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SPONSORSHIP EVALUATION SCALE (SES): A VALIDITY AND RELIABILITY STUDY

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ABSTRACT

Although sponsorship is one of the main fund-raising methods available to sports organizations, and a useful marketing communication tool for a company as sponsor, selecting a suitable partner is a difficult issue for any company. Therefore, an understanding of the views of the people who consume sports is vital. The evaluation of consumer response to sport sponsorship is limited in the academic literature. This research was aimed to conduct a dimensionality, validity and reliability study of the Speed and Thompson Sponsorship Questionnaire in Turkey (2000). Eight hundred and fifty-two (852) university students participated in the study. The validity of the instrument was established by face validity and through construct-related evidence. The reliability of the instrument was tested by Cronbach Alpha which was in the range of .93 to .97 for all subscales ($p<.01$). Results indicated that the 55-item-11-component version of the Sponsorship Evaluation Scale is valid and reliable in measuring effects of sponsorship on the Turkish consumers' with respect to their sponsorship response.

Key words: Sponsorship; Sports; Consumer response; Attitudes; Sponsorship evaluation; Sponsorship effect.

INTRODUCTION

Sponsorship funding has recently become one of the most important and widely used tools of humanitarian and social events, sports and the arts. It is the provision of resources (e.g., money, people, equipment) by an organization (the sponsor) directly to an individual, authority or organization (the sponsored) that enables the latter to pursue some activity in return for benefits contemplated in terms of the sponsor's promotion strategy, and which can be expressed in terms of its corporate, marketing or media objectives (Pope, 1998). Increasing economic difficulties affect sponsor organizations to continue sponsorship. At this point, the evaluation of sponsorships becomes an issue with respect to an organization's sponsorship objectives and the evaluation of return on investment (Karakılıç & Koçak, 2002). One of the confusions around sponsorship is how to evaluate it. In fact, the issue of the evaluation of sponsorship is the most controversial and argued subject in the marketing literature because of a lack of universally accepted techniques by which sponsorship effectiveness can be evaluated or not (Shanklin & Kuzma, 1992; Thwaites, 1994).

The literature reveals that media exposure monitoring, sponsor name awareness, and sponsor-sponsored event associations (Crimmins & Horn, 1996; Easton & Mackie, 1998; Meenaghan, 1996; Nicholls *et al*., 1999; Otker & Hayes, 1987; Parker, 1991; Quester, 1997; Stotlar, 1993)

are the most widely used evaluation techniques of the effectiveness of sponsorships. Despite their considerable corporate popularity, these techniques are the first line measurements of sponsorship effectiveness and they do not serve to facilitate the understanding of consumer engagement with sponsorship (Meenaghan, 2001). As the main focus of sponsorship is to affect individuals or society, the effectiveness of sponsorships should be measured in relation to the consumers. The research on the evaluation of sponsorship effectiveness in relation to the consumer response to sponsorship and the factors that affect consumers response to sponsorship is inadequate and the measurement instruments, too (Gardner & Shuman, 1987; Meenaghan, 2001; Speed & Thompson, 2000).

When the literature is examined, the most extensive approach to measure the effectiveness of sponsorship in relation to consumers' response to sponsorship and the factors that affects consumers' response to sponsorship is the Speed and Thompson model (2000). The evaluation of sponsorships was conducted by means of a Sports Questionnaire which examines the effects of consumers' attitudes towards sporting events, their perceptions of sponsor-event fit and their attitudes towards the sponsor on a multidimensional measure of sponsorship response (interest, favour and use of the sponsor's product). This questionnaire has two components. The first component measures the factors affecting consumers' responses to sponsorship, namely status of the event, liking the event, sponsor-event fit, attitudes toward sponsor, sincerity of sponsor and, ubiquity of sponsor. The second component measures the sponsorship response of consumers by subscales of interest, favour, and the use of a sponsors' product.

Speed and Thompson (2000) conducted semi-structured personal interviews with a judgment sample of managers responsible for sponsorship decision making within a group of Australian companies. With these interviews and a literature survey, they generated an initial conceptual framework, and a first item pool for a questionnaire. The researchers then collected data with the participation of two-hundred and thirty seven (237) undergraduate and postgraduate students with an age ranging from 18 to older than 50. The participants answered the questionnaire for certain identified events and potential companies that could sponsor these events. The products and services offered by these companies were all familiar to the student sample and were appropriate for purchase by this group. By this way, Speed and Thompson (2000) validated the questionnaire and then carried out a reliability test.

As the validity and reliability of Speed and Thompson's questionnaire was conducted for identified events and companies that possibly could sponsor these events, the actual sponsors and their sponsored event pairings were not used for the validity and the reliability of the questionnaire. As far as it is known the validity and reliability of this questionnaire was not conducted by any researchers for actual events and its sponsors, and also for a different cultural setting such as Turkey.

Besides the above, the literature on sponsorship emphasizes the importance of the evaluation of consumer responses to sponsorship and their reactions to it (Walliser, 2003; Cornwell & Maignan, 1998). These studies recommend that rigorously designed studies are needed to further the understanding of consumers' perceptions of, and reactions to sponsorship stimuli for the continuation of sponsorship investments. Therefore, this research was aimed at

conducting the validity and reliability study on the Speed and Thompson Sponsorship Questionnaire (SQ) (Speed & Thompson, 2000) in a developing country, in this case, Turkey.

METHOD

Participants

The sample of the study was undergraduate students at the Middle East Technical University in Ankara (Turkey), and the university setting was purposively selected. The reason being that the product promoted by the sponsor company during the sponsorship, was familiar to the student sample and was appropriate for purchase by them (Yiğit & Khorshid, 2006). The sample consisted of 1002 undergraduate students who were randomly selected. Their ages ranged from 18 to 30 with an average age of 22 years. They were from a wide range of departments from humanities to engineering; all were enrolled in elective courses that were open to all faculties and departments. Participants, who knew the sponsor of the Turkish National Football Team and followed the 17th FIFA Soccer World Cup, participated in the research project.

Measures

Both the Sponsorship Questionnaire (SQ) of Speed and Thompson (2000) and its first item pool were used to collect data. The SQ measures the factors affecting consumers' responses to sponsorship in terms of their interest, favour, and the use of a sponsors' product.

The first part of the questionnaire includes 21 items under six subscales which are Status of the Event (SE), Liking the Event (LE), Sponsor-Event Fit (SEF), Attitude Toward Sponsor (ATS), Sincerity of Sponsor (SS) and, Ubiquity of Sponsor (US). "Status of the Event" measures the perceived importance and significance of the event locally and internationally while "Liking the Event" measures the respondents' degree of liking the event. "Sponsor-Event Fit" measures the respondents' level of agreement on the sponsor and the event for the abstract notions of fit such as similarity, a logical connection, and making sense. "Attitude Toward the Sponsor" subscale is a semantic differential scale, and measures the respondents' attitudes to the sponsor company such as good-bad, like-dislike, pleasant-unpleasant, and favourable-unfavourable. "Sincerity of the Sponsor" measures the respondents' level of agreement on the sponsor's motivation (altruism versus commercial) and likely behavior while "Ubiquity of the Sponsor" measures the respondents' level of agreement on the sponsorship activities undertaken by the sponsor, and their degree of focus.

The second part of the questionnaire has three subscales consisting of three items in each namely Interest, Favour and, Use of the Sponsor's Product. While "Interest" measures the respondents level of attention to the sponsor and its promotions, "Favour" measures their favourability toward the sponsor, and "Use" measures the respondents' willingness to consider and use the sponsor's product.

The SQ is a paper-and-pencil self-report instrument that requests the respondent's to indicate their judgments on a 7-point Likert-type scale indicating their level of agreement for each item within a range of "strongly disagree" (1) to "strongly agree" (7).

Procedure

Data was collected nine months after the sponsored event. The original questionnaire's items (30 items) and the first item pool (31) was combined, and administered to the respondents in their departmental classroom settings. Participation in the study was voluntary. One thousand and two (1002) respondents participated in the data collection. As the main purpose of the SQ was to determine respondents' agreement on their perceptions of the sponsorship and their sponsorship response, only subjects who accurately wrote the name of the sponsor and were aware of the sponsored event were accepted in data analysis. Respondents who could describe themselves as TV viewers or spectators and knew the sponsor of the event in addition could write about the sponsors' services and products that were advertised during the sponsorship period were included in the study. Table 1 shows the distribution of the respondents' participation levels in the sponsored events.

TABLE 1. **PARTICIPATION LEVELS OF THE RESPONDENTS TO THE SPONSORED EVENT**

	n	**%**
I have attended this event more than once as a spectator	30	3.5
I have attended this event once before as a spectator	26	3.1
I watched this event on TV consistently the last time it was held	347	40.7
I watched this event on TV occasionally the last time it was held	260	30.5
I watched this event on TV, but I did not follow all of the matches	189	22.2
Total	852	100.0

Respondents who did not follow (75 respondents; 8%), or know nothing about the event (39 respondents; 4%) or sponsor were eliminated from the study. Additionally, incomplete questionnaires were excluded from the study (36 questionnaires; 4%). A total of 852 (417 females; 48.9% and 435 males; 51.1%) valid questionnaires were eventually included in this study.

The validity of the questionnaire was established by face validity with construct-related evidence. Because of potential cultural differences of the respondents, the items of the original SQ in its first item pool were subjected to face-validity. All the items were translated from English into Turkish independently by two English language specialists and the researcher, while the items were also validated by translation-back-translation to ensure that both versions are equivalent. The final Turkish version of the all items was also administered to 42 undergraduate students in order to minimize the possibility of misinterpretation. No misunderstood items were found. To analyze the factors associated with each section of the questionnaire, the items were subjected to a principal component analysis for construct validity. For the reliability of the scale, the Cronbach Alpha method was used.

RESULTS

Table 2 shows the descriptive statistics of the newly formed scale. It provides the mean score values and the standard deviations of total scales and their subscales.

TABLE 2. **MEANS AND STANDARD DEVIATIONS OF THE TOTAL SCALES AND THEIR SUBSCALES**

	Subscales	**n**	**x**	**sd**
Determinants of sponsorship response (x=4.76, sd=0.83)	Status of the event	852	5.67	1.23
	Attitude toward the event	852	5.66	1.30
	Personal liking of the event	852	5.19	1.64
	Attitude toward the sponsor	852	5.11	1.52
	Image of the sponsor	852	4.89	0.98
	Ubiquity of the sponsor	852	4.66	0.96
	Sponsor-event fit	852	3.96	1.40
	Sincerity of the sponsor	852	3.92	1.21
Consumers' response to sponsorship (x=4.27, sd=1.51)	Favour	852	4.47	1.59
	Interest	852	4.42	1.64
	Use	852	3.93	1.75

The first part of the questionnaire (21 items) and first item pool (28 items) (K=49; total number of items subjected to the principal component analysis) were subjected to a principal component analysis to test the construct validity. The application of the principal component analysis indicated that there were seven components with an Eigen value greater than one, which made it possible to interpret the number of factors that appeared on the screed plot. Items loading .40 or more were taken into consideration. Six items were deleted because of poor item loadings and high item cross loadings (Stevens, 1986) except for item F23 (see Table 3). Although the factor loading of this item was not .40, but close to the required value to be accepted, it was evaluated by the researcher as a necessary item to test the image of the sponsor. Therefore, F23 was not eliminated from the study. When the factor loadings on the rotated factor matrix are closely examined, it is clear that these factors represent a meaningful clustering. The seven-factor solution measured a 64.1% variation of the factors affecting consumers' responses to the sponsorship. Factor 1 (Status of the Event) and 2 (Linking the Event) account for 11.80%, 3 (Attitude towards the Event) with 6.94%, 4 (Sponsor-Event-Fit) with 12.04%, 5 (Attitude towards Sponsor) 8.18%, 6 (Sincerity of the Sponsor) 8.60%, 7 (Ubiquity of the Sponsor) 4.51%, and 8 (Image of the Sponsor) with 12.03% of the total variance.

Although factors 1 and 2 (see Table 3) were seen as one factor in the first principal component analysis, a 2-factor solution was also run (K=7) because of the conceptual distinction between the status of the event and its personal liking (Speed & Thompson, 2000). The application of the principal component analysis highlighted that there were two components with an Eigen value greater than one. The 2-factor solution measured a 77.80% of the total variation. Factor 1 account for 30.4%, and factor 2 for 47.4%. Eigen values of factor 1 and 2 were 2.13 and 3.31, respectively. This values shows that Factor 1 and 2 are acceptable. Analyses showed that each of the 8 factors could be interpreted. When the content of the each of the factors and the study of Speed and Thompson (2000) considered, factor 1 was named as "Status of the Event", factor 1 as "Liking the Event", factor 1 as "Attitude

toward the Event", factor 4 as "Sponsor-Event Fit", factor 5 as "Attitude Toward Sponsor", factor 6 as "Sincerity of the Sponsor", factor 7 as "Ubiquity of the Sponsor ", and factor 8 as "Image of the Sponsor".

TABLE 3. **DETERMINANTS OF SPONSORSHIP RESPONSE**

Factors (Total α=.93)		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
Status of the Event (SE): (α=.74) ($\alpha_{\text{Original Study}}$=.70)									
A 2	This event is important to where I live	.808							
F 1	This event has international significance	.748							
A 1	This is a significant sporting event	.694							
Liking the Event (LE): α=.93)			**($\alpha_{\text{Original Study}}$=.96)**						
A 5	I enjoy following coverage of this event		897						
A 6	This event is important to me		873						
A 4	I would want to attend this event		824						
A 3	I am a strong supporter of this event		807						
Attitude toward Event (ATE): (α=.90)									
F 2	My attitude to the event: dislike-like			.835					
F 3	My attitude to the event: unpleasant-pleasant			825					
F 4	My attitude to the event: bad-good			.813					
F 5	My attitude to the event: unfavourable - favourable			658					
Sponsor-Event Fit (SEF): (α=.92) ($\alpha_{\text{Original Study}}$=.95)									
D 2	The image of the event and the image of the sponsor are similar				.860				
D 1	There is a logical connection between the event and the sponsor				.779				
D 3	The sponsor and the event fit together well				.778				
D 4	The company and the event stand for similar things				.757				
F 8	Skills required to participate in the event are skills the sponsor has				.713				
F 9	The skills required to stage the event are skills that the sponsor has				.711				
D 5	It makes sense to me that this company sponsors this event				.595				
Attitude toward Sponsor (ATS): (α=.95) ($\alpha_{\text{Original Study}}$=.97)									
B 2	My attitude to the sponsor: dislike-like					.830			

Factors (Total α=.93)		Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
B 3	My attitude to the sponsor: unpleasant-pleasant					.827			
B 4	My attitude to the sponsor: unfavourable-favourable					.793			
B 1	My attitude to the sponsor: bad-good					.764			
Sincerity of Sponsor (SS): (α=.76) ($\alpha_{\text{Original Study}}$=.88)									
E 3	This sponsor would probably support the event even if it had a much lower profile						.779		
F13	I think this company would be sincere in their support for this event						.746		
E 2	This sponsor would be likely to have the best interests of the sport at heart						.744		
F14	Commercial motives would not be the most important reasons why this company undertook this sponsorship						.705		
E 1	The main reason the sponsor would be involved in the event is because the sponsor believes the event deserves support						.622		
F16	This company only wants to make money						-.491*		
Ubiquity of Sponsor (US): (α=.57) ($\alpha_{\text{Original Study}}$=.85)									
F 7	This company is very selective in what sports events it sponsors							.704	
F 6	This company's sponsorship is clearly focused on certain sports							.631	
C 2	It is very common to see this company sponsoring sports events							.610	
C 1	This company sponsors many different sports							.436	
Image of the Sponsor (IS): (α=.85)									
F18	This company has good products and services								.751
F17	This is a major company								.707
F19	This company is well managed								.699
F22	This company is a good company to work for								.685
F24	I have a favourable attitude to this company								.677
F21	This company responds to customer needs								.646
F25	This company is a credible sponsor of this event								.587
F20	This company is involved in the community								.506
F28	Sponsorship of this event by this company will enhance the image of the event								.477
F27	Sponsorship of this event by this company will enhance the company's reputation								.465
F23	This company behaves in an unethical way								-.372*
Eigen value		5.07	2.99	5.18	3.52	3.70	1.94	5.17	
Explained Variance (%)		11.8	6.94	12.04	8.18	8.60	4.51	12.03	
Cumulative Variance (%)		11.8	18.74	30.78	38.96	47.56	52.07	64.09	

***** These items were reverse scored. Item loading: .40 or more

Table 4 shows the sponsorship response section of the scale. Items from the original questionnaire (9) and items from its first item pool (3) were subjected to a principal component analysis to test the construct validity. The application of the principal component analysis (K=12) demonstrated that there were three components with an Eigen value greater

than one which made it possible to interpret the number of factors that appeared on the screen plot. All the items were clustered in three meaningful clusters. The three-factor solution measured an 86.69% variation. Factor 1 (Interest) accounts for 28.16%, factor 2 (Favour) for 29.11% and factor 3 (Use) for 29.43% of the total variance. When the content of the each of the factors and the study of Speed and Thompson (2000) considered, factor 1 was named as "Interest", factor 1 as "Favor", and factor 3 as "Use".

