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Construct Validity of the Resistance Training Skills Battery in Children aged 7-10 years

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Running Head: Resistance Training Skill

ABSTRACT

The current study sought to examine the construct validity of the Resistance Training Skills Battery for Children (RTSBc), a movement screen purported to assess resistance training skill in children. Children aged 7-10 years (n = 27, 21 males, 6 females) undertook measures of resistance training skill via the RTSBc, motor competence and muscular fitness. Using a median split for RTSBc scores, children were categorised as high or low resistance training competence. Univariate ANCOVAs, controlling for maturation, were used to examine whether measures of muscular fitness and motor competence scores differed as a function of RTSBc competence. Children who were classified as high for resistance training competence had significantly better motor competence ($P = .001$) and significantly faster 10m sprint speed ($P = .001$). However, medicine ball throw and standing long jump scores as well as peak and average isokinetic muscle strength did not differ as a function of RTSBc ($P > 0.05$). In all cases maturation was significant as a covariate. This study is the first to demonstrate construct validity of the RTSBc as a measure of general motor competence and sprint speed, but not strength, in children aged 7-10 years.

Keywords: Fundamental movement; motor competence; children; strength

Introduction

The importance of strength for children's health has over the last decade gained increased research attention (Smith, et al., 2014; Steene-Johannessen et al., 2009). Physical activity guidelines for youth stress the importance of muscular strength as a health-related factor (Strong, et al., 2005; Bebich-Philip et al., 2016) and the World Health Organization aims to increase participant numbers in muscle strengthening activity (WHO, 2010). Engagement in appropriate resistance training (RT) by children and youth has been shown to be safe, resulting in gains in a number of variables related to health including increased muscular strength, endurance, power, and improved body composition (Lloyd, et al., 2014, Faigenbaum, et al., 2013; Faigenbaum, et al., 2005). Age appropriate RT has been shown to enhance fundamental movement skills (FMS) and physical self-efficacy in children as young as 6 years of age (Duncan, et al., 2017). Alongside age appropriateness, maturation and technical competency are also key aspects which need to be considered when children engage in RT. Furthermore, there has been an increase in sports centres, community groups and schools offering RT programmes for children to increase fitness, motor competence and to reduce injury risk (Faigenbaum, et al., 2013). Given the importance of FMS for children's future PA and the increasing use of RT for children, there is a need to develop practical measures to inform fitness trainers, exercise specialists and Physical Education teachers whether a child is ready to participate in RT. Typically, outcome measures from RT are evaluated using product based methods such as fitness tests (Bebich-Philip, et al., 2016). Product based methods only inform the scientist or coach of the numerical outcome of that measure (e.g., amount of weight lifted). However, process based measures, which provide meaningful feedback on movement technique (Lubans, et al., 2014), may be better placed to inform practitioners whether children are ready to participate in RT. This is because process measures inform the coach of the quality of the movement. While some outcome measures can include both process and product elements, depending on the context there may be a need for one or both types of measure. Lubans et al (2014) developed the Resistance Training Skills Battery (RTSB) to address this issue and provide a means to appraise movement competency specific to RT and to assess technical movements over time using a process based approach (Lubans et al., 2014).The RTSB also may have potential to evaluate RT skill as a consequence of exercise intervention.

