South African Journal for Research in Sport, Physical Education and Recreation, 2016, 38(3): 81 - 93.
Suid-Afrikaanse Tydskrif vir Navorsing in Sport, Liggaamlike Opvoedkunde en Ontspanning, 2016, 38(3): 81 - 93.
ISBN: 0379-9069

ANTHROPOMETRICAL, PHYSICAL, MOTOR AND SPORT PSYCHOLOGICAL PROFILE OF ADOLESCENT MALES WITH SPRINTING POTENTIAL

Ankebé KRUGER & Anita E. PIENAAR
Physical Activity, Sport and Recreation Research Focus Area, North-West University, Potchefstroom, Republic of South Africa

ABSTRACT

This study determined whether anthropometrical, physical, motor and sport psychological differences exist between a group of male adolescents who show talent for sprinting and their less talented counterparts. Grade 8 boys (N=89; mean age: 13.25±0.46 years), from a high school in Potchefstroom voluntarily participated in the study. A general talent identification (TID) protocol and a sport psychological questionnaire were completed. The 40m-sprint test was used to categorise the subjects into two groups. Those in the top 10% were assigned to the talented group (TG) (n=8, mean age=13.79), and the remaining subjects were assigned to the less talented group (LTG) (n=72, mean age=13.55). An analysis of covariance (ANCOVA) was applied with stature as the covariate to adjust for variations in growth status between the two groups. The practical significance of differences between the two groups was determined by means of effect sizes (ES). The level of significance was set at p≤0.05. Significant differences with the potentially talented sprinters, who obtained better scores in upper and lower body explosive power, acceleration, maximal speed, aerobic endurance and in goal setting were found.

***Key words*:** Sprinting; Anthropometry; Physical; Psychology; Adolescence; Boys.

INTRODUCTION

Sprinting is the fastest running event in athletics over short distances and among the oldest track and field events (Wikipedia, 2014). Currently, three sprinting events are held at the Summer Olympics and outdoor World Championships: 100m, 200m and 400m (Wikipedia, 2014). Despite the Summer Olympics and outdoor World Championships, the IAAF World Junior Championships, comprising of track and field events, for junior athletes (aged 19 years or younger) are held biannually. Therefore, children should be ready to perform at a high level at a relatively young age in this event.

Top performance in sprinting is the result of a multifaceted and unique blend of different factors (Onyewadume *et al*., 2004). Sprinting consists of a start, acceleration phase, maximal speed phase and a speed endurance phase. Each phase requires specific physical and motor characteristics to obtain optimal performance in the event (Delecluse *et al*., 1994; Young *et al*., 1995; Carr, 1999). Successful performance in competitive sprinting depends on specific attributes such as stature, anthropometry, muscle strength and flexibility (Onyewadume *et al*., 2004). According to Hadavi and Zarifi (2009), psychological, genetic, biological and sociological factors also influence sprinting performance. In addition, Ericsson (1996) suggests that performers have to engage in 10 years or 10 000 hours of deliberate practice in order to develop talent to its full potential.

Excessive fat mass can be disadvantageous during sprinting events. Several researchers indicate an inverse relationship between fat mass and performance in activities where vertical displacement of body mass takes place (Boileau & Lohman, 1977; Pate *et al*., 1989). Uth (2005) reports that a very low or very high body mass might be a limiting factor in sprinting performance. A higher optimal body mass will be detrimental to a sprinters' performance seeing that it takes a higher force to accelerate a larger body mass. However, performance in sprinting relies heavily on force production which depends on muscle mass. Thus, sprinters with a very low body mass would probably have less muscle mass and consequently a weaker ability for force production.

Although a too high stature might be disadvantageous for sprinters, it might be advantageous as well (Uth, 2005). From a biomechanical point of view, the most important factors influencing performance in sprinting are stride length and frequency (Paruzel-Dyja *et al*., 2006). Thus, a taller sprinter's longer limbs might contribute to increased stride length and consequently increased running speed. It, thus, seems that body mass, height and body mass index are important anthropometrical attributes for successful sprinting. In addition, successful participation in different sport events requires specific motor and physical abilities. Kruger (2006) indicates that aerobic endurance, strength and speed endurance, flexibility, maximal strength, speed, reaction time and good running technique are important motor and physical attributes that a sprinter must possess in order to be successful.