TABLE 4. **SPONSORSHIP RESPONSE OF CONSUMERS**

Factors (Total α**=,97)**		Factor1	Factor2	Factor3
Interest (α=.95) ($\alpha_{\text{Original Study}}$=.91)				
H 2	This sponsorship would increase my interest in the sponsor's advertising	.820		
H 3	This sponsorship would make me more likely to remember the sponsor's promotion	.799		
H 1	This sponsorship would make me more likely to notice the sponsor's name on other occasions	.788		
J 2	This sponsorship would make me more likely to pay attention to the sponsor's advertising	.740		
Favour (α=.95) ($\alpha_{\text{Original Study}}$=.95)				
G 3	This sponsorship would make me like the sponsor more		.824	
J 1	I would feel more positive about the sponsor as a result of this sponsorship		.823	
G 1	This sponsorship makes me feel more favourable towards the sponsor		.787	
G 2	This sponsorship would improve my perception of the sponsor		.786	
Use (α=.95) ($\alpha_{\text{Original Study}}$=.94)				
I 3	I would be more likely to buy from the sponsor as a result of this sponsorship			.849
I 2	This sponsorship would make me more likely to consider this company's products the next time I buy			.801
J 3	Were I in need of the type of product the sponsor supplies, this sponsorship would increase the chances of me choosing the sponsor's product			.794
I 1	This sponsorship would make me more likely to use the sponsor's product			.764
Eigen value		3.38	3.49	3.53
Explained Variance (%)		28.16	29.11	29.43
Cumulative Variance (%)		28.16	57.27	86.69

Item loading: .40 or more

Table 5 shows the correlation matrix for the resulting measures. High and meaningful correlations of factors with each other were very satisfactory for the construct validity.

TABLE 5. **CORRELATION MATRIX FOR SPONSORSHIP EVALUATION SCALE'S SUBSCALES**

	SEF	IS	SS	ATS	ATE	US	LE	SE	Use	Favour	Interest
SEF	1										
IS	.594*	1									
SS	.624*	.554*	1								
ATS	.429*	.598*	.373*	1							
ATE	.216*	.202*	.135*	.313*	1						
US	.302*	.430*	.277*	.334*	.107*	1					
LE	.240*	.240*	.205*	.247*	.599*	.196*	1				
SE	.204*	.241*	.149*	.199*	.449*	.181*	.692*	1			
Use	.575*	.526*	.510*	.418*	.195*	.221*	.235*	.155*	1		
Favour	.581*	.634*	.502*	.495*	.270*	.318*	.327*	.266*	.739*	1	
Interest	.545*	.556*	.429*	.346*	.236*	.259*	.264*	.204*	.765*	.752*	1

* $p<0.01$

SEF: Sponsor Event Fit, IS: Image of the Sponsor, SS: Sincerity of the Sponsor, ATS: Attitude Towards the Sponsor, ATE: Attitude Towards the Event, US: Ubiquity of the Sponsor, LE: Liking the Sponsor, SE: Status of the Event.

Reliability of the scale was addressed by using Cronbach Alpha. Tables 2 and 3 pointed out Cronbach alpha coefficients or internal consistencies for all subscales as well as the total scale. Results showed that the newly formed, and named as the "Sponsorship Evaluation Scale (SES)" had 55-items under 11 components with the range of $\alpha=.57$ to $\alpha=.95$ for all subscales ($p<.01$).

DISCUSSION

Results showed that a total of 11 factors and 55 items questionnaire were formed. Thus, two additional dimensions were added to the Speed and Thompson (2000) model of sponsorship which were the "Image of the Sponsor" and the "Attitude Toward the Event". Figure 1 shows the conceptual framework of the newly formed scale.

Face validity, construct validity, and the high and meaningful correlation of subscales with each other showed that the newly formed Sponsorship Evaluation Scale (SES) valid scale to measure consumers' response to sponsorship and those factors determining their responses. Although nine subscales among eleven were similar to the original scale (Speed & Thompson, 2000), two additional subscales were formed for the Turkish population.

The reliability of the instrument was tested by Cronbach Alpha (α) which was in the range of .74 to .95 for all subscales ($p<.01$) except for "Ubiquity of the Sponsor". As "Ubiquity of the Sponsor" subscale's internal consistency ($\alpha=.57$) was at an acceptable level, but close to the required value to be accepted, other subscales' α values were highly satisfactory. Alpar (2000) stated that scales with .60 to .80 internal consistency values were expressed as reliable. Newly obtained cronbach alpha values for each of the factors were approximately

similar to the original questionnaire (Speed & Thomson, 2000), and cronbach alphas for newly added subscales were between .85 and .90 (see Table 2).

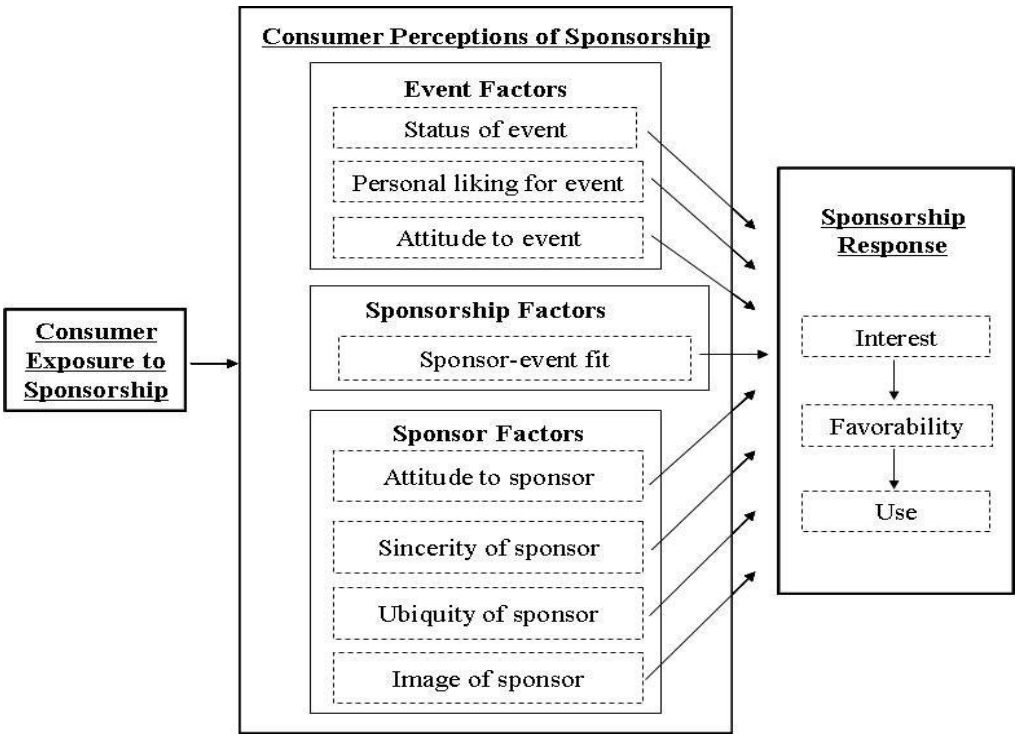

FIGURE 1: **CONCEPTUAL FRAMEWORK FOR THE CURRENT STUDY**

The results of the Principal Component Factor analysis for the first part of the scale indicated that all the items from the original questionnaire, except for "I expect this company to sponsor major events", could be interpreted under the same subscales of the original questionnaire. The factor analysis measured "Liking the Event", and "Attitude Towards the Sponsor" as similar to the original questionnaire, while two items each for "Fit" and "Ubiquity of the Sponsor", three for "Sincerity of the Sponsor", and one for "Status of the Event" were incorporated from the first item pool. In addition, two new subscales were formed. When the items under these subscales were assessed, they were labeled as "Image of the Sponsor (IS = 11-items)", and "Attitude toward the Event (ATE= 4-items)". All the items loaded under IS and ATE were from the first item pool. It can be concluded that the image of the sponsor and attitude towards the event are two further determinant factors of the sponsorship response in Turkey. In conclusion, 49 items were subjected to the principal component analysis, of which five of them from the first item pool and one from the original questionnaire were not loaded meaningfully under any subscale.

For the second part of the scale, the results of Principal Component Factor analysis revealed that all the items of the original questionnaire were loaded meaningfully, and could be

interpreted under the same subscales of the original questionnaire. One item from the first item pool of each of the subscales was loaded.

Consequently, it can be stated that the adjusted instrument called "Sponsorship Evaluation Scale" is a valid and reliable scale, and provides the opportunity to make meaningful interpretations of consumers' responses to sponsorship in terms of interest, favour and use of the sponsor's product, and those factors determining these responses. Besides, the conceptual framework of SES could provide insights to both the managers responsible for preparing sponsorship proposals to apply to potential sponsors as well as the managers of the companies planning and/or conducting sponsorship of any event in terms of sponsorship decision making. Event managers could increase the opportunities of sponsors to add value to their sponsorship. Sponsorship managers could make use of the factors included in the SES during the sponsorship selection decision process and the development of the sponsorship-leveraging strategy. They could select the best sponsorship proposal among the existing alternatives, and begin additional promotions to raise the response to sponsorship.

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DIE ANTROPOMETRIESE VLOERITEM-PRESTASIEDETERMINANTE VAN JONG DOGTERGIMNASTE

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ABSTRACT

The purposes of this study were firstly, to determine the anthropometric variables that differ significantly ($p \leq 0.05$) between successful and less successful young, South-African female gymnasts who participate in the floor item and secondly, to determine the anthropometric variables that contribute to the floor item performance of those gymnasts. Twelve young, female gymnasts (13.39 ± 2.14 years) from a gymnastics club in the North-West Province of South Africa participated in the study. Only gymnasts who participated at level 6-9 and junior as well as senior Olympic level were selected to participate in the study. Sixty-one anthropometric variables were measured on the dominant side of the body according to the methods of Norton et al. (1996). Independent t-tests revealed that the gymnast who obtained the highest marks (top 5) during the execution of the floor item during the South African Gymnastics Championships had statistical and practical significantly larger relaxed and flexed upper arm, wrist and ankle circumferences as well as mesomorphy values than the less successful gymnasts. The cluster analysis-reduced variables were used to perform a forward, stepwise multiple regression analysis which showed that bi-trochanterion (34.86%), femur (17.07%) and bi-deltoid breadth (4.93%); front thigh skinfold (19.71%); fat percentage (7.68%); acromial-radial (4.09%) and foot length (0.05%) as well as waist (6.68%), chest (2.92%) and gluteal thigh circumference (2.02%) contributed 100% to the variance in gymnasts' floor performances. The contributions of bi-trochanterion breadth, femur breadth, gluteal thigh circumference and foot length to floor-gymnastic performance were significant. Only gluteal thigh circumference showed a negative relationship with floor-gymnastic performance. The conclusion that can therefore be drawn is that larger limb and torso circumferences, waist breadths, fat percentages and front thigh skinfolds, as well as upper arm and foot lengths are important anthropometric floor performance determinants for young, South African female gymnasts and should be included in the sports-scientific testing protocols of gymnasts.

Key words: Gymnastics; Floor; Anthropometry; Performance; Females; Girls.

PROBLEEMSTELLING

Die literatuur maak melding van 'n heel aantal fisieke (Novak *et al.*, 1977; Bajin, 1987; Bompa, 1999; Brown, 2001), motoriese (Novak *et al.*, 1977; Bompa 1999; Brown, 2001) en antropometriese prestasiedeterminante (Caldarone *et al.*, 1986; Claessens *et al.*, 1999) wat vir gimnastiek van belang is. Ten spyte van die beskikbaarheid van literatuur wat verskillende prestasiederminante in gimnastiek uitwys, blyk dit dat daar geen navorsing bestaan wat die

presiese bydrae van elk van die determinante by meer gevorderde, Suid-Afrikaanse (SA) gimnaste ondersoek het nie. 'n Studie waarin al die genoemde gimnastiek-prestasiedeterminante ondersoek word, sal egter te omvattend wees vir 'n artikel van hierdie aard. Dit is in die lig hiervan dat slegs die antropometriese prestasiedeterminante vir die gimnastiek-vloeritem in die studie aandag geniet.

Die beskikbare literatuur wat handel oor die verskille wat voorkom met betrekking tot die antropometriese samestelling van suksesvolle en minder suksesvolle gimnaste het die volgende aan die lig gebring: Gimnaste wat beter prestasies in internasionale kompetisies behaal, toon betekenisvol laer liggaamsmassa-, breër torakale deursnee- en kleiner subskapulêre velvouwaardes as dié wat nie sulke topprestasies behaal nie (Pool *et al*., 1969). Volgens Falls en Humphrey (1977) se navorsingsbevindinge het die gimnaste wat plekke behaal het op die "Association for Intercollegiate Athletics for Women Gymnastics Meet" betekenisvol laer vetpersentasies behaal as die gimnaste wat nie plekke behaal het nie. Vergelykings tussen die drie beste en drie swakste damesgimnaste wat aan die vyfde Internasionale Gimnastiekkampioenskap in 1977 deelgeneem het, het soortgelyke vetpersentasieresultate opgelewer, met die beste gimnaste wat betekenisvol laer vetpersentasie-waardes as die swakste gimnaste behaal het. Tesame hiermee het Dotan *et al.* (1980) in hul studie bevind dat talentvolle, jong gimnaste betekenisvol kleiner vetmassa-, voet- en beenlengtewaardes toon as hul minder talentvolle eweknieë.