The RTSB contains 6 RT skills which represent movements most commonly used in RT youth programmes (Behm et al., 2008; Faigenbaum et al., 2005; Lloyd, et al., 2013) and includes positions and movements considered to provide the basis for strength development (Barnett, et al., 2015). Initial research using the RTSB with adolescents (12-16 years) reported that the RTSB was reliable as a means to rank adolescents on the basis of their skill competency and that it was sensitive enough to detect differences in RT skill competency over time (Lubans, et al., 2014). The RTSB also evidenced construct validity, with scores significantly related to muscular fitness (timed push-up, handgrip strength, standing long jump), suggesting that the more proficient participants on the RTSB scored better on tests of muscular fitness (Lubans, et al., 2014). More recently, Bebich-Philip et al. (2016) adapted the RTSB for children (RTSBc). In their study, Bebich-Philip et al. (2016) used a panel of pediatric exercise experts to review the original RTSB for suitability of use with children. Based on their recommendations, the RTSBc was modified, replacing the lunge exercise with a step-up exercise and changing the front support with chest touches to be performed against a wall rather than on the floor. The rationale for this change, suggested by Bebich-Philip et al. (2016) was that the step-up decreased balance difficulty whilst still assessing dynamic stability during single-limb movements. As a consequence, the RTSBc includes the following exercises: Suspended row, push-up, step-up, body-weight squat, front support with chest touches and standing overhead press. In their study with 20, 6-12 year old children, Bebich-Philip screened retrospectively with videos of movements and demonstrated that the RTSBc had good interrater (ICC = 0.92) and intrarater (ICC = 0.97) reliability. They also noted weak relationships between RTSBc scores and Body Mass Index (BMI) and body fat percentage in their sample. Bebich-Philip et al. (2016) concluded that the RTSBc can be used reliably to assess RT competency of children. Whilst such data are useful, an important next step is to determine the construct validity of the RTSBc. No study to date has explored this issue but for the RTSBc to be considered a measure of RT skill in children, evidence of it's validity is essential. Construct validity is particularly important in this instance by establishing if resistance training skill in children differentiates theoretically related constructs (e.g., muscular fitness and motor competence) (Thomas, Nelson & Silverman, 2015). As children are not simply small adults, it is important to not assume the validity of the RTSB, as examined in adolescents, can be inferred to children where motor competence may be less well developed. The current study aimed to address this issue by examining whether children who scored high or low on the RTSBc had different scores for tests of muscular fitness and motor competence.

Method

Participants

Following institutional ethics approval and informed parental consent, an opportunistic sample of 27 children (21 boys, 6 girls), aged 7-10 years (mean ± SD age = 8.3 ±1.8 years), were recruited from the community. In order to take part children had to provide verbal assent to take part and have no comorbidities or musculoskeletal impairment that prevent physical activity.

Procedures

Experimental Design

The participants attended the human performance laboratory on two separate occasions, separated by 24 hours. On the first occasion, the children undertook anthropometric measurement, performed the RTSBc, and assessment of field based measures of muscular fitness. A full familiarisation was given on both the RTSBc and field based measures of muscular fitness. Performance of both sets of tests (RTSBC and muscular fitness) was also separated by 2 hours allowing for appropriate recovery between tests to ensure 'fatigue' did influence performance on the different tests. The children also undertook isokinetic strength assessment as a familiarisation. On the second occasion the children undertook measures of general motor competence and isokinetic muscle strength assessment.

Anthropometry

Height (cm), sitting height (cm), leg length (cm) and mass (kg) were recorded to the nearest cm and 100g respectively using a stadiometer (SECA Instruments, Ltd, Germany), electronic weighing scales (SECA, Instruments, Ltd, Germany) and anthropometric measuring tape. Children were dressed in shorts and t-shirt and without shoes. The age at peak height velocity (APHV) was determined using height, sitting height, leg length, body mass and chronological age as a measure of maturation using the Mirwald prediction equation (Mirwald, Baxter-Jones, Bailey, & Beunen, 2002).

RTSBc

The RTSBc consists of 6 RT skills (bodyweight squat, push-up, step-up, suspended row, standing overhead press and front support with chest touches) with proficiency in these exercises providing the platform for development of muscular strength in a variety of human movements (Bebich-Philip et al., 2016). Procedures for familiarisation, administering and scoring the RTSBc were taken from the previously validated methodology for the RTSB (Lubans et al., 2014) and RTSBc (Bebich-Philip, et al., 2016). Before performing each skill, the participants observed movement demonstrations and received verbal instruction pertaining to each movement. The verbal instruction comprised a description of each test and how the movement should be performed. These were taken from the instructions for the RTSBc as per Bebich-Philip et al (2016). Participants were given a ‘practice’ attempt on each movement to ensure comprehension of instructions with additional instruction provided if the task was not understood. General encouragement was provided during performance of each skill but no specific feedback (ie coaching cues) was provided.