Several studies have already reported results on the relationship between certain anthropometrical, physical, physiological and motor characteristics and performance in different sporting codes such as track and field (Thomas *et al*., 1983; Mero *et al*., 1990; Onyewadume *et al*., 2004; Uth, 2005; Paruzel-Dyja *et al*., 2006; Vučetić *et al*., 2008; Abraham, 2010; Habibi *et al.*, 2010; Pilianidis & Mantzouranis, 2011), rugby league (Gabbett *et al*., 2009), football, baseball and lacrosse (Nesser *et al*., 1996), handball (Mohamed *et al*., 2009), tennis (Sánchez-Muñoz *et al*., 2007), Australian rules football (Keogh, 1999), field hockey (Keogh *et al*., 2003), rowers (Mikulić, 2008) and volleyball players (Gabbett *et al*., 2007). In addition to anthropometrical, biomechanical, physical, physiological and motor characteristics, psychological indicators may also be important in discriminating between successful and less successful athletes (Krane & Williams, 2010).

Several studies report that psychological skills can distinguish elite athletes from non-elite athletes. Grossarth-Maticek *et al*. (1990) found psychological skills as performance determinants in football and boxing. Elite rodeo riders outscored non-elite riders on psychological skills such as motivation, confidence, anxiety control and concentration (Meyers *et al*., 1996). In track and field events, Cox *et al*. (2010) found elite athletes outscored their collegiate level counterparts on confidence and anxiety control. Despite the importance of psychological skills in sport performance as reported in these studies, only one study could be traced regarding the psychological characteristics of sprinters. Thomas *et al*. (1983) found that anxiety and extraversion-introversion were important performance predictors of sprinters in their study of national class athletes. No studies, however, could be traced on the psychological make-up of adolescent athletes with potential for sprinting.

It is clear from the literature that distinctions can be made between athletes of different levels of sport participation based on specific anthropometrical, physical, motor and sport psychological attributes. A multidimensional sport talent profile, which includes anthropometrical, physical, technical and psychological characteristics of successful athletes in a certain sport might be useful in different ways. If specific anthropometrical, physical, technical and psychological characteristics can be determined, these characteristics might be used as a guideline in the composition of training programmes and even for selection purposes. Only one study regarding talent prediction in athletics on adolescents could be traced (Headly, 2000). Although an extensive study, it also has specific shortcomings. The talent identification determinants that were identified within the study were not specific to the different events in athletics and no psychological measurements were included in die testing protocol.

PURPOSE OF THE STUDY

The purpose of this study was to determine if anthropometrical, physical, motor and sport psychological differences exist between a group of male adolescents who show talent for sprinting and their less talented counterparts. The results can make a significant contribution to the field of Sport Science in assisting coaches, sport scientists as well as sport psychological consultants in the composition of holistic sport specific training programmes for male adolescent sprinters. The results can furthermore be used in identifying potentially talented sprinters and might contribute to the development of well-rounded sprinters in the learning to train phase of the Long-Term Athlete Development program (LTAD) (Vardhan *et al*., 2012).

METHODOLOGY

Research design

A cross-sectional research design was used on a selected group of school children. The data was collected by means of anthropometrical, physical and motor tests, as well as a sport psychological questionnaire. This project was part of a larger three-year longitudinal study. Only the data of the baseline measurements were used for the purpose of this study. Ethical approval (NWU-00142-11-A1) for the study was obtained from the Ethics Committee of the North-West University (NWU).

Subjects

Grade 8 boys (N=89), with a mean age of 13.25 (SD±0.46) years, from a high school in Potchefstroom in the North-West Province, who consented to participate in the study, were recruited to participate in the study. They were subjected to a general talent identification (TID) protocol and they completed a sport psychological questionnaire. Although only 1 school was part of the study, the learners represent children who came from 46 different primary schools in the surrounding area. The result of the 40m sprint test, which is normally used by coaches to predict sprinting time in the 100m, was used to categorize the subjects into 2 groups. The subjects whose performance was in the top 10% were assigned to the talented group (TG) (N=8, mean age=13.79), and the remaining subjects were assigned to the less talented group (LTG) (N=72, mean age=13.55). According to Australian norms for 13-year-old boys, 5.87 seconds on a 40m sprint test placed the talented group above the 95th percentile for the speed test. Nine boys did not complete the speed test and, therefore, their results had been omitted from further analysis.

Test procedure

Administration of testing

The testing was done over 2 consecutive days during school hours. Because the learners were under age, informed consent forms had to be completed by their parents. All the learners were informed of the purpose and nature of the research study. They were ensured of the confidentiality of their results and were told that the data would only be used for the research project. Any participant had the right to withdraw from the research project at any time.