Wat navorsing oor die moontlike verband tussen verskillende antropometriese veranderlikes en gimnastiekprestasie betref, het Pool *et al.* (1969) en Claessens *et al.* (1999) bevind dat 'n betekenisvolle korrelasie bestaan tussen gimnaste se vetpersentasies, hul endomorfiewaardes en die puntetellings wat hul met kompetisiedeelname behaal. 'n Korter sithoogte en voorarmlengte, sowel as kleiner dy- en groter bo-armomtrekke, word ook met beter gimnastiekprestasies geassosieer (Claessens *et al.* 1999). Pienaar en Van der Walt (1988) het in hul studie op ses- tot negejarige dogtergimnaste gevind dat 81% van die variansie met betrekking tot kompetisiepunte verklaar kan word aan die hand van 'n 14-veranderlike-regressievergelykingsmodel wat onder andere suprasternale sithoogte, transversale bors-, biakromiale en bikondilêre deursnee; boarmlengte; boarm-, bors-, bobeen- en kuitomtrek sowel as bisepsvelvouwaarde ingesluit het. Die 8-veranderlikemodel wat onder andere liggaamsmassa, biakromiale deursnee en gespanne boarm-, bors- en bobeenomtrek ingesluit het, kon net 64% van die kompetisiepuntvariansie verklaar.

Slegs een studie kon gevind word waarin die bydrae van verskillende antropometriese veranderlikes tot itemspesifieke gimnastiekprestasies ondersoek is. Claessens *et al.* (1999) het bevind dat velvoue (biseps, triseps, subskapulêre, crista iliaca en kuit) en endomorfie 'n betekenisvolle, negatiewe korrelasie met vloeritem-puntetelling getoon het.

Uit die bogenoemde literatuurbevindinge is dit dus duidelik dat sekere van die antropo-metriese veranderlikes wel verband hou met algehele en itemspesifieke gimnastiekprestasies. Die meerderheid navorsing wat in dié verband bestaan, is egter slegs van toepassing op nie-Suid-Afrikaanse gimnaste en lig nie die presiese bydrae van elk van die antropometriese veranderlikes op gimnastiekprestasies uit nie. Dit is teen hierdie agtergrond dat die volgende navorsingsvrae gestel word: Ten eerste, wat is die antropometriese veranderlikes wat betekenisvol verskil tussen suksesvolle en minder suksesvolle SA-dogtergimnaste in die

vloeritem? Tweedens, wat is die antropometriese veranderlikes wat bydrae tot die prestasies (puntetoekenning) wat SA-dogtergimnaste in die vloeritem behaal? Die beantwoording van dié vrae sal moontlik afrigters en sportwetenskaplikes in staat stel om meer talentvolle gimnaste te identifiseer en ook om vas te stel wat die mees bepalende antropometriese komponente is wat aandag moet geniet tydens gimnastiekkondisionerings-programme.

Die noodsaaklikheid van ’n studie van hierdie aard word beklemtoon deur die feit dat slegs een Suid-Afrikaanse artistiese gimnas, byname Zandré Labuschagne, gedurende die afgelope 44 jaar daarin kon slaag om vir die Olimpiese Spele te kwalifiseer (News 24, 2003). Die uitwysing van antropometriese prestasiedeterminante vir die vloeritem kan dit moontlik maak om talentvolle artistiese gimnaste op ’n jong leeftyd te identifiseer en te lei tot die bereiking van topprestasies in dié item.

METODE VAN ONDERSOEK

Navorsingsontwerp

’n Eenmalige dwarsdeursnee-opname is vir die doel van die studie uitgevoer.

Die proefpersone

’n Groep van 12 jong, provinsiale dogtergimnaste ($\overline{X}$ = 13.39 $\pm$ 2.14 jaar) van ’n gimnastiekklub in die Noordwes-Provinsie (SA) is vir die studie gebruik. Slegs gimnaste wat op vlak 6-9 sowel as op junior en senior Olimpiese vlak kompeteer, is vir die doel van die studie gebruik. Dié groep is onder andere saamgestel uit een gimnas wat aan die Olimpiese Spele van 2004 deelgeneem het.

Die toetsingsprosedure

Die studie (met die nommer 04M13) is deur die Noordwes-Universiteit se Etiekkomitee goedgekeur. Die gimnaste en hulle ouers is ingelig oor die toetsprosedures en ingeligtetoestemming-vorms is deur beide die genoemde partye onderteken voordat die toetsings ’n aanvang geneem het. Die gimnaste se demografiese, persoonlike en oefengewoontes, beseringsinsidensie, aktiwiteitsdeelnamevlak en fisiekevoorbereiding-inligting is deur middel van ’n demografiese en algemene inligtingsvraelys ingesamel.

Elk van die proefpersone is gedurende die week van deelname aan hul primêre gimnastiekkompetisie (Suid-Afrikaanse Gimnastiekkampioenskap) aan die ondergenoemde metings onderwerp. Die volgende antropometriese veranderlikes is volgens die metodes van Norton *et al*. (1996) aan die dominante kant van die liggaam gemeet:

Absolute liggaamsgrootte

Die volgende veranderlikes is onder hierdie kategorie bepaal: liggaamsmassa; liggaamslengte; sithoogte; armspan; kop-, nek-, ontspanne boarm-, gespanne boarm-, voorarm-, gewrig-, bors-, middel-, heup-, bo-dy-, mid-dy-, kuit- en enkelomtrek; biakromiale, transversale bors-, anterior-posterior-(AP)-bors-, bi-iliokristale, humerus-, gewrigs-, hand- en femurdeursnee; boonsteledemaat-, arm-, voorarm-, hand-, ondersteledemaat-, dy-, been- en voetlengte.

Somatotipering

Die somatotipering van gimnaste het gefokus op die beoordeling van hul endo-, meso- en ektomorfiewaardes. Aangesien somatotipe bereken word deur van ’n aantal antropometriese veranderlikes gebruik te maak, is laasgenoemde ook hier aangeraak: liggaamslengte; triseps-, subskapulêre, kuit- en supraspinale velvou; humerus- en femurdeursnee; gespanne boarm- en kuitomtrek; sowel as liggaamsmassa. Die laasgenoemde veranderlikes is in die formule van Carter en Heath (1990) ingesluit om somatotipering te bepaal.

Relatiewe liggaamsgroottes

Relatiewe liggaamsgrootte is bepaal deur ’n verskeidenheid metings, naamlik: armspan; sithoogte; arm-, vooram-, hand-, dy-, been- en voetlengte; biakromiale, transversale bors-, AP-bors-, bi-iliokristale, humerus- en femurdeursnee; kop-, nek-, ontspanne boarm-, gespanne boarm-, voorarm-, gewrig-, bors-, middel-, heup-, bo-dy-, mid-dy-, kuit- en enkelomtrek; triseps-, subskapulêre, biseps-, iliospinale, supraspinale, abdominale, frontale dy- en mediale kuitvelvou. Liggaamsmassa-indeks (LMI) is bepaal deur die liggaamsmassa (kg) van elke gimnas te deel deur die vierkantswortel van die liggaamslengte (m) van elke gimnas (Heyward & Stolarczyk, 1996).

Liggaamsamestelling

Vetmassa, spiermassa en skeletmassa is onder hierdie kategorie geanaliseer. Vir die bepaling van vetmassa is die triseps-, kuit- en subskapulêre velvou gebruik. Liggaamslengte, femur-, humerus-, gewrig- en enkeldeursnee is gebruik vir die bepaling van skeletmassapersentasie, terwyl liggaamsmassa, liggaamslengte, arm-, dy- en kuitomtrek, sowel as die triseps-, dy- en kuitvelvou, vir die bepaling van spiermassapersentasie gebruik is. Vetpersentasie, spiermassapersentasie en skeletmassapersentasie is bepaal volgens die formules van onderskeidelik Slaughter *et al*. (1988), Lee *et al*. (2000) en Martin *et al*. (soos aangehaal deur Drinkwater & Mazza, 1994).

Statistiese verwerking

Die Statistica-statistiekverwerkingspakket (StatSoft, 2005) wat op die Noordwes-Universiteit-netwerk beskikbaar is, is gebruik om die data te verwerk. Ten eerste is die beskrywende statistiek (gemiddeldes, minimum en maksimum waardes sowel as standaardafwykings) van die verskillende veranderlikes bereken. Dit is opgevolg met ’n analise wat die gimnaste in ’n rangorde geplaas het volgens die vloeritempunte wat hul tydens die Suid-Afrikaanse Gimnastiekkampioenskap behaal het. Ten einde te kompenseer vir die verskillende vlakke waarop die gimnaste deelgeneem het, is daar ’n ekstra 1.125 punte per vlak vir elke vlak hoër as vlak 6 toegeken. Die punte is gebruik om die gimnaste in ’n rangorde te plaas volgens die prestasies wat in die sprongitem behaal is. Die gimnas met die hoogste punt is eerste geplaas en die gimnas met laagste punt laaste. Dit is opgevolg met ’n onafhanklike t-toets wat gebruik is om te bepaal of daar wel betekenisvolle verskille tussen die vyf hoogste geplaaste gimnaste en die res van die gimnaste is. Praktiese betekenisvolheid van dié genoemde verskille is hierna deur middel van effekgroottes (EG) bepaal waar EG = $(M_1 – M_2)/s$ (Thomas & Nelson, 2001). M_1 is die gemiddeld van die eerste groep, M_2 is die gemiddeld van die tweede groep en s is die standaardafwyking. Thomas en Nelson (2001) het voorgestel dat die gepoelde standaardafwyking (Sp) gebruik word

$$s_p = \sqrt{\frac{s_1^2(n_1-1) + s_2^2(n_2-1)}{n_1+n_2-2}}$$

Hier is $s1^2$ = die variansie van die eerste groep, $s2^2$ = die variansie van die tweede groep, n1 = die aantal gimnaste in die eerste groep en n2 = die aantal gimnaste in die tweede groep. Effekgroottes (uitgedruk as Cohen se d-waarde) kan as volg geïnterpreteer word: 'n EG van min of meer 0.8 is groot, 'n EG van min of meer 0.5 is gemiddeld en 'n EG van min of meer 0.2 is klein. Effekgroottes is slegs bereken by die veranderlikes wat statisties betekenisvolle verskille getoon het. Vervolgens is 'n trosontledinganalise op die verskillende antropometriese veranderlikes uitgevoer om daardeur die mees bepalende veranderlikes vir die vloeritem uit te sonder. Die trosontleding is opgevolg met 'n voorwaartse, stapsgewyse meervoudige regressie-analise om die bydrae van elk van die trosontleding-geïdentifiseerde veranderlikes tot vloeritem-gimnastiekprestasie vas te stel. Die aangepaste punte wat elk van die gimnaste in die vloeritem behaal het, is as die afhanklike veranderlikes vir die meervoudige regressie-analise gestel. Die vlak van betekenisvolheid is op kleiner as en gelyk aan 0.05 gestel.

BESPREKING VAN DIE RESULTATE

Ten eerste die beskrywende statistiek, die statisties (onafhanklike t-toets) sowel as prakties betekenisvolheid (effekgroottes) van verskille tussen die vyf hoogste geplaaste gimnaste en die res van die dogtergimnaste met betrekking tot ouderdom en liggaamsamestelling weergegee (Tabel 1).

TABEL 1. **BESKRYWENDE STATISTIEK VIR OUDERDOM EN LIGGAAMSSAMESTELLING VAN JONG DOGTERGIMNASTE (N=12)**

Veranderlikes	**Suksesvol**		**Minder suksesvol**		**Verskille en betekenisvolheid van verskille**	**Effekgrootte**
	$\overline{X}$	SA	$\overline{X}$	SA		
Ouderdom (jaar)	14.00	2.48	12.77	1.80	1.23	-
Massa (kg)	45.57	12.44	38.44	4.59	7.13	-
LMI (kg/m^2)	19.41	3.23	17.35	0.82	2.06	-
Skraalliggaamsmassa (kg)	38.12	9.48	32.70	3.44	5.42	-
Som van 6 velvoue (mm)	56.61	14.73	48.91	8.54	7.70	-
Vetpersentasie (%)	15.94	2.76	14.82	1.85	0.84	-
Vetmassa (kg)	7.45	3.09	5.74	1.32	1.71	-
Endomorfie	2.59	0.62	2.29	0.36	0.31	-
Mesomorfie	4.84	0.64	3.69	0.99	1.15*	1.3^{+++}
Ektomorfie	2.87	1.35	3.69	0.66	-0.82	-
Spiermassa (kg)	19.98	3.92	17.84	1.37	2.14	-
Spiermassa (%)	44.56	3.35	46.62	2.91	-2.07	-
Skeletmassa (kg)	6.23	0.73	5.55	0.70	0.68	-
Skeletmassa (%)	14.13	2.16	14.45	0.83	-0.32	-

$\overline{X}$ = Gemiddeld SA = Standaardafwyking *p ≤ 0.05 +++ = Groot effekgrootte

Die beskrywende statistiek sowel as die betekenisvolheid van verskille (onafhanklike t-toets) tussen die vyf hoogs geplaaste gimnaste en die res van die dogtergimnaste met betrekking tot velvoue word in Tabel 2 weergegee.

TABEL 2. **BESKRYWENDE STATISTIEK VIR DIE VELVOUE VAN JONG DOGTERGIMNASTE (N=12)**

Veranderlikes	**Totale gimnastiek-groep**		**Suksesvol**		**Minder suksesvol**		**Verskille en betekenisvolheid van verskille**
	$\overline{X}$	SA	$\overline{X}$	SA	$\overline{X}$	SA	
Trisepsvelvou (mm)	9.13	2.11	9.50	2.39	8.86	2.04	0.64
Bisepsvelvou (mm)	5.03	1.36	4.84	1.21	5.16	1.54	-0.32
Midaksilêre velvou (mm)	5.14	1.24	5.73	1.61	4.71	0.78	1.02
Subskapulêre velvou (mm)	6.28	1.22	6.81	1.70	5.89	0.62	0.92
Pektorale velvou (mm)	4.62	1.12	4.51	1.19	4.70	1.15	-0.19
Abdominale velvou (mm)	8.17	3.20	9.13	4.13	7.49	2.46	1.64
Crista illiaca-velvou (mm)	10.58	3.96	12.48	4.26	9.21	3.39	3.27
Supraspinale velvou (mm)	6.10	1.98	6.96	2.33	5.49	1.58	1.47
Frontale dyvelvou (mm)	14.60	4.22	15.53	5.11	13.93	3.74	1.60
Mediale kuitvelvou (mm)	8.36	1.50	8.82	1.59	8.03	1.46	0.79

$\overline{X}$ = Gemiddeld SA = Standaardafwyking

Die beskrywende statistiek, die statisties (onafhanklike t-toets) sowel as prakties betekenisvolheid (effekgroottes) van verskille tussen die vyf hoogste geplaaste vyf gimnaste en die res van die dogtergimnaste met betrekking tot omtrekke word in Tabel 3 weergegee.