Participants completed each skill in the following order as per the process reported by Bebich-Philip et al (2016): Push-up, step-up, body-weight squat, standing overhead press, front support with chest touches and suspended row. Participants performed 2 sets of 4 repetitions for each of the RT skills and were given 30s to recover between sets and exercises. All the movements were completed with body-weight only, except for the standing overhead press which was completed using a light wooden dowel. Performance of the RTSBc was video recorded (Sony HDR-CX405, Sony, UK) and subsequently scored via Quintic Biomechanics analysis software v21 (Quintic Consultancy Ltd., Coventry, UK). Scoring of the RTSBc was completed in line with prior studies (Bebich-Philip et al., 2016; Lubans, et al., 2014) by using the best repetition in each set. Full details of the scoring protocol are presented in the paper by Bebich-Philip et al., 2016). Each of the skills have four (suspended row and push-up) or five (step-up, standing overhead press, body weight squat, front support) performance criteria. Participants were awarded a score of ‘1’ if the criteria was demonstrated or ‘0’ if it was absent. Totals for 2 sets were summed to obtain a raw RT score for each exercise. The raw RT scores were then summed (0-56) to provide the resistance training skills quotient for children (RTSQc) in accordance with prior studies using the RTSBc (Bebich-Philip, et al., 2017) and RTSB (Lubans, et al., 2014). According to Bebich-Philip, et al., (2016) competency in individual skills is achieved if 3 out of 4 is scored (push-up and suspended row) or 4 out of 5 (Step-up, front support, squat and overhead press) performance criteria are satisfied and competency across all 6 individual RT skills are required to be considered ‘ready’ to begin RT. In the present study no child met this criteria across all 6 RT skills and in each of the two sets of each RT skill. Consequently, a median split was used to create 2 groups representing high and low RTSBc scores.

Two researchers experienced in the assessment of childrens’ movement skills analysed and scored the videos. Both researchers were trained in two separate two-three hour sessions by watching videoed skills of children's performing the RTSBc and rating these against a previously determined 'gold standard' rating. Similar to procedures used for the scoring of general motor competence (Barnett, et al., 2014), training was considered complete when each observer's scores for the two trials differed by no more than one component per trial from the instructor score for each skill (>80% agreement). Inter- and intra-rater reliability analysis was performed for all the skills between the two researchers on 14% of all the videos (i.e., 3 participants). All the videos for 3 participants (i.e., 18 videos) were rated by each researcher. Videos were selected by the first author at random (every 7th participant). For intra-rater reliability coding of the videos was performed separately by the two researchers and then compared. Intraclass correlation coefficients for inter and intra-rater reliability were .914 (95% CI = .85 - .94) and .974 (95% CI = .93 - .98) respectively.

Field Based Assessment of Muscular Fitness

Three field based measures of muscular fitness were taken; 10m sprint time, standing long jump and seated medicine ball (1kg) throw were assessed. A 10-metre sprint run was timed using smart speed gates (Fusion Sport, Coopers Plains, Australia) and standing long jump measured (distance from the take-off line to the back of the closest heel on landing) using a tape measure. Following familiarisation, two trials were used with the fastest time (secs) and longest jump (cm) being used for analysis. The seated medicine ball throw (cm), using a 1kg medicine ball, was employed as a measure of upper body strength as it is a reliable and valid measure of upper body strength in children aged 5 and over (Davis, et al., 2008). Children sat on the floor before throwing the medicine ball forwards like a chest pass three times with the furthest distance thrown (m) assessed using a tape measure. Administration of the test followed procedures described by Davis et al (2008). The children were instructed that on the researchers signal (‘go’) that, “you will lift the medicine ball to your chest and throw it forward as hard as you can”. These three measures were employed as they are commonly used measures of muscular fitness with children which are valid and reliable (Davis, et al., 2008, Petersen, 2015, Duncan, et al., 2017).

General Motor Competence

General motor competence was assessed using six motor skills (3 locomotor, 3 object control) from the Test of Gross Motor Development-2 (TGMD-2) (Ulrich, 2000). In the current study the following skills were assessed: run, jump, hop, catch, overhand throw and bounce, on the basis that the PE curriculum in England for children in this age group focuses on children mastering these basic skill movements (Department for Education, 2013). Each skill comprises 3-4 components and to determine the mastery of the skill, the TGMD-2 assesses whether each component of each skill was present or absent. Each skill was video-recorded (Sony HDR-CX405, Sony, UK) and analysed using Quintic Biomechanics analysis software v21 (Quintic Consultancy Ltd., Coventry, UK). Scores from two trials were summed to create a total (scored 0-48) overall raw score. Subtest scores for locomotor motor competence (0-26) and object control motor competence (0-22) were also created using the sum of the run, jump and hop for locomotor motor competence and the catch, overhand throw and bounce for object control motor competence. In all cases scores for total motor competence, locomotor and object control motor competence followed the recommended guidelines for administration and scoring of the TGMD-2 (Ulrich, 2000).