Demographic and general information questionnaire

A questionnaire in which learners had to provide information with regard to the following was administered during the testing period:

- Name of the learner, date of birth, gender and ethnic group;
- General level of physical activity over the past three months;
- How does his physical activity compare with those of his friends;
- Involvement in organised sport and/or training programme during the past six months;
- Involvement in general physical activities during the past six months;
- Opinion on whether he was as physically active as he should have been;
- What did he do during the past month;
- If he was not active enough, what might the possible reasons be;
- What type of transport he uses to get to school;
- What type of sport/s is he currently participating in;
- His best performance in sport in the year of testing (2010); and
- His three favourite sports.

Measuring instruments

The protocol used for the purpose of this study was based on an existing Australian Talent Search for the identification of sport talent among children 12 years and older (Australian Sports Commission, 1995). This protocol consists of 11 tests consisting of 4 anthropometrical and 7 physical and motor abilities. Cricket ball throw was added to the existing talent search protocol. The anthropometrical measurements included stature, body mass, relative sitting height and arm span and were measured using standard measuring procedures as described in the Australian manual (Australian Sports Commission, 1995). All measurements were taken by International Society for the Advancement of Kinanthropometry (ISAK) Level 2 accredited anthropometrists. The physical and motor tests that were used included the basketball throw, throw and catch test, cricket ball throw, vertical jump test, 40m sprint, 5m agility and the bleep test (Australian Sports Commission, 1995). Following a brief description of the tests:

Basketball throw: The subject had to sit with the buttocks, back and head against a wall with their legs on the floor in front of the body. A 2-handed chest pass is used to push the ball in a horizontal direction as far as possible, while the back stays against the wall. The better of 2 attempts were recorded.

Throw and catch test: This test consists of a total of 20 underhand throws with a tennis ball which have to hit a round target with a diameter of 30cm against a wall, which is placed 2.5m from the starting line. The first 10 throws are executed with the dominant hand, while catching the ball with the dominant hand where after the second 10 throws is executed with the dominant hand, while catching with the non-dominant hand.

Cricket ball throw: The subject threw the cricket ball over arm with the preferred hand as far as possible. A 20m run up was allowed and the subject had to throw the ball without running over the line. The better of 2 attempts were recorded.

Vertical jump test: The subject stands with the preferred side nearest to the wall and reaches upwards with the inside arm as high as possible while the feet stay flat on the ground. After recording the distance of the reach height, the subject is instructed to jump as high as possible, touching the wall with the inside arm. Performance in the vertical jump test is determined by subtracting the jumping height from the reaching height. The better of 2 attempts were recorded in centimetres.

40m-Sprint test: Speed lights (Brower Timing Systems, Utah, USA) were set up on the 0, 10 and 40m marks. The subject had to be in a stationary position before the start. The subject should have to run as fast as possible through the last gate. The better of 2 attempts were recorded.

5m-Agility test: The test consists of 2 markers that are placed 5m apart. The subject had to complete 5 consecutive runs between the 2 markers as fast as possible. The best time of 2 attempts were recorded in seconds.

Bleep test: This test is an aerobic endurance test measured over a distance of 20m. It is a multi-stage shuttle run with a progressive increase in pace. Performance in the bleep test is expressed as the number of shuttles and levels completed.

Sport psychological skills profile

The Athletic Copings Skills Inventory (ACSI-28), developed by Smith *et al*. (1995) was used to determine the learners' sport psychological skills profile. The ACSI-28 questionnaire is divided into 7 subscales and has a total of 28 questions. This questionnaire determines a person's ability to cope with adversity, peaking under pressure, goal setting/mental preparation, concentration, freedom from worry, confidence and achievement motivation and the person's coachability. Each of the 7 subscales consists of 4 items measured on a 4-point Likert scale ranging from 0 (almost never) to 3 (almost always). In some cases, reverse scoring applies. The test-retest reliability of the ACSI-28 yielded a mean stability of r=0.84 (Smith *et al*., 1995). A sport psychological consultant was present for the duration of completing the questionnaire to answer any questions or to explain unfamiliar terminology to the pupils.