TABEL 3. **BESKRYWENDE STATISTIEK VIR OMTREKKE VAN JONG DOGTERGIMNASTE (N=12)**

Veranderlikes	**Totale gimnastiek-groep**		**Suksesvol**		**Minder suksesvol**		**Verskille en betekenis-volheid van verskille**	**Effek-grootte**
	$\overline{X}$	SA	$\overline{X}$	SA	$\overline{X}$	SA		
Kopomtrek (cm)	52.87	1.13	53.01	1.08	52.76	1.24	0.25	-
Nekomtrek (cm)	29.20	1.70	30.01	2.04	28.63	1.26	1.38	-
Ontspanne boarm-omtrek (cm)	22.94	2.69	24.73	3.28	21.66	1.25	3.07*	1.4^{+++}
Gespanne boarm-omtrek (cm)	24.86	2.51	26.69	2.88	23.56	1.10	3.13*	1.0^{+++}
Voorarmomtrek (cm)	22.10	1.92	23.21	2.00	21.31	1.53	1.90	-
Gewrigsomtrek (cm)	14.53	0.91	15.22	0.64	14.03	0.75	1.19*	0.8^{+++}
Mesosternale borsomtrek (cm)	71.06	18.83	79.33	7.69	65.15	22.65	14.18	-
Middelomtrek (cm)	60.90	4.24	62.79	5.70	59.54	2.48	3.25	-
Heupomtrek (cm)	77.54	6.54	80.48	8.41	75.44	4.36	5.04	-
Dyomtrek gluteaal (cm)	46.15	5.08	48.26	6.96	44.64	2.95	3.62	-
Dyomtrek (cm)	42.61	4.97	44.84	7.06	41.01	2.24	3.83	-
Kuitomtrek (cm)	30.58	3.40	32.26	4.78	29.37	1.39	2.89	-
Enkelomtrek (cm)	19.58	1.34	20.68	1.24	18.79	0.73	1.89*	0.8^{+++}

$\overline{X}$ = Gemiddeld SA = Standaardafwyking *$p \leq 0.05$ +++ = Groot effekgrootte

Die beskrywende statistiek sowel as die betekenisvolheid van verskille (onafhanklike t-toets) tussen die vyf hoogste geplaaste gimnaste en die res van die dogtergimnaste met betrekking tot lengtes en hoogtes word in Tabel 4 weergegee.

TABEL 4. **BESKRYWENDE STATISTIEK VIR LENGTES EN HOOGTES VAN JONG DOGTERGIMNASTE (N=12)**

Veranderlikes	**Totale gimnastiekgroep**		**Suksesvol**		**Minder suksesvol**		**Verskille en betekenisvolheid van verskille**
	$\overline{X}$	SA	$\overline{X}$	SA	$\overline{X}$	SA	
Liggaamslengte (cm)	150.07	7.64	152.08	8.60	148.64	7.21	3.44
Sithoogte (cm)	116.26	4.46	118.30	5.29	114.80	3.44	3.50
Armspan (cm)	151.80	7.61	154.86	8.73	149.61	6.47	5.25
Akromiale-radiale lengte (cm)	27.23	2.12	27.30	1.50	27.19	2.59	0.11
Radiale stillion-lengte (cm)	21.95	1.43	22.10	1.58	21.85	1.43	0.25
Midstillion-daktillion-lengte (cm)	17.36	0.71	17.68	0.86	17.13	0.52	0.55
Iliospinale bokshoogte (cm)	47.80	4.99	50.00	6.50	46.24	3.24	3.76
Troganterion bokshoogte (cm)	41.53	3.81	41.96	4.79	41.21	3.32	0.75
Troganterion-tibiale laterale lengte (cm)	38.16	2.95	38.79	3.62	37.71	2.57	1.08
Tibiale laterale tot vloer-hoogte (cm)	40.66	3.04	40.07	3.00	41.09	3.22	-1.02
Tibiale med-sphy-lengte (cm)	33.78	1.90	33.50	2.50	33.98	1.54	-0.48
Voetlengte (cm)	22.61	1.04	23.07	1.39	22.29	0.63	0.78

$\overline{X}$ = Gemiddeld SA = Standaardafwyking

Die beskrywende statistiek sowel as die betekenisvolheid van verskille (onafhanklike t-toets) tussen die vyf hoogste geplaaste gimnaste en die res van die dogtergimnaste met betrekking tot breedtes word in Tabel 5 weergegee.

Vergelykings tussen die vyf hoogste geplaaste gimnaste in die vloeritem en die res van die gimnaste toon dat die suksesvolle gimnaste betekenisvol hoër waardes in vyf uit die 61 (8.20%) antropometriese veranderlikes as die minder suksesvolle gimnaste behaal het. Dit het die volgende ingesluit: ontspanne en gespanne boarm-, gewrigs- en enkelomtrek, sowel as mesomorfie.

TABEL 5. **BESKRYWENDE STATISTIEK VIR BREEDTES VAN JONG DOGTERGIMNASTE (N=12)**

Veranderlikes	**Totale gimnastiek-groep**		**Suksesvol**		**Minder suksesvol**		**Verskille en betekenisvol-heid van verskille**
	$\overline{X}$	SA	$\overline{X}$	SA	$\overline{X}$	SA	
Biakromiale breedte (cm)	33.43	2.18	34.12	3.15	32.94	1.19	1.18
Bi-iliokristale breedte (cm)	22.70	1.74	23.23	1.98	22.31	1.60	0.92
Transversale borsbreedte (cm)	25.67	9.80	30.19	14.77	22.44	1.26	7.75
A-P-borsdiepte (cm)	15.13	0.58	15.30	0.45	15.00	0.66	0.30
Humerusbreedte (cm)	5.98	0.27	6.15	0.17	5.86	0.27	0.29
Gewrigbreedte (cm)	4.88	0.27	5.04	0.20	4.76	0.26	0.28
Handbreedte (cm)	6.85	0.40	7.11	0.43	6.67	0.28	0.44
Femurbreedte (cm)	8.26	0.57	8.60	0.63	8.02	0.42	0.58
Enkelbreedte (cm)	6.31	0.27	6.38	0.21	6.26	0.31	0.12
Voetbreedte (cm)	7.12	0.88	7.48	1.17	6.86	0.57	0.62
Bideltoïed-breedte (cm)	36.25	2.89	37.75	3.67	35.19	1.77	2.56
Bitroganteriese breedte (cm)	26.28	2.56	27.70	2.88	25.26	1.89	2.44

$\overline{X}$ = Gemiddeld SA = Standaardafwyking

Pienaar en Van der Walt (1988) het reeds in 1988 getoon dat gespanne boarmomtrek een van die antropometriese veranderlikes is wat in ’n regressievergelyking ingesluit kan word om kompetisiepunte by ses- tot negejarige dogtergimnaste te voorspel. So ook het verskeie navorsers gevind dat gimnaste wat oor groter bo-armomtrekke beskik beter gimnastiek-prestasies behaal en aan hoër vlakke van gimnastiek deelneem (Claessens *et al.* 1999; Caldarone *et al.*, 1986). Scanlan *et al.* (1999) wys daarop dat ’n direkte verband tussen gespanne bo-armomtrek (r = 0.45), gespanne boarm-dwarsdeursneeoppervlakte (r = 0.45) sowel as mesomorfie (r = 0.44) en maksimale bolyfkrag by dames bestaan. In nog ’n studie is gevind dat gespanne armomtrek betekenisvol met bolyfkrag korreleer (Mayhew *et al.*, 1989). Na aanleiding van laasgenoemde kan daar dus die aanname gemaak word dat groter boarm-omtrekke en mesomorfie-waardes as belangrike antropometriese veranderlikes vir die generering van maksimale bolyfkrag bestaan. Beweginguitvoerings van onder andere die opdruk tot ’n handstand, v-sitposisie, handstand-pirouette en tuimelbewegings in die vloeritem word volgens Sands *et al.* (2003) bevoordeel deur die generering van hoër maksimale bolyfkragwaardes. Gimnaste wat dus oor hoër boarmomtrek- en mesomorfiewaardes beskik behoort dus suksesvoller te wees in die uitvoering van bewegings wat maksimale bolyfkrag vereis.

Tuimelbewegings maak ’n groot deel van die vloeritem uit aangesien daar van gimnaste vereis word om ten minste drie tot vier tuimelreekse tydens kompetisiedeelname uit te voer (USA Gymnastics, 2005). Een tuimelreeks bestaan uit ’n verskeidenheid van bewegings wat salto’s en tolbewegings in verskillende rigtings insluit (USA Gymnastics, 2005). Volgens Richards (2006) is eksplosiewe beenspierkrag van die absolute belang vir die suksesvolle uitvoering van die laasgenoemde tuimelreeksbewegings. Daar kan dus verwag word dat enkelomtrek betekenisvol groter waardes by die suksesvolle vergeleke met die minder

suksesvolle gimnaste sal toon, in die lig van die navorsingsresultaat dat daar ’n positiewe korrelasie tussen die enkeldeursnee van junior dogtersportlui en hulle been-eksplosiewe kragwaardes bestaan (Ray & Khanna, 1991). Aangesien enkeldeursnee ’n bepaler van enkelomtrek is, kan die aanname gemaak word dat groter enkelomtrek-waardes suksesvolle gimnaste meer sal bevoordeel met betrekking tot die tuimelbewegings wat eksplosiewe krag vereis vergeleke met die minder suksesvolle gimnaste.

Die gewrig speel ’n primêre rol in die uitvoering van die handstand, v-sitposisie en handoorslag, arabiersprong en flik-flak, wat almal bewegings is wat met deelname aan die vloeritem uitgevoer word. Die gevolg is dat die gewrig wat die skakel tussen die hand en die arm vorm, baie sterk ontwikkel moet wees. Die gewrig moet in die meeste gevalle in staat wees om die gimnas se hele liggaamsgewig met die uitvoering van die laasgenoemde bewegings te verplaas. Die voorarmfleksore is meerendeels op die metakarpale en karpale bene van die hand ingeplant (Behnke, 2006), wat beteken dat verdikking in die spierstrukture vanweë hoë impakkragte moontlik tot groter gewrigsomtrekke by suksesvolle gimnaste aanleiding kan gee.

Aangesien gewrigsdeursnee (wat onder andere ’n bepaler van gewrigsomtrek is) in samehang met ander deursneë gebruik word om skeletmassa indirek te bereken, kan verwag word dat die suksesvolle gimnaste betekenisvol groter gewrigsomtrekke sal toon as minder suksesvolle gimnaste. Dit word veronderstel in die lig van die feit dat navorsing getoon het dat aanvangsouderdom vir gimnastiekdeelname tesame met liggaamslengte, LMI, liggaamsmassa, skraalliggaamsmassa en liggaamsvet ’n positiewe effek op dogtergimnaste se beenminerale digtheid (BMD) het (Markou *et al.*, 2004). Die suksesvolle gimnaste in die studie toon ’n jonger aanvangsouderdom vir gimnastiekdeelname (5.06 ± 1.38 teenoor 5.91 ± 1.35 jaar), ’n langer gemiddelde liggaamslengte (152.08 ± 8.60 teenoor 148.64 ± 7.21 cm), ’n groter LMI (19.41 ± 3.23 teenoor 17.35 ± 0.82 kg/m^2), ’n groter liggaamsmassa (45.52 ± 12.44 teenoor 38.44 ± 4.59 kg) en skraalliggaamsmassa (38.12 ± 9.48 teenoor 32.70 ± 3.44 kg), sowel as ’n groter gemiddelde liggaamsvetmassa (7.45 ± 3.09 teenoor 5.74 ± 1.32 kg) as hul minder suksesvolle eweknieë, wat dus hulle BMD en skeletdeursneë sal bevoordeel.

In ’n verdere ontleding is ’n trosontleding gedoen om die antropometriese veranderlikes wat met mekaar in verband staan, uit te sonder en te elimineer. Die antropometriese veranderlikes van die dogtergimnaste is deur middel van die trosonleding verminder vanaf 61 na 26 veranderlikes wat die volgende ingesluit het: frontale dyvelvou en triseps-velvou; gluteale dy-, mesosternale, bors-, gewrig-, gespanne bo-arm-, kuit-, middel-, mid-dy- en kopomtrek; troganterion-tibiale laterale, midstillion-daktillion, voet- en akromiale-radiale lengte; transversale bors en bitroganteriese deursnee; bideltoïed- en femurbreedte; A-P-borsdiepte; sithoogte; troganterion en iliospinale bokshoogte; spiermassa- en vetmassapersentasie; som van die ses velvoue, sowel as ektomorfie.

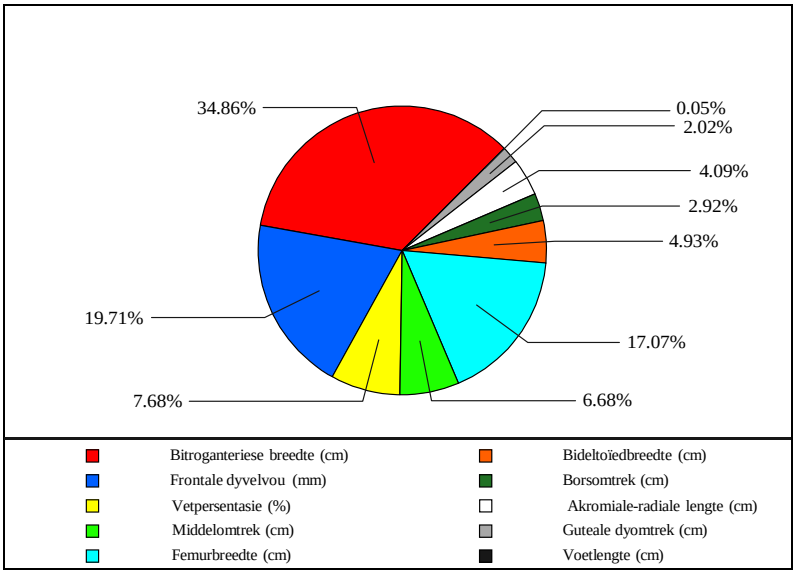
In ’n daaropvolgende stap is ’n voorwaartse, stapsgewyse, meervoudige regressie-analise uitgevoer met dieselfde trosontleding-geïdentifiseerde, antropometriese veranderlikes wat as die onafhanklike veranderlikes ingevoer is, terwyl die vloeritem-puntetelling as die afhanklike veranderlike ingesleutel is. Resultate van dié analise word in Tabel 6 en Figuur 1 weergegee.

TABEL 6: **RESULTATE VAN DIE VOORWAARTSE, STAPSGEWYSE, MEERVOUDIGE REGRESSIE-ANALISE OM AAN TE DUI WATTER ANTROPOMETRIESE VERANDERLIKES DIE MEESTE TOT VLOERITEM-GIMNASTIEKPRESTASIE BY JONG DOGTERGIMNASTE BYDRAE**

Veranderlike	**Beta in**	**Meervoudige R^2**	**R^2-verandering**	**p-vlak**
Bitroganteriese breedte (cm)	2.2267	0.3486	0.3486	0.0433*
Frontale dyvelvou (mm)	-2.0524	0.5457	0.1971	0.0796
Vetpersentasie (%)	0.8213	0.6225	0.0768	0.2378
Middelomtrek (cm)	-1.8603	0.6892	0.0668	0.2598
Femurbreedte (cm)	1.4512	0.8600	0.1707	0.0353*
Bideltoïedbreedte (cm)	0.1271	0.9093	0.0493	0.1602
Borsomtrek (cm)	-0.3048	0.9385	0.0292	0.2403
Akromiale-radiale lengte (cm)	0.4344	0.9793	0.0409	0.0928
Gluteale dyomtrek (cm)	-0.2411	0.9995	0.0202	0.0112*
Voetlengte (cm)	-0.2174	1.0000	0.0005	0.0058*

R = Korrelasie *$p \leq 0.05$

Die persentasie bydrae van elk van die antropometriese veranderlikes tot vloeritem-puntetelling is vervolgens deur middel van die r^2-veranderingwaardes wat vanuit die meervoudige regressie-analise verkry is, grafies voorgestel (Figuur 1).