Two researchers experienced in the assessment of children's movement skills analysed the videos. Both researchers were trained in two separate two-three hour sessions by watching videoed skills of children's skill performances and rating these against a previously rated 'gold standard' rating. Congruent with prior research (Barnett, et al., 2014), training was considered complete when each observer's scores for the two trials differed by no more than one component per trial from the instructor score for each skill (>80% agreement). Inter- and intra-rater reliability analysis was performed for all the skills between the two researchers on 10% of all the videos. Intraclass correlation coefficients for inter and intra-rater reliability were .925 (95% CI = .87 - .95) and .987 (95% CI = .94 - .98) respectively. The process followed was the same as that described for reliability analysis of the RTSBc.

Isokinetic Muscle Strength Assessment

The optimal method to assess isokinetic muscle strength in paediatric populations remains unclear and studies on the subject are equivocal (De Ste Croix, et al., 2003). As a consequence, the present study followed recommended guidelines by De Ste Croix et al (2003) relating to assessment of isokinetic muscle strength in children. Maximal voluntary strength of the knee extensors of the dominant leg were evaluated using isokinetic dynamometry (KinCom 125AP; Chattanooga Group, Chattanooga, TN). Isokinetic muscle strength assessment took place in two stages. On the first visit to the laboratory, the children undertook the isokinetic strength assessment protocol as a familiarisation procedure as researchers have indicated that such a familiarisation process may reduce the effect of learning on the test data (De Ste Croix, et al., 2003). This is particularly the case for children where they may be unsure of the sensations of isokinetic testing as it is novel and unique, as are the strategies used by the nervous system to produce actions of maximal effort, especially eccentric actions (Enoka, 1996). The isokinetic dynamometer was set up in accordance with the manufacturer's instructions. The lateral femoral epicondyle and lateral malleolus were used as the anatomical reference points for the knee and ankle, as is conventional (Tallis et al, 2016). The position of the seat and dynamometer head were saved and then recalled on the subsequent visit. Familiarisation data was not collected and only data collected on the second visit to the laboratory was used for analysis. In the present study, and on each day of assessment, the inbuilt dynamometer warm up feature was used in order to minimize injury risk and to ensure that participants were primed for the exercise protocol. This adhered to recommended warm up guidelines for children as stated by De Ste Croix et al., (2003). Maximal voluntary concentric and eccentric force of the knee extensors was measured through 70°, at a contraction velocities of both 30°/sec and 120°/sec. Maximal voluntary force was achieved with 2-3 attempts, which is common for this type of testing (Tallis et al 2016). Each attempt was separated by 60 seconds of recovery. Participants were given strong verbal encouragement throughout both trials, but were not given any feedback about their performance during the protocol. Peak and average force (N) produced were recorded for each repetition. On completion, due to significant correlations between variables, scores for each velocity (30°/sec or 120°/sec) and for each muscle action (eccentric and concentric) were transformed into z-scores and summed for both peak and average force. In this way 2 composite measures of muscle strength (one for peak force, one for average force) were created and used for subsequent analysis.

Statistical Analysis

Preliminary analysis indicated that there were no significant gender differences in any of the measures assessed (all P>0.05) therefore, gender was not considered further in subsequent analysis. In order to examine whether there were any differences in muscular fitness, general motor competence, locomotor competence, object control motor competence and isokinetic muscle strength as a function of RTSBc scores, a series of analysis of covariance (ANCOVA), controlling for APHV was employed. Partial eta^2 was used as measure of effect size and Bonferroni post-hoc pairwise comparisons were used to examine where any differences lay. Data are presented as Mean ± SD. Statistical analysis was performed using SPSS 22.0 (Chicago, IL, USA). Statistical significance was set at a level of *P*<0.05.

Results

Mean ± SE of measures of muscular fitness, motor competence and isokinetic strength according to resistance training skill status (high vs low) are presentenced in Table 1.