Data analysis

The Statistical Consultation Services of the NWU determined the statistical procedures for this study, which were performed using SPSS for Windows (version 17). The validity and reliability of the psychological scales for the specific sample was determined by means of factor analysis and the Cronbach alpha's coefficient. An analysis of covariance (ANCOVA) test was applied with stature as the covariate to adjust for variations in growth status between the 2 groups. Boys were in an accelerated growth phase between 12 and 14 years. Therefore, stature was used as a covariate. The practical significance of differences between the 2 groups was determined by means of effect sizes (ES) (0.3 is seen as small, 0.5 as medium and 0.8 as large). The level of significance was set at $p \leq 0.05$.

RESULTS

Table 1 serves as a descriptive table for the talented and less talented potential sprinters regarding their age, 40m sprinting time, mean physical activity, participation in organized sports, as well as their best performance in their main sport.

Table 1. **DESCRIPTIVE INFORMATION OF TALENTED AND LESS TALENTED GROUPS**

Variables	**Talented group** (n=8)	**Less talented group** (n=72)
Age (years)	13.79	13.55
40m sprinting time (seconds)	5.87	6.73
Mean physical activity	4.58	3.84
Participated in organised sport for last 6 months	1.15	1.00

Activity level: 1=Inactive 2=Not very active 3=Moderately active 4=Active 5=Very active

The adjusted mean with stature as covariate, MSE, statistical and practical significance for both groups of the anthropometrical, physical and motor test variables are presented in Table 2.

Table 2. **ANCOVA RESULTS WITH STATURE AS COVARIATE: DIFFERENCES BETWEEN TALENTED AND LESS-TALENTED SPRINTERS FOR ANTHROPOMETRICAL, PHYSICAL AND MOTOR VARIABLES**

Test variables	**Adjusted mean**		**MSE**	**p-Value**	**Effect size (ES)**
	TG	**LTG**			
Body mass (kg)	55.22	55.98	104.36	0.846	0.07
(n)	(8)	(72)			
Sitting height (cm)	123.49	121.87	4.25	0.143	0.27
(n)	(8)	(72)			
Arm span (cm)	165.81	165.98	17.97	0.914	0.04
(n)	(8)	(72)			
Basketball throw (m)	6.83	6.04	0.39	0.003*	1.27***
(n)	(7)	(72)			

*Table 2. **(continued)***

Test variables	Adjusted mean TG	LTG	MSE	p-Value	Effect size (ES)
Cricket ball throw (m)	52.79	40.43	67.16	0.723	0.42
(n)	(8)	(71)			
Throw and catch	10.67	8.68	12.20	0.138	0.57
(n)	(8)	(72)			
Vertical jump (cm)	42.70	33.10	42.69	0.000*	1.47***
(n)	(8)	(72)			
Agility (sec)	18.38	19.63	1.87	0.019*	0.91***
(n)	(8)	(72)			
Speed (0-10m) (sec)	1.89	2.09	0.02	0.000*	1.41***
(n)	(8)	(72)			
Beep (level)	8.71	6.70	3.72	0.008*	1.04***
(n)	(8)	(66)			

LTG=less talented group; TG=talented group   * p≤0.05   *=small ES   **=medium ES   ***=large ES

The results of the ANCOVA revealed that the potentially talented sprinters outperformed the less talented sprinters statistically and practically significantly in the basketball throw, vertical jump, 0-10m speed, agility and aerobic endurance. However, no differences were found between the groups regarding the anthropometric characteristics. The adjusted mean and MSE for both groups for the sport psychological variables are displayed in Table 3.

Table 3. **ANCOVA WITH STATURE AS COVARIATE: DIFFERENCES BETWEEN TALENTED AND LESS TALENTED SPRINTERS FOR PSYCHOLOGICAL VARIABLES**

Test variable	Adjusted mean (%) TG (n=8)	LTG (n=72)	MSE	p-Value	Effect size (ES)
Coping with adversity	72.56	63.00	331.21	0.172	0.53
Peaking under pressure	58.61	56.68	594.01	0.836	0.08
Goal setting/Mental prep.	70.66	54.88	448.61	0.054*	0.75***
Concentration	69.70	66.21	290.07	0.593	0.20
Freedom from worry	48.74	53.84	365.77	0.485	0.27
Confidence & motivation	85.33	74.32	301.75	0.100	0.63
Coachability	76.18	71.74	187.62	0.398	0.32
Average coping ability	68.83	62.96	131.42	0.183	0.51

LTG=less talented group; TG=talented group   * p≤0.05   *=small ES   **=medium ES   ***=large ES

The ANCOVA revealed that the potentially talented sprinters significantly outperformed the less talented sprinters in goal setting. Although not statistically significant, a trend was apparent that the potentially talented sprinters had higher mean percentages in all the other subscales of the ACSI-28 (coping with adversity, peaking under pressure, concentration, self-confidence, coachability and the overall score for coping ability). They also showed a lower percentage in the freedom from worry subscale.