FIGUUR 1. **PERSENTASIE BYDRAE VAN ELK VAN DIE VOORWAARTSE, STAPSGEWYSE, MEERVOUDIGE REGRESSIE-ANALISE-GEÏDENTIFISEERDE VERANDERLIKES TOT VLOERITEMGIMNASTIEKPRESTASIE BY JONG DOGTERGIMNASTE**

Volgens bogenoemde resultate word die punte wat deur die gimnaste in die vloeritem behaal is, die meeste beïnvloed (71.64%) deur die gimnaste se bitroganteriese breedtes (34.86%), frontale dyvelvoue (19.71%) en femurbreedtes (17.07%). Verder verklaar vetpersentasie (7.68%), middelomtrek (6.68%), bideltoïedbreedte (4.93%), akromiale-radiale lengte (4.09%), borsomtrek (2.92%), gluteale dyomtrek (2.02%) en voetlengte (0.05%) die res van die variansie (28.37%). Die bitroganteriese en femurbreedte, gluteale dyomtrek en voetlengte het betekenisvol ($p \leq 0.05$) tot die vloeritem-puntetelling bygedra. Slegs gluteale dyomtrek het negatief met vloeritem-gimnastiekprestasie gekorreleer.

Navorsing deur Ray en Khanna (1991) het bevind dat daar ’n direkte positiewe korrelasie tussen bitroganteriese breedte, femurbreedte en eksplosiewe beenkrag by junior dogtersportlui bestaan. Bitroganteriese en femurbreedte het onderskeidelik die grootste en derde-grootste bydrae tot vloeritem-puntetelling gelewer. Om die moontlike verband tussen bitroganteriese en femurbreedte en eksplosiewe beenkrag in dié studie te bevestig, is die korrelasiekoëffisiënte van die verband tussen die eksplosiewe beenkragtoetswaardes (tweebeen- vertikale sprongtoets, dominante eenbeen- vertikale sprongtoets en vertikale sprongtoets na arabiersprong-flik-flak), wat in ’n ander deel van die gimnastiekprojek verkry is, en die bitroganteriese en femurbreedtes van die gimnaste bereken. Nie-betekenisvolle r-waardes van onderskeidelik $r = 0.53$ en $r = 0.55$ het tussen die eenbeen- vertikale sprongtoets sowel as die vertikale sprongtoets na arabiersprong-flik-flak en bitroganteriese breedte-waardes na vore gekom. Hoë betekenisvolle korrelasies is gevind met betrekking tot die verband tussen femurbreedte en tweebeen- vertikale sprongwaardes ($r = 0.80$, $p = 0.002$) sowel as tussen femurbreedte en die dominante eenbeen- vertikale sprongwaardes ($r = 0.79$, $p = 0.002$). Groter bitroganteriese en femurbreedtes kan dus moontlik met hoër eksplosiewe beenkragwaardes verband hou.

Pool *et al.* (1969) het reeds in 1969 die verband tussen gimnaste se eksplosiewe beenkragwaardes (soos bepaal deur middel van die vertikale sprongtoets) en vloeritempunte aangetoon. Hulle het betekenisvolle korrelasies tussen die laasgenoemde twee veranderlikes gevind (Pool *et al*., 1969). In aansluiting hierby het Bajin (1987) ook tot die gevolgtrekking gekom dat gimnaste wat beter waardes in onderskeidelik die horisontale en vertikale sprongtoetse behaal, moeiliker vaardighede in die vloeritem kon uitvoer. Gimnaste wat dus oor groter bitroganteriese en femurbreedtes beskik, behoort dus vanweë ’n sterk positiewe verband tussen dié antropometriese metings en been-eksplosiewe krag beter in die vloeritem te presteer.

Frontale dyvelvou het as die tweede-belangrikste vloeritem-prestasiedeterminant na vore gekom, terwyl vetpersentasie ook ’n klein bydrae (7.68%) tot vloeritem-puntetelling gelewer het. Dit is egter vreemd dat frontale dyvelvou, wat onder andere gebruik word om vetpersentasie te bereken (Withers *et al.*, 1987), en vetpersentasie positief gekorreleer het met vloeritemprestasies, aangesien verskeie navorsers getoon het dat gimnaste met hoër vetpersentasies swakker presteer in gimnastiek (Claessens *et al*., 1999; Norton *et al.*, 1996). Die navorsingsbevinding is moontlik te wyte aan die feit dat die suksesvolle gimnaste in hierdie studie verder gevorder is wat hulle liggaamsontwikkeling en groei betref, vergeleke met die minder suksesvolle gimnaste. Hulle is dus ook die groep wat vanweë hul meer gevorderde ontwikkeling en biologiese ryping ’n hoër vetpersentasie toon vergeleke met die meer onvolwasse, minder suksesvolle gimnaste. Volgens Brown (2001) bereik meer volwasse

en groter gimnaste dikwels meer sukses as hulle minder volwasse en kleiner eweknieë vanweë hul beter ontwikkelde en afgeronde vaardigheidsvlakke. Brown (2001) stel dit ook dat internasionale afrigters nie meer so gesteld op liggaamsgrootte is nie, solank 'n gimnas haar liggaam in die regte posisie kan plaas en bewegings korrek kan uitvoer. Dit sal egter beteken dat die laasgenoemde groep harder sal moet werk om hulle krag:liggaamsmassa-verhoudings te verhoog.

Die middelomtrek het 'n bydrae van 6.68% tot vloeritempuntetelling gelewer. Vanuit 'n vergelyking tussen die suksesvolle en minder suksesvolle gimnaste in Tabel 1 is dit duidelik dat die suksesvolle gimnaste telkens hoër velvoumates in die abdominale area as die minder suksesvolle gimnaste behaal het. Meer vetweefsel in die abdominale area sal tot groter middelomtrek-waardes lei, wat 'n verklaring mag bied vir die uitwys van middelomtrek as 'n antropometriese prestasiedeterminant. Soos reeds genoem, sal die suksesvolle gimnaste hoër vetpersentasies toon, wat ook hoër velvouwaardes impliseer, vanweë hul meer volwasse ontwikkeling.

Wat borsomtrek betref, wys navorsing daarop dat die vermoë van dames om borsopdruk-oefeninge uit te voer, op grond van hulle borsomtrekke voorspel kan word (Reynolds *et al*., 2006). Dié verband is ook bevestig deur Mayhew *et al.* (1989), wat getoon het dat borsomtrek 'n betekenisvolle korrelasiekoëffisiënt van 0.49 met dames se bolyfkragwaardes toon. Terselfdertyd het hulle ook bevind dat bideltoïedbreedte betekenisvol (r = 0.36) met die bolyfkrag van dames korreleer (Mayhew *et al.,* 1989). Daar kan verwag word dat borsomtrek wel 'n invloed op die laasgenoemde kragbepalingsoefeninge sal hê aangesien die borsomtrekmeting onder andere deur die grootte van die pectoralis major- en latissimus dorsi-spiergroepe bepaal word. Gimnaste wat oor groter borsomtrekmates beskik, behoort dus groter pectoralis major- en latissimus dorsi-spiergroepe te toon, wat moontlik tot verhoogde bolyfkrag sal aanleiding gee. Dieselfde geld vir die bideltoïedbreedte van gimnaste aangesien die deltoïed-spiergroep die superior aspek van die skouergewrig bedek en dus ook tot groter bideltoïedbreedtes kan lei.

Om die verband tussen die laasgenoemde veranderlikes te staaf, is 'n verdere analise met addisionele data van die gimnastiekprojek gedoen. Die sprei-L-handstandopduktoets is tydens dié projek gebruik om maksimale bolyfkrag te bepaal. 'n Nie-betekenisvolle en betekensivolle korrelasiekoëffisiënt van onderskeidelik r = 0.32 en r = 0.84 (p = 0.001) is met die vergelyking tussen die sprei-L-handstandopdruktoets-, borsomtrek en bideltoïedbreedte-waardes van dié gimnaste gevind. Dit beteken dus dat onderskeidelik 10.24% en 70.56% van die variansie in maksimale bolyfkrag verklaar kan word aan die hand van die borsomtrek en bideltoïedbreedte-waardes van die gimnaste.

Hoewel borsomtrek dus inderdaad 'n bydrae tot maksimale bolyfkrag by gimnaste lewer, is die verband heelwat kleiner as wat eers vermoed is. Ten spyte hiervan wil dit nog steeds voorkom of borsomtrek wel as 'n belangrike antropometriese prestasiedeterminant beskou kan word vanweë die noodsaaklikheid van maksimale bolyfkrag vir die uitvoering van bewegings in die vloeritem (Stark, 1991). Anders as in die geval van borsomtrek blyk dit dat bideltoïedbreedte wel 'n groot bydra tot bolyfkraggenerering by die gimnaste in dié studie lewer. Die belang van hierdie veranderlike vir die behaling van gimnastiekprestasies kan dus nie onderskat word nie. Die gimnaste wat meer sukses in die vloeritem behaal, sal dus die

gimnaste wees wat die grootste borsomtrekke en bideltoïeddeursneë toon, moontlik vanweë die kragvoordeel wat dit tot gevolg het.

Akromiale-radiale (boarm-) lengte van die gimnaste het ook ’n positiewe bydrae (4.09%) tot prestasies in die vloeritem gemaak. Dit is moeilik om die resultaat te verklaar. Dit is wel moontlik dat die meer volwasse en groter liggaamsbou van die suksesvolle gimnaste weer eens daartoe aanleiding gegee het dat langer boarmlengtes as ’n belangrike prestasiedeterminant na vore gekom het.

Die laaste twee veranderlikes (gluteale dyomtrek en voetlengte) wat uit die voorwaartse, stapsgewyse meervoudige regressie-analise na vore gekom het se gesamentlike bydrae tot vloerprestasie is baie klein (2.07%), maar tog statistiese betekenisvol. Die feit dat gluteale dyomtrek negatief met vloeritem-prestasie gekorreleer het, is baie moeilik om te verklaar. ’n Aantal redes kan egter hiervoor gegee word. Ten eerste kon die hoë variasie tussen die waardes van die verskillende gimnaste die resultate van die meervoudige regressie-analise negatief beïnvloed het. So byvoorbeeld het die individuele gluteale dyomtrekwaardes tussen 41.30 cm (minimum) en 57.00 cm (maksimum) gevarieer, met ’n standaardafwyking van 5.08 cm. Tweedens toon ’n verdere analise dat sekere gimnaste wat die beste puntetellings in die vloeritem behaal het, baie klein gluteale dyomtrekwaardes getoon het. So byvoorbeeld het die gimnas wat die vyfde-hoogste puntetelling behaal het, ’n omtrek van 41.95 cm getoon, terwyl die een wat die derde-hoogste telling behaal het, ’n omtrekwaarde van 42.15 cm getoon het. Die twee topgimnaste met betrekking tot vloeritem-puntetelling het metings van onderskeidelik 54.2 en 57 cm getoon, wat duidelik daarop dui dat daar diskrepanse betreffende die bes presterende gimnaste se dyomtrekwaardes bestaan. Die laasgenoemde diskrepanse kon daartoe gelei het dat die resultate van die meervoudige regressie-analise skeefgetrek is vanweë die klein groep proefpersone wat in die studie gebruik is.

Hoewel voetlengte se bydrae tot vloeritem-puntetelling slegs 0.5% was, is dit ook betekenisvol. Die resultaat is moontlik toe te skryf aan die verband wat tussen voetlengte en been-eksplosiewe krag bestaan (Davis *et al.*, 2006). Weereens kan die laasgenoemde verband getoets word deur die r-waarde tussen die gimnaste se voetlengtes en tweebeen-vertikale sprongwaardes wat vanuit die gimnastiekprojek bepaal is te bereken. ’n Betekenisvolle r-waarde van 0.76 ($p = 0.004$) is tussen die laasgenoemde veranderlikes gevind. Dié verband kan moontlik toegeskryf word aan ’n langer hefboomarm en kontaktyd met die grond wat deur ’n langer voet teweeggebring word. Dit het alles tot gevolg dat ’n groter enkelwringkrag in die vertikale rigting gegenereer kan word.

GEVOLGTREKKING

Die resultate van die onafhanklike t-toets het ten eerste getoon dat die jong, suksesvolle (vyf hoogste geplaaste) dogtergimnaste in die vloeritem betekenisvol hoër ($p \leq 0.05$) waardes met betrekking tot ontspanne en gespanne boarm-, gewrigs- en enkelomtrek sowel as mesomorfie vergeleke met die minder suksesvolle gimnaste getoon het. Tweedens het die voorwaartse, stapsgewyse meervoudige regressie-analise getoon dat bitroganteriese breedte (34.86%), frontale dyvelvou (19.71%), femurbreedte (17.07%), vetpersentasie (7.68%), middelomtrek (6.68%), bideltoïedbreedte (4.93%), akromiale-radiale lengte (4.09%), bors- (2.92%) en gluteale dyomtrek (2.02%) sowel as voetlengte (0.05%) ’n 100%-bydrae tot die prestasies

(puntetoekenning) wat SA-dogtergimnaste in die vloeritem behaal, lewer. Die bitroganteriese en femurbreedte, gluteale dyomtrek en voetlengte het betekenisvol ($p \leq 0.05$) bygedrae tot die vloeritem-puntetelling. Slegs gluteale dyomtrek het negatief met vloergimnastiekprestasie gekorreleer.

Die finale gevolgtrekking wat dus uit dié studie gemaak kan word, is dat verskeie antropometriese veranderlikes wel as belangrike determinante van prestasies in die gimnastiek-vloeritem kan dien. Die antropometriese veranderlikes wat veral van belang is as prestasiedeterminante is: ledemaat- en rompomtrekke; heupbreedte, vetpersentasie en die dyvelvou, sowel as boarm- en voetlengte. 'n Moontlike verklaring vir die uitwysing van laasgenoemde antropometriese veranderlikes as prestasiedeterminante kan geleë wees in die matige tot sterk verbande wat voorkom tussen die antropometriese metings en die vermoë om krag en eksplosiewe krag te genereer. Hiermee tesame toon die data van dié studie dat gimnaste wat meer suksesvol is in die vloeritem oor die algemeen 'n langer gimnastiekdeelnametyd toon en wat hul liggaamlike ontwikkeling betref, meer volwasse as die minder suksesvolle gimnaste is. Dié gimnastiekdeelnametyd- en rypwordingsverskille tussen die twee genoemde populasies het alles tot gevolg dat die suksesvolle gimnaste groter antropometriese liggaamsmetings as hul minder suksesvolle eweknieë toon.

Die antropometriese vloeritem-prestasiedeterminante wat in die studie na vore gekom het, moet dus in ag geneem word met die fisieke kondisionering van gimnaste wat in die vloeritem spesialiseer. Voorts moet sportwetenskaplikes dié antropometriese prestasiedeterminante ook in die gimnastiek-toetsprotokolle wat gebruik word insluit sodat talentvolle gimnaste reeds op 'n vroeë ouderdom getoets en geïdentifiseer kan word.