Table 1 Here

When ANCOVA analysis, controlling for APHV, was conducted, examining differences in measures of muscular fitness as a consequence of RTSBc skill there was no significant difference in standing long jump (P = 0.06, $P\eta^2$ = .151) between children of high and low RTSB competence. APHV was however significant (P = .004, $P\eta^2$ = .324, β = 12.5) with older APHV associated with greater standing long jump distance. For

10m sprint there was a significant difference in sprint times (P = .002, $P\eta^2$ .364) where children who were high in RTSBc competence ran more quickly than those who were low in RTSBc competence. APHV was also significant as a covariate (P = .018, $P\eta^2$ = .227, β = -.101) with older APHV associated with faster sprint speed. When seated medicine ball throw distance was used as the dependant variable, like standing long jump, there was no significant difference in medicine ball throw distance according to RTSBc competence (P = 0.147, $P\eta^2$ = .093) but APHV was significant (P = .001, $P\eta^2$ = .409, β = 61.6) with older APHV associated with higher medicine ball throw scores.

In regard to general motor competence, there was a significant difference in TGMD2 scores between children who were high or low for RTSBc competence (P = 0.001, $P\eta^2$ = .636) with higher scores for TGMD2 in the high competence RTSBC group. APHV was again significant as a covariate (P = .013, $P\eta^2$ = .294, β = 3.93) indicating that older APHV was associated with higher TGMD2 scores.

When subtest scores for locomotor and object control motor competence were analysed separately the results remained similar to those of general motor competence. Children in the high competence RTSBC group demonstrated significantly higher TGMD2 locomotor scores (P = .0001, $P\eta^2$ = .580) compared to their low RTSBC peers. This pattern was replicated for TGMD2 object control scores (P = .0001, $P\eta^2$ = .619) where children in high competence RTSBC group demonstrated significantly higher TGMD2 object control scores. APHV was significant as a covariate for both TGMD2 locomotor (P = .05, $P\eta^2$ = .210, β = 1.36) and object control (P = .005, $P\eta^2$ = .358, β = 2.85) scores where older APHV was associated with higher TGMD2 scores.

For the isokinetic muscle strength measures, results did not differ whether peak isokinetic scores or average isokinetic scores were considered. For peak isokinetic strength there was no difference as a consequence of RTSBc competence (P = 0.249, $P\eta^2$ = .069). This was also the case for average isokinetic strength (P = 0.247, $P\eta^2$ = .071). Similarly, APHV was significant as a covariate for peak isokinetic strength (P = .018, $P\eta^2$ = .261, β = 2.423) and average isokinetic strength (P = .025, $P\eta^2$ = .239, β = 2.350) with older APHV associated with greater isokinetic muscle strength.

Table 2 Here

Discussion

This study aimed to examine the validity of the RTSBc by exploring whether children who scored high or low on the RTSBc had different scores for tests of muscular fitness and motor competence, the underpinning qualities the RTSBc appears to assess. This is the first study to examine this issue and, as such, presents novel information that may be relevant to Physical Education teachers, strength and conditioning coaches and exercise scientists. The results of the present study suggests that scores on the RTSBc differentiate general motor competence in children aged 7-10 years of age but that the children who scored higher or lower on the RTSBc were not significantly different on measures of muscular strength.

The results of the present study suggest that RTSBc scores do not differentiate between strength measures in children aged 7-10 years of age. Recently, Smith et al (2017) reported that scores on the RTSB were significantly and moderately associated with muscular fitness, as assessed by standing long jump and push up test performance in a sample of 548 Australian adolescents. In some ways the results reported by Smith et al (2017) align with the results of the present study in that scores for 10m running speed, 1kg medicine ball throw distance and standing long jump distance were significantly associated with RTSBc scores. However, when a median split was employed in the current study, children classed as high for RTSBc scores did not demonstrate significantly greater standing long jump distance, medicine ball throw distance or isokinetic muscle strength performance compared to those classed as low for RTSBc scores. As such, the construct validity of the RTSBc is only partially supported in the current study. We do however recognise that the results are based on a relatively small sample size and the difference in standing long jump scores was non-significant at P =.06. Future research examining this issue with a larger sample size and additional groupings (e.g., low, medium and high RTSBc competence) would be welcome in verifying the findings of the current study.

It is also important to highlight that, although isokinetic dynamometry provides a precise measure of muscular strength in children, it primarily assesses isolated joint muscle strength, specifically at the knee in the current study. The RTSBc includes three tests that are upper body dominant and all the tasks within the RTSBc require contributions from musculature other than the knee as well as requiring inter-muscular coordination. Thus, isokinetic muscle strength around the knee joint may not fully reflect the muscular demands of performing the range of resistance training movements assessed by the RTSBc.

