06	54	↑ 20
Upper body vertical pulling (unilateral/bilateral)	4.41	0.69	22	4.31	0.71	4	↑ 18
Lateral flexion	3.44	0.92	73	3.13	1.07	58	↑ 15
Jumping (lateral)	4.21	0.77	45	3.85	0.77	31	↑ 14
Jumping (repeated)	4.24	0.75	40	3.90	0.76	27	↑ 13

Table 3. Continued.

Greatest rank decrease							
Reacceleration	4.48	0.69	20	3.48	0.95	50	↓ 30
Turning	4.65	0.59	7	3.72	0.97	35	↓ 28
Cutting	4.61	0.60	10	3.70	0.93	36	↓ 26
Change of Direction combinations	4.49	0.67	17	3.62	0.95	39	↓ 22
Deceleration	4.89	0.36	1	4.08	0.91	21	↓ 20
Balance (moving)	4.35	0.93	28	3.55	1.01	44	↓ 16
Landing (unilateral)	4.75	0.53	5	4.10	0.66	19	↓ 14
Kicking	4.00	1.07	56	2.42	1.33	70	↓ 14
Dribbling (hands)	3.59	1.17	68	1.96	1.07	82	↓ 14
Swimming	3.54	1.26	70	1.79	1.00	84	↓ 14

Figures

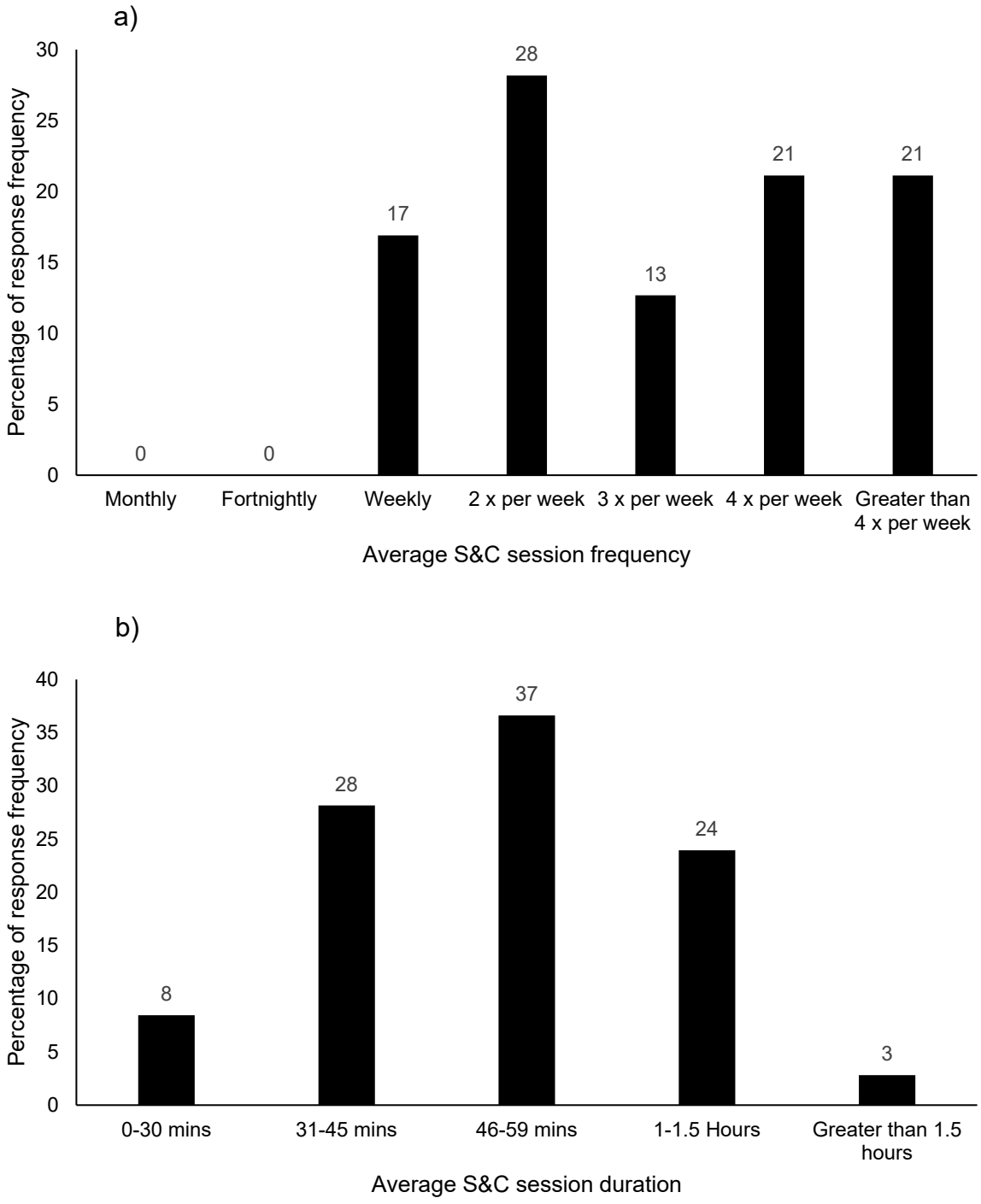

Figure 1. Percentage of response frequency relating to a) how frequently practitioners deliver S&C sessions to their athletes or individuals; and b) their average duration of S&C delivery.

Figure captions (as a list)

Figure 1. Percentage of response frequency relating to a) how frequently practitioners deliver S&C sessions to their athletes or individuals; and b) their average duration of S&C delivery.