Dit is in die lig van die laasgenoemde resultate en bespreking dat tekortkominge van die studie sowel as aanbevelings vir die opheffing van dié tekortkominge onder die soeklig geplaas word. Ten eerste kan aanbeveel word dat 'n groter getal gimnaste in studies van hierdie aard gebruik word. Die relatief klein groepgroottes kon daartoe gelei het dat uitskieters die gemiddelde waardes van die antropometriese veranderlikes beïnvloed het. Voorts kon die klein groepgroottes die statistiese betekenisvolheid van resultate beïnvloed het. Tweedens kan aanbeveel word dat gimnaste van dieselfde ouderdomsgroepe eerder saam gegroepeer word om sodoende die effek van ouderdom op die verband tussen die onderskeie antropometriese veranderlikes en gimnastiekprestasie te bepaal. Derdens sal dit raadsaam wees om 'n uitgebreide studie te onderneem waarin die invloed van verskillende antropometriese veranderlikes op elk van die oorblywende gimnastiekitems (balk, brug en spronge) sowel as algehele gimnastiekprestasie te bepaal. Ter afsluiting kan aanbeveel word dat hierdie studie as 'n loodstudie beskou word en die studieontwerp as 'n voorbeeld gebruik word om dié studie uit te brei en op 'n groter groep gimnaste toe te pas. Dit sal verseker dat die resultate dan as verteenwoordigend van jong, SA-dogtergimnaste in die hele land kan wees.

SUMMARY

The anthropometric floor item performance determinants of young female gymnasts

Although the available literature mentions a variety of physical, motor and anthropometric performance determinants for gymnastics, nobody has yet attempted to establish the

performance determinants of more advanced, young, South African (SA) female gymnasts. Due to the comprehensiveness of a multifactorial investigation where all the gymnastics performance determinants are included, the aim of this study was only to focus on the anthropometric performance determinants of one item in artistic gymnastics, namely the floor item. The purposes of this study were, therefore, firstly to determine the anthropometric variables that differ significantly ($p \leq 0.05$) between successful and less successful young, SA female gymnasts in the floor item and secondly, to determine the anthropometric variables that contribute to the performance of young, SA female gymnasts in the floor item.

Twelve young, female gymnasts (13.39 ± 2.14 years) from a gymnastics club in the North-West Province of South Africa participated in the study. Only gymnasts who participated at level 6-9 and junior as well as senior Olympic level were selected to participate in this study. Sixty-one anthropometric variables were measured on the dominant side of the body according to the methods of Norton *et al.* (1996). Firstly, the descriptive statistics (means and standard deviations) of the gymnastics population were calculated. This was followed by an analysis which intended to arrange the gymnasts in a ranking order according to the floor performances (marks) that were achieved during the South African Gymnastics Championships. Due to differences in the participation level, data was normalised by making use of correction factors. The analysis was succeeded by an independent t-test in which the gymnasts who achieved the top five positions in the ranking were compared with the rest of the gymnasts. The practical significance of differences was determined by calculating effect sizes. Thereafter, a cluster analysis of the different anthropometric variables was done to detect clusters of measures that appear to tap similar abilities. In the next step, a forward stepwise multiple regression analysis was performed to determine the contributions of each of the cluster analysis' reduced anthropometric variables to the performances (marks) that each gymnast had obtained during the South African Gymnastics Championships. The level of significance was set at $p \leq 0.05$.

The results of the study firstly showed that the successful gymnasts in the floor item had statistical and practical significantly larger relaxed and flexed upper arm, wrist and ankle circumferences as well as mesomorphy values compared to the less successful gymnasts. The forward stepwise multiple regression analysis indicated that that bi-trochanterion (34.86%), femur (17.07%) and bi-deltoid breadth (4.93%); front thigh skinfold (19.71%); fat percentage (7.68%); acromial-radial (4.09%) and foot length (0.05%) as well as waist (6.68%), chest (2.92%) and gluteal thigh circumference (2.02%), contributed 100% to the variance in gymnasts' floor performances. The contribution of bi-trochanterion and femur breadth as well as gluteal thigh circumference and foot length to floor gymnastic performance was significant. Only gluteal thigh circumference showed a negative relationship with floor gymnastic performance.

It can therefore be concluded that larger limb and torso circumferences, waist breadths, fat percentages and front thigh skinfolds as well as upper arm and foot lengths are important anthropometric floor performance determinants for young, South African female gymnasts and should be included in the sport-scientific testing protocols of gymnasts.

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THE EFFECTS OF CREATINE SUPPLEMENTATION ON SPRINT RUNNING PERFORMANCE AND SELECTED HORMONAL RESPONSES

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ABSTRACT

The purpose of this study was to determine the influence of short-term creatine supplementation on sprint running performance (100 and 200 m) and circulating hormone [growth hormone (GH), testosterone and cortisol] concentrations. Twenty amateur male runners were randomly divided into a creatine supplementation group, or placebo group. Subjects were provided with capsules containing either creatine monohydrate or identical powdered cellulose placebo. Daily creatine monohydrate supplementation was 20 g/day parceled into three equal dosages to be consumed with each major meal. Subjects were tested for performance and resting blood hormone concentrations before and after six days. A double-blind research design was employed in this study. After this creatine loading, the mean running performance time of the creatine supplementation group decreased significantly in the 100 m, but not the 200 m. Serum GH, testosterone, and cortisol concentrations were not affected by creatine supplementation. It can therefore be concluded that although short-term creatine supplementation was found to improve sprint performance in the 100 m in amateur runners, this performance improvement did not appear to be hormonally mediated.

Key words: Sprint performance; Creatine supplementation; Hormonal responses; Creatine loading.

INTRODUCTION

Creatine is a popular dietary supplement that is used by athletes to increase muscle mass and strength and especially to improve sports performance (Kreider, 2003; Rawson & Persky, 2007). Supplementation thereof has been demonstrated to increase resting concentrations of creatine and phosphocreatine in skeletal muscle (Navratil *et al*., 2009).

Gotshalk *et al.* (2008) reported that creatine supplementation (0.3 g/kg/day for seven days) resulted in a significant increase in the amount of work performed during five sets of bench press and jump squats in comparison to a placebo group. Mujika *et al*. (2000) found that creatine supplementation (20 g/day for six days) improved repeated sprint performance (6×15 m sprints with 30 sec. recovery) and jumping ability in soccer players. In a study by Skare

and Skadberg (2001) creatine supplementation (20 g/day) also decreased 100 m sprint times and reduced the total time of 6 × 60 m sprints in a group of well-trained adolescent competitive runners.

Not all previous studies have, however, found that creatine supplementation enhances exercise performance. Op't Eijnde *et al*. (2001) reported that creatine (20 g/day for five days) did not enhance stroke performance or 70 m agility sprint performance in well-trained tennis players. Improvements in performance were also not identified during single or repetitive sprint bouts (Greenhaff *et al*., 1993; Kinugasa *et al*., 2004) or in swimmers in 25, 50, and 100 m race distances (Mujika *et al.*, 1996; Mendes *et al*., 2004). The scarcity of published reports concerning single sprints lasting 6-60 sec., the lack of standardization of exercise protocols and variations in individual training levels may account for these discrepant results and suggest that additional studies are needed.

As creatine supplementation rapidly increases body mass and fat-free mass (Rawson & Persky, 2007; Gotshalk *et al.*, 2008), it has been hypothesised that creatine induces hypertrophy through endocrine mechanisms. Few studies evaluating the effects of creatine supplementation on performance have, however, included additional analysis of hormonal responses on consecutive days and these have produced conflicting results. Volek *et al*. (1997) assessed circulating testosterone and cortisol concentrations immediately post-exercise (five sets of bench presses and jump squats) in creatine (25 g/d for seven days) and placebo supplemented subjects and found no effect. Schedel *et al*. (2000), however, found increased serum growth hormone (GH) concentrations (83%) in response to a 20 g oral creatine bolus.

These discrepancies in the findings may primarily be attributed to variations in the performance level of subjects (amateur vs. elite), experimental protocol, gender and age. The purpose of this study was therefore to determine the influence short-term creatine supplementation on performance and hormonal responses to sprint running performance in subjects who were modestly trained.

METHOD

Subjects

Twenty healthy young male amateur runners (mean age: 21 years) volunteered to participate in this study. Because less intensively trained athletes may have a greater capacity to increase their intramuscular stores of creatine than the elite athletes (Selsby *et al.*, 2003), amateur runners were selected to participate in this study. All subjects were informed of the purpose, procedures and possible risks of the investigation before they gave written consent to participate in the study. They were also required to confirm that they had not taken any anabolic supplements or drugs during the previous year and had refrained from creatine supplementation for at least three months before the start of this study. The Institutional Review Board of the University approved the research protocol. The subjects had been doing sprint training (100 and 110 m), twice per week for a period of at least three months and had previously taken part in club sport activities (such as mini-football). The subjects refrained from any additional nutrition supplementation and exercise during this study and were encouraged to adhere to their usual dietary patterns. Before the study, subjects were assigned

to a creatine supplementation (CR) or a placebo (PL) group using a randomized double-blind design.

Experimental design

A double-blind, randomized study was employed using two experimental groups (creatine or placebo supplementation) who underwent six days supplementation. After pre-testing (one day later), subjects were provided with capsules containing either creatine monohydrate (Creatine Fuel, Twin Laboratories, Inc., Hauppague, NY) or identical powdered cellulose placebo. Daily creatine monohydrate supplementation was 20 g/day parceled into three equal dosages to be consumed with each major meal. The subjects consumed the supplements for six days.

Testing occurred before and at the end of six days of supplementation. Performance tests in 100 and 200 m sprint were started after the subjects underwent a standard warm-up. Fifteen minutes of recovery was given between tests. Participations were asked to refrain from exercise and from consumption of alcohol for 48 hours prior to each protocol day.

Body composition

Body composition was determined from seven skinfold sites (triceps, subscapular, midaxillary, chest, suprailiac, abdomen, and thigh) according to the method of Lohman, *et al*. (1988) using a Lange skinfold caliper. Skinfold measurements were based on the average of two trials and obtained on the right side in serial fashion by the same investigator. Body density was estimated using the age-adjusted equation of Pollock and Jackson (1984). The three-compartment Siri equation was used for % body fat (Siri, 1961). Height and body mass were assessed by digital scale (Japan) and height rod (Iran).

Blood collection and analyses

Blood samples were obtained via venipuncture, after five minutes in a supine position, from an antecubital vein by using a 20-guage needle and vacutainer tubes for the determination of serum testosterone, cortisol and GH concentration. Blood samples were obtained, pre and after six days of supplementation (immediately after running tests), in the early morning hours, and after a 10 hour overnight fast and occurred during a standardized time of day for each subject in order to minimize the effects of diurnal hormonal variations. The blood was processed and centrifuged, and the resultant serum was stored at −80°C until analyzed. Total serum testosterone, cortisol and GH were determined in duplicate by using standard radioimmunoassay procedures and were assayed via kits (Yellow Spring, OH).

Statistical analyses

Data are reported as mean ± SEM. A two-way analysis of variance (ANOVA) with repeated-measures design was used to establish whether PL and CR treatments differed with time. In the case of a significant *F* value, a Fisher's least significant difference (LSD) *post hoc* test was used to locate the exact time point of the differences between means. The level of significance for this investigation was set at $P<0.05$.

RESULTS

Physical characteristics and dietary intakes of the subjects

There were no significant differences between groups in terms of mean (± SD) physical characteristics. In the CR group these included age (21.75 ± 1.32 years), height (176.32 ± 6.35 cm), body mass (69.16 ± 8.65 kg) and percent body fat (16.12 ± 4.12%), whereas in the PL group, age (20.83 ± 1.73 years), height (75.60 ± 3.22 cm), body mass (69.12 ± 10.46 kg) and percent body fat (16.92 ± 5.25%).

No significant differences were observed between the CR and PL groups regarding the composition of carbohydrate, protein, and fat in the diet during the supplementation period.

Performance

The mean changes in running performance times in CR and PL groups are shown in Table 1. They were significantly decreased in the CR group in the 100 m ($P = 0.04$), but not in the 200 m ($P>0.05$).

TABLE 1. **RUNNING PERFORMANCE TIMES DURING THE PRE AND POST-SUPPLEMENTATION PERIOD IN THE PL (*N*=10) AND CR (*N*=10) GROUPS. DATA PRESENTED AS MEAN ± SEM**

	Pre	Post	Pre	Post
	CR		PL	
100 m (sec)	11.96 ± 3.9	11.23 ± 1.8*	11.82 ± 3.7	11.79 ± 3.2
200 m (sec)	22.82 ± 4.9	22.47 ± 6.4	22.79 ± 5.3	22.71 ± 5.7

(CR: creatine supplementation group, PL: placebo supplementation group)
* Significant difference ($P<0.05$) to Pre-test

Body composition

The CR group gained significantly more body mass (0.79 ± 0.11 kg) and fat-free mass (0.54 ± 0.05 kg) than the PL group (Table 2).

TABLE 2. **MEASURES OF BODY COMPOSITION IN THE PL (*N*=10) AND CR (*N*=10) GROUPS DURING THE PRE AND POST-SUPPLEMENTATION PERIOD. DATA PRESENTED AS MEAN ± SEM**

	CR group	PL group
Body mass (kg)		
Pre	69.16 ± 8.65	69.12 ± 10.46
Post	69.95 ± 9.76*	69.20 ± 11.12
Body fat (%) #		
Pre	16.12 ± 4.12	16.92 ± 5.25
Post	15.97 ± 4.67	16.65 ± 5.89
Body fat (kg) #		
Pre	11.23 ± 4.51	11.55 ± 6.48
Post	11.48 ± 4.84	11.69 ± 6.53
Fat-free mass (kg) #		
Pre	57.93 ± 5.68	57.57 ± 7.27
Post	58.47 ± 5.23*	57.51 ± 7.55

Values are mean ± SE obtained from skinfold analyses (based on the average of two trials and obtained on the right side)
*$P < 0.05$ from corresponding Pre value for the CR group only

Hormonal responses

The hormonal responses measured are presented in Table 3. No significant changes were observed in serum GH, testosterone and cortisol concentrations from before to after-supplementation in both groups of CR and PL (P>0.05).

TABLE 3. **SERUM GROWTH HORMONE, TESTOSTERONE AND CORTISOL CONCENTRATIONS IN THE PL (*N*=10) AND CR (*N*=10) GROUPS DURING THE PRE AND POST-SUPPLEMENTATION PERIOD. DATA PRESENTED AS MEAN ± SEM**

	Pre	Post	Pre	Post
	CR		PL	
Serum GH (ng/ml)	11.19 ± 2.03	11.23 ± 2.76	11.64 ± 2.26	11.67 ± 2.35
Serum Testosterone (ng/ml)	6.21 ± 1.37	6.18 ± 1.55	6.57 ± 2.24	6.64 ± 2.85
Serum Cortisol (mg %)	19.35 ± 2.17	19.30 ± 3.57	20.17 ± 2.33	19.98 ± 3.64

DISCUSSION

It has been well established that increasing dietary availability of creatine serves to increase total creatine and phosphocreatine concentrations in the muscle (Kreider, 2003). It is also known that the availability of creatine and phosphocreatine play a significant role in contributing to energy metabolism particularly during intense exercise. Theoretically, increasing the availability of phosphocreatine would enhance cellular bioenergetics of the

phosphagen system that is involved in high-intensity exercise performance of very short duration (Kreider, 2003), or the resynthesis of phosphocreatine during recovery (Greenhaff *et al*., 1993). The results of this study indicated that creatine supplementation 20 g/day (three times a day) for six days with no physical training decreased sprint running time (100 m) in the 20 amateur runners assessed in this study. The present study supports the finding Skare and Skadberg (2001), who also reported that short-term creatine supplementation (20 g/day) decreased 100-m sprint times in runners.