DISCUSSION

The purpose of this study was to determine if possible motor, physical and sport psychological differences exist between male adolescents who show talent for sprinting and their less talented counterparts. The study indicated significant differences with the potentially talented sprinters, which obtained statistical significantly better scores in upper and lower body explosive power (basketball throw and vertical jump), acceleration (0-10m speed), maximal speed (0-40m speed), aerobic endurance (beep test) and in goal setting.

Various researchers reported that a powerful angular drive of the arms would assist forward drive during the starting phase of the sprint (Cherry, 1982; Schnier, 1982; Embling, 1984; Korchemny, 1992). The talented group in this study significantly outscored the less talented group in explosive upper body power (as determined by the basketball throw), and in arm speed (as determined by the cricket ball throw). It is assumed that this higher explosive upper body power will contribute to a more vigorous arm drive during the sprint start and subsequently enhance performance in the 100m sprinting.

Sprinting further requires high anaerobic capacity (Amusa & Toriola, 2003). The ability of an athlete to cover a distance in the shortest possible time is dependent on explosive power of the muscles (Amusa & Toriola, 2003). The potentially talented sprinters outscored their less talented counterparts significantly with regards to explosive leg power as measured by the vertical jump test. These results agree with other researchers who also regard explosive leg power as an important factor in sprinting (Meckel *et al*., 1995; Young *et al*., 1995; Morin & Belli, 2003).

Furthermore, potentially talented sprinters significantly outscored their less talented counterparts in the agility test. According to Kukolj *et al*. (1999:121), “sprinting is generally considered as a dynamic movement requiring high muscle power”. Seeing that agility is also regarded as a dynamic movement requiring high muscle power, it can be assumed that sprinting and agility performance could be closely related (Sporiš *et al*., 2010). Few studies, however, examined the relationship between sprinting ability and agility performance (Paoule *et al*., 2002; Little & Williams, 2005). Paoule *et al*. (2002) reported a high correlation between agility and sprinting performance (r=0.73) in a group of college-aged women. Vescovi and McGuigan (2008) concur that a moderate correlation (r=0.55) exists between agility and sprinting among a group of high school soccer players. In addition, Jarvis *et al*. (2009) also found significant correlations between 40m linear sprint running and the Illinois agility run among forwards (r=0.68) and backs (r=0.81) in sub-elite rugby union players. From the results of the current study and the abovementioned literature, it could be assumed that implementing agility training into a sprinters’ training program design would be advantageous in improving linear sprint performance.

Rapid acceleration is important in the starting phase of the sprint (Mero *et al*., 1990). Nesser *et al*. (1996) found that the faster an athlete can accelerate, the faster that athlete will be able to reach maximal speed. Their findings substantiate the importance of rapid acceleration needed for better sprint performance, which is in agreement with the results of the current study. Agility depends on speed, balance and coordination and will consequently also contribute to a better controlled acceleration phase.

The current results further indicate that the potentially talented sprinters achieved a significantly better score in the bleep test, which is an indirect test of aerobic capacity, in comparison to their less talented counterparts. The relative aerobic-anaerobic energy system contribution for 100m track events is determined as 21-79% respectively (Duffield *et al*., 2004). Therefore, it can be assumed that the better the aerobic energy system, the better the performance in the 100m sprint.

Only one sport psychological skill, namely goal setting, made a distinction between the potentially talented and less talented sprinters. Goal setting is regarded as an important sport psychological skill that influence the performance of participants with a positive effect on confidence, motivation and anxiety control independent of the participants' age and skill level (Cox, 2007; Leuens, 2008; Gould, 2010). Various previous studies reported that successful athletes are significantly better in goal setting than their less successful counterparts, which support the results of the current study (Katsikas *et al*., 2009; Cox *et al*., 2010; Weinberg & Gould, 2015). Although not statistically significant, trends were, however, also observed in all the other sport psychological variables of higher mean values among the talented group.

CONCLUSION AND RECOMMENDATIONS

A comparison of motor, physical and sport psychological attributes of potentially talented adolescent sprinters and their less talented counterparts revealed that upper and lower body explosive power, acceleration, maximal speed, aerobic endurance and goal setting showed significant distinction ability between the two groups. These differences suggest that various motor, physical and sport psychological variables can be used to identify potentially talented sprinters during adolescence.