Of note, scores on the RTSBc did differentiate children’s general motor competence as assessed by the TGMD-2. In some ways this could be anticipated as the RTSBc battery and TGMD-2 have commonality as both are process oriented assessments and both assess movement competency, albeit using different movements. When TGMD-2 scores were split into locomotor and object control skills separately the results remained the same. In the context of the results of the current study, in the population examined, the RTSBc appears to share some similarity with general motor competence in terms of the skills it purports to assess.

The current study is one of only two studies to date to examine RTSBc scores. Where Bebich-Phillip et al. (2016) determined the interrater and intrarater reliability of the RTSBc, the present study sought to examine the construct validity of the RTSBc. The present study controlled for maturation (via APHV) in statistical analysis. Neither the work of Bebich-Philip et al (2016) nor Smith et al (2017) attempted to account for maturation. In the present study, APHV was significantly, associated with all of the measures of muscular fitness examined. This is important in the case of the present study and for future researchers, as it indicated that older APHV was associated with better performance on measures of muscular fitness and general motor competence. The impact of maturation on muscular strength and performance in boys is established (Faigenbaum, et al., 2009), demonstrating enhanced muscular fitness and strength as boys pass from childhood into adolescence. In the study by Smith et al (2017) the mean age of participants was 14.1 years. Thus, the stronger association between RTSB scores and measures of muscular fitness in Smith et al (2017) compared to the present study may be a consequence of participant maturation levels. Future research examining this topic therefore needs to consider maturation in its analysis. Examining how RTSB scores may change through childhood into adolescence would also be beneficial in illustrating how maturation may influence developmental trajectories of RT skill in young people.

There are of course limitations to the current study. We acknowledge that the sample included in the current study, although comparable to that used in the study by Bebich-Phlip et al (2016), is relatively small, and may increase chances of a Type

II error. The requirements and demands of isokinetic muscle strength familiarisation and assessment with children precluded recruitment of a larger sample. The gender imbalance of the sample should also be noted. No child in the current study met the requirements stated by Bebich-Philip et al (2016) to be classified as 'competent' across all 6 exercises in the RTSBc and high and low RTSBc competency was based on an arbitrary median split. Although this method creates two equal groups reflecting high and low competence, it is specific to the population being examined. Using such a dichotomous grouping does enable preliminary establishment of construct validity of the RTSBc but may not be sensitive enough to detect differences in fitness that might be present when examining a larger sample and additional groupings (e.g., tertiles). Given the findings presented in the current study it would be prudent for future research to establish whether this is the case using tertiles of competence reflecting high, medium and low RTSBc competence.

It is also important to point out that the current study assessed the RTSBc, whereas Smith et al (2017) used the RTSB. In the RTSBc, two movement patterns differ from that of the RTSB, where Bebich-Philip et al (2016) replaced the lunge with a box step and changed the front support with chest touches so it was performed against a wall, rather than on the floor in the RTSB. These changes were made following consultation with the developers of the RTSB and an expert panel of pediatric exercise specialists and based on the suggestion that the step-up decreased balance demands, compared to the lunge whilst at the same time assessing dynamic stability during lower limb movements. However, the lunge serves as a prerequisite to many resistance exercises and forms the basis of many foundational movement patterns in sport. The step-up may not therefore have been the most appropriate exercise to include in lieu of the lunge as it is not a simple regression movement from the lunge.

The current study sought specifically to examine the construct validity of the RTSBc as reported by Bebich-Philip et al. (2016) but future work would be welcome which examines whether a replacement of the lunge with the step-up is actually needed in children. Although the change in movements in the RTSBc, compared to the RTSB, may explain the differences in results of the current study compared to that using the RTSB (Smith et al., 2017), the authors of the current study feel this is less likely compared to the confounding issue of maturation.

Conclusions

The current study suggests that the RTSBc evidences construct validity against general motor competence and some field based measures of muscular fitness in a sample of 7-10-year-old children, controlling for maturation. However, maturation was a significant covariate in all analyses, indicating the need for researchers to account for this variable when examining resistance training skill in children. It is also important to note here that the RTSBc purportedly assesses resistance training skill in children but technical competency during resistance training itself remains the most important determinant of the appropriateness of exercise selection and children's readiness to utilise such approaches.

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