Although the findings of our study support those of previous investigations (Mujika *et a*l. 2000; Skare & Skadberg, 2001; Anomasiri *et al*., 2004; Hoffman *et al.,* 2005; Kraemer *et al.,* 2007; Gotshalk *et al.,* 2008) and suggest that short-term creatine supplementation can significantly increase exercise performance, they do conflict with others (Greenhaff *et al*., 1993; Mujika *et al.,* 1996; Kinugasa *et al*., 2004; Mendes *et al*., 2004) that did not replicate this difference. A possible explanation for the contrasting findings may be related to the calibre of the subjects examined. It is interesting to the note that Greenhaff *et al*. (1993), Mujika *et al.(*1996), Kinugasa *et al*.(2004) and Mendes *et al*.(2004) used competitive or elite athletes as subjects whereas our subjects were amateur. Harris *et al.* (1992) and Greenhaff *et al.* (1994) indicate that the extent of creatine uptake into the muscle is inversely related to an individual's initial muscle creatine content. The higher the initial intramuscular creatine concentration, the more difficult it is to increase stores (Harris *et al*., 1992; Greenhaff *et al*., 1994). Therefore, it is possible that our amateur runners had a greater capacity to increase their intramuscular stores of creatine than their elite counterparts (Greenhaff *et al*., 1993; Mujika *et al.,* 1996; Kinugasa *et al*., 2004; Mendes *et al*., 2004), who may already have had maximal intramuscular creatine concentrations. However, in this study intramuscular stores of creatine were not measured.

Based on the role of creatine supplementation in elevating intramuscular phosphocreatine stores and sustaining ATP production during muscle contraction (Kreider, 2003), the expectation was that creatine supplementation would have decreased both 100 m and 200 m performance. However, a significant improvement in mean 200 m times was not apparent. This may have been due to the large intersubject variability and small sample size. Participants of this study were, however, also in the collegiate amateur category. It is therefore possible that their poor technique and coordination may have been affecting performance results. Since the 100 m is shorter than 200 m, performance difference in 100 m would be less. It is therefore likely that large intersubject variability and or poor technique and coordination may have had less of an effect during the 100 m event. The small observed changes may however be meaningful for competitive running performers.

As creatine supplementation results in a rapid increase in body mass and fat-free mass (Rawson & Persky, 2007; Gotshalk *et al.,* 2008), it has been hypothesised that creatine induces muscle hypertrophy through endocrine mechanisms. Blood concentrations of GH and testosterone stimulate muscle protein accretion (Kraemer *et al.,* 2007) as GH stimulates protein synthesis by activating ribosomal initiation factors and improving translational efficiency (Bush *et al*., 2003). Testosterone also increases protein synthesis by binding to the androgen receptor for the complex to become a transcription factor and thirdly by possibly activating muscle satellite cells, which is important because gene transcription is an initial target for the modulation of protein synthesis (Herbst & Bhasin, 2004; Olsen *et al*., 2006).

No significant effects of creatine supplementation on serum GH, testosterone and cortisol responses at rest were found. The unchanged GH and cortisol after creatine supplementation is also consistent with other reports. For example, Op't Eijnde and Hespel (2001) found that creatine supplementation (20 g/day for five days) could not alter cortisol and GH responses to a single bout of heavy resistance exercise. Moreover, Volek *et al*. (1997) assessed testosterone and cortisol immediately post-exercise (five sets of bench presses and jump squats) in creatine (25g/day for seven days) and placebo-supplemented subjects, and found no effect of creatine on testosterone and cortisol hormones status. Results of this study and previous data indicate that it is unlikely that creatine supplementation is hormonally mediated. Furthermore, it is possible that creatine supplementation may affect other protein synthesis factors. Deldicque *et al*. (2005) reported that creatine supplementation (21g/day for five days) can facilitate muscle anabolism through increase of IGF-I (30%) and IGF-II (40%) mRNA in muscle.

Six days of creatine supplementation resulted in a small but significant increase in both body mass (0.79 ± 0.11 kg) and fat-free mass (0.54 ± 0.05 kg). These results are similar to the previous findings of Gotshalk *et al*. (2002 & 2008). A limitation of the current study was that muscle mass and body water were not measured. Nevertheless, the acute increase in body mass is most likely due to an increase in total body water (Ziegenfuss *et al*. 1998) and not an increase in muscle protein or muscle mass (Gotshalk *et al.*, 2008).

In conclusion, the data suggest that short-term creatine supplementation increases sprint running performance in amateur runners. An association between creatine supplementation and serum testosterone or decreased serum cortisol concentrations was, however, not found and the possibility that creatine supplementation is hormonally mediated by, a systemic change in these hormonal alterations is not supported.

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FACTORS AFFECTING THE RECOVERY-STRESS, BURNOUT AND MOOD STATE SCORES OF ELITE STUDENT RUGBY PLAYERS

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ABSTRACT

A sample of 41 male student rugby players (mean age: 21.87 ± 1.39 years) completed the Recovery-Stress Questionnaire (Kellmann & Kallus, 2001), Athlete Burnout Questionnaire (Raedeke & Smith, 2001) and Stellenbosch Mood Scale (Terry et al., 2003) repeatedly over a five-month period. Independent t-tests, one-way analysis of variance and effect sizes were used to indicate significant differences between groups (categorised according to playing position, experience level and starting status). The group of forwards were shown to have significantly ($d \approx 0.5$) better results than the backline players for 12 of the 39 tested variables. The group of less experienced players had significantly less General and Sport-specific Stress and negative Mood State scores than their very experienced and novice counterparts, whilst the novice players showed greater General and Sport-specific Recovery scores. Differences in starting status were also observed as the reserve players were shown to have significantly higher General and Sport-specific Recovery scores and better Mood State scores than the regular starters. These results suggest that playing position, experience level and starting status should be considered in player management strategies and during the psycho-social monitoring of players aimed at reducing the onset and development of overtraining and burnout.

Key words: Overtraining; Recovery-stress; Burnout; Mood States; Rugby.

INTRODUCTION AND PROBLEM STATEMENT

Numerous physiological, psychological and social stressors are believed to contribute to the onset and development of the overtraining and burnout syndromes (Kenttä & Hassmén, 1998; Kenttä *et al*., 2001). In Kenttä and Hassmén's (1998) conceptual model of overtraining and recovery, overtraining and burnout are seen as the negative products of long-term imbalances between the total stressors and total recovery efforts, which exceed an athlete's maximum stress tolerance. Despite the significant contributions of psychological and social stressors,

increased training loads are still regarded as the greatest contributor to these syndromes. In this regard rugby players have reported heightened exhaustion levels due to increased average weekly training volumes, more games per season and shorter off-seasons (Creswell & Eklund, 2005). The best treatment for athletes suffering from these conditions seems to be complete rest, but this approach directly opposes the instinctive reaction of coaches and players to increase their training efforts in response to poor performances (Marshall, 2005).

Overtraining can be defined as "a syndrome that results when excessive, usually physical overload on an athlete occurs without adequate rest" (Gould & Dieffenbach, 2002: 25). Raedeke *et al*. (2002) conceptualised athlete burnout as an enduring psycho-social syndrome characterised by a reduced sense of accomplishment (a perceived lack of achievement and success), sport devaluation (a decrease of the perceived benefits gained from sport involvement) and emotional and physical exhaustion (feelings of being overextended and exhausted due to sport involvement). These syndromes are distinctly different, although they share certain signs, symptoms and contributing causes.

Between 5.6% and 24.3% of rugby players experience burnout symptoms on a frequent basis (Creswell & Eklund, 2006a), whilst a substantial number (30%) of team sport athletes have been shown to suffer from overtraining syndrome (Kenttä *et al*., 2001). The negative impact of these syndromes on the performance and well-being of rugby players is of great concern for coaches, sport psychology consultants, sport scientists, sport medicine personnel and the players themselves (Creswell & Eklund, 2003).

Grobbelaar *et al*. (2010) monitored the burnout and recovery-stress levels of rugby players throughout a five-month pre-season, pre-competition and competitive season and reported significant fluctuations during this period. However, this study did not investigate possible contributing factors to the observed changes over time. A number of sport-related factors which affect the recovery-stress, burnout and mood state scores of athletes have been identified (e.g., starting status, playing position and experience level). Raglin and Wilson (2000) found that players not selected in the starting team were more likely to exhibit increases in mood disturbance during intense training than those in the starting line-up. Mashiko *et al*. (2004) noted that the influence of playing position should be accounted for in the development of recovery strategies directly after the conclusion of rugby matches. It was also revealed that more experienced soccer players had significantly greater positive general mood profiles than less experienced players (Thelwell *et al*., 2006). From their extensive research on burnout among rugby players, Creswell and Eklund (2005; 2006a; 2006c) deemed factors such as playing position, experience levels and starting status worthy of further investigation as possible contributing factors to the onset and development of burnout.

Subsequently, the aim of this study was to compare elite student rugby players' recovery-stress, burnout and mood state scores, based on their playing position, experience level and starting status. Information on the role of these factors on overtraining and burnout scores might assist coaches, sport psychology consultants and sport scientists in the prevention or management of the possible onset and development of these negative experiential syndromes.

RESEARCH METHODS

Research design

A longitudinal research design was implemented. Data were gathered on seven test points (at three-weekly intervals) over a five-month training and competitive period.

Subjects

Forty-one male rugby union players (with a mean age of 21.87 ± 1.39 years at the first data collection point) from a leading club in South Africa, i.e. the North-West University PUK Rugby Institute (NWU-PRI) were included as subjects in this study. They had on average been playing rugby for 13.76 ± 2.39 years. These players formed part of the NWU-PRI senior training squad and represented the 1st or 2nd senior teams until after the completion of the 2008 FNB Varsity Cup rugby tournament. In order to qualify for participation in this tournament (which included the top eight tertiary institution teams in South Africa) the subjects had to be 25 years of age or younger and enrolled as students. The subject group is, therefore, a particularly homogenous group, since they were all subject to similar training and competitive stressors (having been part of the same training programme and matches), as well as non-training stressors (studies and general student life).

The decision to study student rugby players was based on availability and their proposed vulnerability to overtrain and burn out due to their sport participation and the added stress of their academic endeavours. Only players who completed at least four of the seven test occasions over the five-month period and who remained in the senior training squad throughout were included in the subject group. Missing data from the final dataset were 13.59%, which is deemed acceptable for repeated measurements over this timeframe.

Research instruments

The Recovery-Stress Questionnaire for athletes (RESTQ-52 Sport)

The RESTQ-52 Sport, developed by Kellmann and Kallus (2001) measures the frequency of stressors and recovery activities and provides the coaching staff with important information during the training process. The recovery-stress state indicates the extent to which athletes are physically and/or mentally stressed, whether or not they are capable of using individual strategies for recovery, as well as which strategies they use. The RESTQ Sport consists of two versions (i.e., a 52 and 72 item questionnaire). Kellmann and Kallus (2001) recommend the use of the 52 item version in longitudinal research designs such as the present one. Participants were asked to respond to the items on a seven-point Likert-type scale anchored by descriptors ranging from "Never" [0] to "Always" [6] indicating how often the respondent participated in various activities during the past three days/nights. Nineteen subscale scores were derived, which were further grouped into the following four major subscale groups:

- **General Stress Subscale** (*General Stress, Emotional Stress, Social Stress, Conflicts/Pressure, Fatigue, Lack of Energy and Physical Complaints*).
- **General Recovery Activity Subscale** (*Success, Social Recovery, Physical Recovery, General Well-being and Sleep Quality*).

- **Sport-specific Stress Subscale** (*Disturbed Breaks, Burnout/Emotional Exhaustion and Fitness/ Injury*).
- **Sport-specific Recovery Activity Subscale** (*Fitness/Being in Shape, Personal Accomplishments, Self-efficacy and Self-regulation*).

In the RESTQ-52 Sport, two items respectively contribute to each of the *General Stress* and *General Recovery Activity* subscales, with four items contributing to each of the *Sport-specific Stress* and *Sport-specific Recovery Activity* subscales. Construct validity has been reported for this instrument (Kellmann & Kallus, 2001). Due to the small sample size validity will not be determined. In the present survey, acceptable Cronbach alphas (ranging from 0.58 - 0.88) were calculated for 15 of the 19 subscales. Four of the subscales yielded poor reliability scores (*Lack of Energy* = 0.34; *Physical Complaints* = -0.02; *Social Recovery* = 0.39; *Physical Recovery* = 0.42). As a result, these four subscales were removed from the data set and substituted by the two items from which they were each derived. Thereafter, the four major subscale groups were found to be reliable (*General Stress major subscale group* = 0.81; *General Recovery Activity major subscale group* = 0.68; *Sport-specific Stress major subscale group* = 0.67; *Sport-specific Recovery Activity major subscale group* = 0.86).

The Athlete Burnout Questionnaire (ABQ)

The 15-item ABQ was developed by Raedeke and Smith (2001) as a valid and reliable measure of the following three burnout subscales (with five items contributing to each):

- *Reduced Sense of Accomplishment* (e.g., "It seems no matter what I do, I don't perform as well as I should").
- *Sport Devaluation* (e.g., "I have negative feelings toward sport").
- *Emotional/Physical Exhaustion* (e.g., "I am exhausted by the mental and physical demands of my sport").

For this study, the ABQ was adapted to be specific for the rugby population through minor word substitution (i.e., changing the word "sports" to "rugby") as was done by Creswell and Eklund (2006a; 2006b) in their studies on New Zealand rugby players. Participants responded to individual items on a five-point Likert-type scale anchored by descriptors ranging from "Almost never" [1] to "Most of the time" [5]. The *Total Burnout Score* was derived by averaging the three subscale scores. Internal consistency estimates observed in the present investigation (Cronbach alphas between 0.73 to 0.81 for the three subscales and the *Total Burnout Score*) were largely consistent with previous reports.

The Stellenbosch Mood Scale (STEMS)

The STEMS (Terry *et al.*, 2003) is a dual-language (English and Afrikaans) version of the Brunel Mood Scale (BRUMS) questionnaire of Terry *et al*. (1999) which is a derivative of the Profile of Mood States (POMS) questionnaire of McNair *et al*. (1971). The STEMS consists of 24 items and measures six subscales, i.e. *Tension, Depression, Anger, Vigour, Fatigue* and *Confusion*, with four items contributing to each subscale. A *Total Mood Disturbance Score* was derived by subtracting the negative mood state scores from the *Vigour* score. Participants were asked to rate "How are you feeling right now" in terms of 24 mood descriptors on a five-point Likert-type scale, anchored by descriptors ranging from "Not at

all" [0] to "Extremely" [4]. Acceptable Cronbach alpha coefficients (ranging from 0.65 to 0.87) were found with this dataset.