These results are potentially useful in the identification of young talented adolescents who show promise to become a possible sprinter, and to develop their talent by means of development programmes. The variables of the general TID model can be used in this regard (excluding the throw and catch test). Although the psychological variables showed less distinction ability at this young age, clear trends were observed of distinct ability. The distinct ability of psychological variables might become stronger over time. However, more research is needed and especially longitudinal studies to determine the possible growing importance of these variables in TID programmes. It is recommended that psychological variables should be part of the development programmes of talented adolescents in order to prepare their minds to be ready for the different challenges that sport on a high level pose to an athlete.

However, the results of the present study must be interpreted with caution since the participants were a selected group of learners from one geographical area in Potchefstroom, South Africa. Hence generalisations of the results to other potentially talented sprinters might not be accurate.

Further studies in this area of talent identification on potentially talented sprinters are needed to identify the motor, physical and sport psychological variables, which can be used in a holistic talent identification program. Inclusion of a much larger sample size of athletes from different geographical areas is also an important aspect to keep in mind for future research.

The results of this study can make a significant contribution to the field of Sport Science in assisting coaches, sport scientists, as well as sport psychological consultants in the composition of a holistic sport specific training programmes for adolescent sprinters. The results can also be used in identifying potentially talented adolescent sprinters and might contribute to the development of well-rounded sprinters in the learn-to-train phase of the LTAD (Vardhan *et al*., 2012).

REFERENCES

ABRAHAM, G. (2010). Analysis of anthropometry, body composition and performance variables of young Indian athletes in Southern region. *Indian Journal of Science and Technology*, 3(12): 1210-1213.

AMUSA, L.O. & TORIOLA, A.L. (2003). Leg power and physical performance measures of top national track athletes. *Journal of Exercise Science and Fitness*, 1(1): 61-67.

AUSTRALIAN SPORTS COMMISSION (1995). *School teacher manual.* Canberra (Australia): Paragon Printers.

BOILEAU, R.A. & LOHMAN, T.G. (1977). The measurement of human physique and its effect on physical performance. *Orthopaedic Clinics of North American Journal*, 8(3): 563-581.

CARR, G. (1999). *Fundamentals of track and field* (2nd ed.). Champaign, IL: Human Kinetics.

CHERRY, A. (1982). The sprinter start. *Texas Coach*, 26(4): 42-44.

COX, R.H. (2007). *Sport psychology*: *Concepts and applications*. New York, NY: McGraw-Hill Publishers.

COX, R.H.; SHANNON, J.K.; MCGUIRE, R.T. & MCBRIDE, A. (2010). Predicting subjective athletic performance from psychological skills after controlling for sex and sport. *Journal of Sport Behaviour*, 33(2): 129-145.

DELECLUSE, C.; VAN COPPENOLLE, H.; WILLEMS, E.; VAN LEEMPUTTE, M.; DIELS, R. & GORIS, M. (1994). Influence of high-resistance and high-velocity training on sprinting performance. *Medicine and Science in Sports and Exercise*, 27(8): 1203-1209.

DUFFIELD, R.; DAWSON, B. & GOODMAN, B. (2004). Energy system contribution to 100-m and 200-m track running events. *Journal of Science and Medicine in Sport*, 7(3): 302-313.

EMBLING, S. (1984). The sprint start. *Modern Athlete and Coach*, 22(1): 30-31.

ERICSSON, K.A. (1996). *The road to excellence*: *The acquisition of expert performance in the arts and science*, *sports and games.* Mahwah, NJ: Erlbaum.

GABBETT, T.; GEORGIEFF, B. & DOMROW, N. (2007). The use of physiological, anthropometric, and skill data to predict selection in a talent-identified junior volleyball squad. *Journal of Sports Sciences*, 25(12): 1337-1344.

GABBETT, T.; KELLY, J.; RALPH, S. & DRISCOLL, D. (2009). Physiological and anthropometric characteristics of junior elite and sub-elite rugby league players, with special reference to starters and non-starters. *Journal of Science and Medicine in Sport*, 12(1): 215-222.

GOULD, D. (2010). Goal setting for peak performance. In J.M. Williams (Ed.), *Applied sport psychology* (pp.201-220). New York, NY: McGraw-Hill.

GROSSARTH-MATICEK, R.; EYSENCK, H.J.; RIEDER, H. & RAKIC, L. (1990). Psychological factors as determinants of success in football and boxing: The effects of behaviour therapy. *International Journal of Sport Psychology*, 21(3): 237-255.

HABIBI, A.; SHABANI, M.; RAHIMI, E.; FATEMI, R.; NAJAFI, A.; ANALOEI, H. & HOSSEINI, M. (2010). Relationship between jump test results and acceleration phase of sprint performance in national and regional 100m sprinters. *Journal of Human Kinetics*, 23(January): 29-35.

HADAVI, F. & ZARIFI, A. (2009). Talent identification and development model in Iranian athletics. *World Journal of Sport Sciences*, 2(4): 248-253.

HEADLY, N. (2000). Indicators of potential performance in track and field athletics. Unpublished PhD dissertation. Port Elizabeth (RSA): University of Port Elizabeth.

JARVIS, S.; SULLIVAN, L.O.; DAVIES, B.; WILTSHIRE, H. & BAKER, J.S. (2009). Interrelationship between measured running intensities and agility performance in subelite rugby union players. *Research in Sports and Medicine*, 17(4): 217-230.

KATSIKAS, C.; ARGEITAKI, P. & SMIRNITIOU, A. (2009). Performance strategies of Greek track and field athletes: Gender and level differences. *Biology of Exercise*, 5(1): 29-38.

KEOGH, J. (1999). The use of physical fitness scores and anthropometric data to predict selection in an elite under 18 Australian Rules football team. *Journal of Science and Medicine in Sport*, 2(2): 125-133.

KEOGH, J.W.L.; WEBER, C.L. & DALTON, C.T. (2003). Evaluation of anthropometric, physiological, and skill-related tests for talent identification in female field hockey. *Canadian Journal of Applied Physiology*, 28(3): 397-409.

KORCHEMNY, R. (1992). A new concept for sprint start and acceleration. *New Studies in Athletics*, 7(4): 65-72.

KRANE, V. & WILLIAMS, J.M. (2010). Psychological characteristics of peak performance. In J.M. Williams (Ed.), *Applied sport psychology: Personal growth to peak performance* (pp. 169-188). New York, NY: McGraw-Hill.

KRUGER, A. (2006). Sport specific talent identification determinants and development of sprinting and long jumping ability among 10-15-year-old children from underprivileged communities. Unpublished PhD dissertation. Potchefstroom (RSA): North-West University.

KUKOLJ, M.; ROPRET, R.; UGARKOVIC, D. & JARIC, S. (1999). Anthropometric, strength and power predictors of sprinting performance. *Journal of Sports Medicine and Physical Fitness*, 39(2): 120-122.

LEUENS, A. (2008). *Sport psychology*. New York, NY: Psychology Press.

LITTLE, T. & WILLIAMS, A.G. (2005). Specificity of acceleration, maximum speed, and agility in professional soccer players. *Journal of Strength and Conditioning Research*, 19(1): 76-78.

MECKEL, Y.; ATTERBOM, H.; GRONDJINOVSKY, A.; BEN-SIRA, D. & ROTSTEIN, A. (1995). Physiological characteristics of female 100 meter sprinters of different performance levels. *Journal of Sports Medicine and Physical Fitness*, 35(3): 169-175.

MERO, A.; KAUHANEN, H.; PELTOLA, E.; VUORIMAA, T. & KOMI, P.V. (1990). Physiological performance capacity in different prepubescent athletics groups. *Journal of Sports Medicine and Physical Fitness*, 30(1): 57-66.

MEYERS, M.C.; LEUNES, A.D. & BOURGEOIS, A.E. (1996). Psychological skills assessment and athletic performance in collegiate rodeo athletes. *Journal of Sport Behaviour*, 19(2): 132-146.

MIKULIĆ, P. (2008). Anthropometric and physiological profiles of rowers of varying ages and ranks. *Kinesiology*, 1: 80-88.

MOHAMED, H.; VAEYENS, R.; MATTHYS, S.; MULTAEL, M.; LEFEVRE, J.; LENOIR, M. & PHILLIPPAERTS, R. (2009). Anthropometric and performance measures for the development of a talent detection and identification model in youth handball. *Journal of Sport Sciences*, 27(3): 257-266.

MORIN, J.B. & BELLI, A. (2003). Mechanical factors of 100m sprint performance in trained athletes. *Science and Sports*, 18: 161-163.

NESSER, T.W.; LATIN, R.W.; BERG, K. & PRENTICE, E. (1996). Physiological determinants of 40-meter sprint performance in young male athletes. *Journal of Strength and Conditioning Research*, 10(4): 263-267.

ONYEWADUME, I.U.; AMUSA, L.O. & OWOLABI, E.O. (2004). Physique, anaerobic power and pulmonary measures of Botswana track athletes. *Kinesiology*, 36(2): 250-259.

PAOULE, K.; MADOLE, K.; GARHAMMER, J.; LACOURSE, M. & ROZENEK, R. (2002). Reliability and validity of the t-test as a measure of agility, leg power, and leg speed in college-aged men and women. *Journal of Strength and Conditioning Research*, 14: 443-450.

PARUZEL-DYJA, M.; WALASZCZYK, A. & ISKRA, J. (2006). Elite male and female sprinters' body build, stride length and stride frequency. *Studies in Physical Culture and Tourism*, 13(1): 33-37.

PATE, R.R.; SLENTZ, C.A. & KATZ, D.P. (1989). Relationships between skinfold thickness and performance of health related fitness test items. *Research Quarterly for Exercise and Sport*, 60(2): 183-189.

PILIANIDIS, T. & MANTZOURANIS, N. (2011). Start reaction time and performance time in women's sprint at the world championships in athletics. *Studies in Physical Culture and Tourism*, 18(3): 271-275.

SÁNCHEZ-MUÑOZ, C.; SANZ, D. & ZABALA, M. (2007). Anthropometric characteristics, body composition and somatotype of elite junior tennis players. *British Journal of Sports Medicine*, 41(11): 793-799.

SCHNIER, B. (1982). Sprints and hurdles/film analysis. *Track and Field Quarterly Review*, 82(2): 36-38.

SMITH, R.E.; SCHUTZ, R.W.; SMOLL, F.L. & PTACEK, J.T. (1995). Development and validation of a multidimensional measure of sport-specific psychological skills: The Athletic Coping Skills Inventory - 28. *Journal of Sport and Exercise Psychology*, 17(4): 379-398.

SPORIŠ, G.; MILANOVIĆ, L.; JUKIĆ, I.; OMRČEN, D. & MOLINUEVO, J.S. (2010). The effect of agility training on athletic power performance. *Kinesiology*, 42(1): 65-72.

THOMAS, T.R.; ZEBAS, C.J.; BAHRKE, M.S.; ARAUJO, J. & ETHERIDGE, G.L. (1983). Physiological and psychological correlates of success in track and field athletes. *British Journal of Sports Medicine*, 17: 102-109.

UTH, N. (2005). Anthropometric comparison of world-class sprinters and normal populations. *Journal of Sport Science and Medicine*, 4: 608-616.

VARDHAN, D., BALYI, I. & DUFFY, P. (2012). "Sport for life: South African model for long-term participant development". Hyperlink: [https://www.google.co.za/?gfe_rd=cr&ei=qVM1VPjnIOuo8wfLw4KYDA&gws_rd=ssl#q=long+term+athlete+development+program+sascoc]. Retrieved on 16 March 2014.

VESCOVI, J.D. & MCGUIGAN, M.R. (2008). Relationship between sprinting, agility, and jump ability in female athletes. *Journal of Sport Sciences*, 26(1): 97-107.

VUČETIĆ, V.; MATKOVIĆ, B.R. & ŠENTIJA, D. (2008). Morphological differences of elite Croatian track-and-field athletes. *Collegium Antropologicum*, 32(3): 863-868.

WEINBERG, R.S. & GOULD, D. (2015). *Foundations of sport and exercise psychology* (6th ed.). Champaign, IL: Human Kinetics.

WIKIPEDIA (2014). "Sprint (running)". Hyperlink: [http://en.wikipedia.org/wiki/Sprint_(running)]. Retrieved on 23 June 2014.

YOUNG, W.; MCLEAN, B. & ARDAGNA, J. (1995). Relationship between strength qualities and sprinting performance. *Journal of Sports Medicine and Physical Fitness*, 35(l): 13-19.

Dr Ankebé KRUGER: Physical Activity, Sport and Recreation Research Focus Area, North-West University, Private Bag X6001, Potchefstroom 2520, Republic of South Africa. Tel.: +27 (0)18 299 1793, Fax.: +27 (0)18 299 2022, Email: Ankebe.Kruger@nwu.ac.za

(Subject Editor: Prof Ben Steyn)