Descriptive variables

The following descriptive variables were recorded throughout the study period.

- Playing position (Forward or backline player).
- Experience level: Players were grouped into the following three groups:
  - Very experienced group, i.e. players representing the 1st team for ≥3 years.
  - Less experienced group, i.e., players with one or two years experience at this level.
  - Novice group, i.e., players in their first season at this level.
- Starting status (For inclusion within a specific group, a player had to be included in that group for at least four of the seven games). Based on data obtained during the round-robin matches, players were grouped into the following two categories:
  - Regular starters (Included in the starting line-up for at least four of the matches).
  - Non-starters/ reserves (Included in the match 22 on at least four of the occasions).

Procedures

This study was approved by the Ethics Committee of the North-West University, Potchefstroom Campus (Reference number: NWU-0064-08-S1). The head coach of the NWU-PRI senior 1st team was informed about the nature and purpose of the study and was asked for consent, cooperation and input, which was provided. Multiple testing dates were scheduled from the start of pre-season training (31st October 2007) until the completion of the round-robin stage of the FNB Varsity Cup tournament (26th March 2008).

Where possible, testing was scheduled before the mid-week mental skills training and video analysis sessions. The participants were informed about the nature and purpose of the study and all of the participants completed informed (written) consent forms before their first completion of the research instruments. Confidentiality of results was guaranteed and participation at each test point was voluntary. Instructions to the subjects included a statement aimed at discouraging socially desirable answers.

Since this study did not aim to investigate changes in the various subscale scores over time, but rather to compare the scores of different sub-groups of players, the average scores obtained by each subject over the seven test points were calculated and used in the statistical analysis (for the comparison involving playing position and experience level). For the comparison between the regular starters and the reserve players, only the average scores of the data gathered during the competition period (Test 6 & Test 7) were used, as the possible influence of selection/non-selection and the resulting game-time is believed to be particularly relevant during this period. Also, only those players (n = 23) who were in the starting line-up or match-22 of the NWU-PRI's first team for at least four of the seven round-robin matches during the Varsity Cup tournament were included in this analysis.

Statistical analysis

The Statistical Data Processing package STATISTICA (Statsoft Inc, 2007) was used for the statistical analysis and the level of statistical significance was set at $p<0.05$. For the comparisons involving the forwards and backline players, as well as between the regular starters and reserves (two groups respectively), independent *t*-tests were performed, whilst a One Way Analysis of Variance (ANOVA) were used to determine statistically significant differences between the three groups with varying experience levels. The ANOVA's were followed by Tukey's post Hoc tests for unequal sample sizes. In addition, because the subjects were not randomly selected, effect sizes (ES) were used to indicate practical significant differences for the subscales at the various time points, in which: ES = $(M_1 - M_2)/s_{(max)}$. Here, M_1 = the mean value of the first group in the comparison, M_2 = the mean value of the second group in the comparison and $s_{(max)}$ = the largest standard deviation of the two groups in the comparison. The calculated ES are expressed as Cohen's *d*-value and can be interpreted as follows: $d \approx 0.20$, 0.50 and 0.80 respectively indicate small, moderate and large practical significant differences (Steyn, 2009).

RESULTS AND DISCUSSION

Table 1 indicates the results of the comparison between the forwards and backline players for the various subscales. No significant age differences or numbers of years playing rugby were observed between players in the two positional groups. From these results it is evident that the forwards outperformed the backline players in all but one of the 39 variables in the analysis, whilst 21 of these variables were of moderate ($d \approx 0.5$) practical significant magnitude. Although this comparison conclusively showed the forwards to have more favourable scores than the backline players, the results differ from Creswell and Eklund's (2006a) study on burnout among professional New Zealand rugby players. The forwards (1.85 ± 0.08) in their study were reported to have significantly ($p = 0.008$) higher *Sport Devaluation* scores than the backline players (1.58 ± 0.09). Also, the forwards (2.43 ± 0.29) in the present study had significantly ($p = 0.062$) higher *Emotional/Physical Exhaustion* scores than the backline players (2.27 ± 0.30), which can in part be attributed to the greater workloads performed by forwards during rugby matches (Deutsch *et al*., 1998). These conflicting results emphasise the need for further research in this regard, as this discrepancy either relates to the level of participation or other within-group influence(s) not accounted for in either/both of these studies.

TABLE 1. **COMPARISON BETWEEN FORWARDS AND BACKLINE PLAYERS FOR THE RESTQ-52 SPORT, ABQ AND STEMS SUBSCALES**

	Forwards (n=23)	Backline players (n=18)	Statistical significance (p value)	Practical significance (Cohen's *d*)
Average age	22.31 ± 1.36	22.18 ± 1.47	0.77	0.09
Average years playing rugby	13.59 ± 2.24	14.00 ± 2.61	0.60	0.16
TOTAL RECOVERY-STRESS (RESTQ-SPORT)	**4.56 ± 2.05**	3.35 ± 1.80	0.05■	0.59°
GENERAL STRESS MAJOR SCALE #	**1.38 ± 0.62**	1.57 ± 0.68	0.34	0.29
General Stress #	**1.05 ± 0.69**	1.31 ± 0.72	0.24	0.37°
Emotional Stress #	**1.26 ± 0.68**	1.49 ± 0.62	0.26	0.34
Social Stress #	**1.30 ± 0.81**	1.55 ± 0.76	0.33	0.30
Conflicts/Pressure #	**2.00 ± 0.97**	2.23 ± 1.08	0.48	0.21
Fatigue #	**1.47 ± 0.66**	1.48 ± 0.80	0.97	0.01
Item 6 - I had difficulties in concentrating #	**1.54 ± 0.60**	1.88 ± 0.95	0.17	0.36°
Item 23 - I put off making decisions #	**1.25 ± 0.67**	1.60 ± 0.87	0.15	0.40°
Item 9 - I had a headache #	1.05 ± 0.70	**0.97 ± 0.89**	0.75	0.09
Item 12 - I felt uncomfortable #	**1.32 ± 0.87**	1.46 ± 0.85	0.62	0.16
GENERAL RECOVERY MAJOR SCALE	**3.65 ± 0.71**	3.31 ± 0.53	0.08	0.48°
Success	**3.28 ± 0.89**	2.84 ± 0.52	0.07	0.50°
Item 2 - I laughed	**3.81 ± 0.81**	3.80 ± 0.67	0.95	0.02
Item 8 - I had a good time with my friends	**3.80 ± 1.13**	3.55 ± 0.89	0.45	0.22
Item 4 - I felt physically relaxed	**3.00 ± 0.68**	2.75 ± 0.79	0.28	0.31
Item 21 - I felt as if I could get everything done	**3.29 ± 0.94**	2.80 ± 0.67	0.07	0.51°
General Well-being	**3.83 ± 0.82**	3.50 ± 0.67	0.13	0.39°
Sleep Quality	**4.21 ± 0.96**	3.76 ± 0.81	0.12	0.47°
SPORT-SPECIFIC STRESS MAJOR SCALE #	**1.26 ± 0.51**	1.67 ± 0.73	0.04*	0.56°
Disturbed Breaks #	**1.01 ± 0.59**	1.35 ± 0.62	0.08	0.55°
Burnout/Emotional Exhaustion #	**0.81 ± 0.54**	1.08 ± 0.75	0.19	0.36°
Injury #	**1.96 ± 0.68**	2.58 ± 1.05	0.03*	0.59°
SPORT-SPECIFIC RECOVERY MAJOR SCALE	**3.55 ± 0.86**	3.29 ± 0.55	0.27	0.30
Being in shape	**3.58 ± 0.84**	3.27 ± 0.67	0.22	0.36°
Personal accomplishment	**3.21 ± 1.01**	2.89 ± 0.65	0.24	0.32
Self-efficacy	**3.73 ± 0.94**	3.43 ± 0.64	0.25	0.32
Self-regulation	**3.68 ± 1.00**	3.57 ± 0.71	0.70	0.11
TOTAL BURNOUT SCORE (ABQ) #	**1.71 ± 0.39**	1.96 ± 0.48	0.07	0.53°
Reduced Sense of Accomplishment #	**2.14 ± 0.53**	2.38 ± 0.52	0.15	0.45°
Sport Devaluation #	**1.39 ± 0.47**	1.58 ± 0.54	0.25	0.34
Emotional/Physical Exhaustion #	**1.61 ± 0.38**	1.94 ± 0.52	0.02*	0.64°
TOTAL MOOD DISTURBANCE SCORE (STEMS)	**-1.23 ± 8.06**	-5.66 ± 12.0	0.17	0.37°
Tension #	**2.10 ± 1.76**	3.36 ± 3.39	0.13	0.37°
Depressive mood #	**1.41 ± 1.78**	2.23 ± 2.34	0.21	0.35°
Anger #	**1.79 ± 1.88**	2.13 ± 1.90	0.57	0.18
Vigour	**9.58 ± 2.18**	8.98 ± 2.13	0.39	0.27
Fatigue #	**3.86 ± 1.35**	4.19 ± 1.92	0.52	0.17
Confusion #	**1.65 ± 1.63**	2.74 ± 2.93	0.14	0.37°

Lower values represent better results
Values in **bold** depict the group with the more favourable results for the particular subscale

* Statistically significant differences ($p<0.05$)

■ Borderline statistical significant difference ($p=0.052$)

° Moderate practical significant differences ($d \approx 0.5$)

TABLE 2. **COMPARISON OF THE RESTQ-52 SPORT SUBSCALES BETWEEN THE GROUPS OF VERY EXPERIENCED, LESS EXPERIENCED AND NOVICE PLAYERS**

	Group 1 Very experienced players (≥ 3 years) (n = 12)	Group 2 Less experienced players (1 or 2 years) (n = 15)	Group 3 Novice players (0 years at this level) (n = 14)	Analysis of variance (ANOVA) Statistical significance (p value)	Effect size results (Cohen's *d*-value)		
					Practical significance between Groups 1 & 2	Practical significance between Groups 1 & 3	Practical significance between Groups 2 & 3
Average age	23.15 ± 0.99	22.67 ± 1.33	21.05 ± 0.85	≤0.01*	0.36°	2.11°°	1.21°°
Years playing rugby	15.25 ± 1.66	13.57 ± 2.06	12.71 ± 2.70	0.02*	0.81°°	0.94°°	0.32
TOTAL RECOVERY-STRESS (RESTQ-52)	3.30 ± 2.00	**4.49 ± 2.25**	4.17 ± 1.70	0.30	0.53°	0.44°	0.14
GENERAL STRESS MAJOR SCALE #	1.77 ± 0.66	**1.11 ± 0.48**	1.58 ± 0.64	0.02*	1.00°°	0.30	0.72°°
General Stress Minor #	1.50 ± 0.68	**0.83 ± 0.62**	1.23 ± 0.70	0.04*	0.98°°	0.37°	0.58°
Emotional Stress #	1.75 ± 0.68	**1.08 ± 0.46**	1.36 ± 0.68	0.02*	0.99°°	0.62°	0.37°
Social Stress #	1.81 ± 0.88	**0.99 ± 0.59**	1.51 ± 0.72	0.02*	0.93°°	0.34	0.73°°
Conflicts/ Pressure #	2.36 ± 1.13	**1.67 ± 0.78**	2.35 ± 1.04	0.11	0.61°	0.01	0.65°
Fatigue #	1.72 ± 0.76	**1.20 ± 0.68**	1.56 ± 0.66	0.15	0.68°°	0.21	0.52°
Item 6 - I had difficulties in concentrating #	1.82 ± 0.55	**1.38 ± 0.82**	1.92 ± 0.86	0.15	0.54°	0.11	0.62°
Item 23 - I put off making decisions #	1.70 ± 1.00	**1.12 ± 0.67**	1.45 ± 0.59	0.15	0.58°	0.25	0.49°
Item 9 - I had a headache #	1.06 ± 0.64	**0.61 ± 0.56**	1.39 ± 0.93	0.02*	0.70°°	0.35°	0.84°°
Item 12 - I felt uncomfortable #	1.96 ± 0.74	**0.93 ± 0.65**	1.36 ± 0.87	≤0.01*	1.39°°	0.69°°	0.50°
GENERAL RECOVERY MAJOR SCALE	3.37 ± 0.62	3.41 ± 0.82	**3.72 ± 0.44**	0.25	0.05	0.56°	0.38°
Success	2.88 ± 0.75	3.01 ± 0.89	**3.35 ± 0.63**	0.27	0.15	0.63°	0.39°
Item 2 - I laughed	3.86 ± 0.79	3.66 ± 0.93	**3.92 ± 0.45**	0.65	0.21	0.07	0.27
Item 8 - I had a good time with my friends	3.73 ± 1.16	3.21 ± 1.02	**4.17 ± 0.71**	0.04*	0.45°	0.38°	0.94°°
Item 4 - I felt physically relaxed	2.67 ± 0.51	**3.07 ± 1.01**	2.90 ± 0.49	0.36	0.40°	0.46°	0.17
Item 21 - I felt as if I could get everything done	2.77 ± 0.58	3.17 ± 0.98	**3.23 ± 0.90**	0.34	0.41°	0.52°	0.06
General Well-being	3.61 ± 0.74	3.68 ± 0.94	**3.76 ± 0.61**	0.57	0.07	0.21	0.09
Sleep Quality	3.85 ± 0.85	3.79 ± 0.95	**4.38 ± 0.87**	0.17	0.07	0.60°	0.62°

	Group 1 Very experienced players (≥ 3 years) (n = 12)	Group 2 Less experienced players (1 or 2 years) (n = 15)	Group 3 Novice players (0 years at this level) (n = 14)	Analysis of variance (ANOVA) Statistical significance (p value)	Effect size results (Cohen's *d*-value)		
					Practical significance between Groups 1 & 2	Practical significance between Groups 1 & 3	Practical significance between Groups 2 & 3
SPORT-SPECIFIC STRESS MAJOR SCALE[#]	1.66 ± 0.69	**1.18 ± 0.51**	1.53 ± 0.68	0.13	0.70°°	0.20	0.51°
Disturbed Breaks [#]	1.38 ± 0.52	**0.85 ± 0.59**	1.31 ± 0.64	0.05*	0.90°°	0.11	0.70°°
Burnout/ Emotional Exhaustion [#]	1.07 ± 0.77	**0.73 ± 0.52**	1.03 ± 0.65	0.31	0.44°	0.04	0.47°
Injury [#]	2.55 ± 1.00	**1.97 ± 0.71**	*2.25 ±0.98*	0.26	0.58°	0.30	0.28
SPORT-SPECIFIC RECOVERY MAJOR SCALE	3.36 ± 0.78	3.38 ± 0.86	**3.56 ± 0.59**	0.75	0.02	0.25	0.21
Being in shape	3.26 ± 0.71	3.45 ± 1.00	**3.59 ± 0.55**	0.56	0.20	0.47°	0.14
Personal accomplishment	**3.21 ± 0.88**	2.90 ± 0.92	3.13 ± 0.84	0.63	0.34	0.08	0.26
Self-efficacy	3.49 ± 0.77	*3.49 ±0.99*	**3.80 ± 0.69**	0.53	0.00	0.41°	0.31
Self-regulation	3.49 ± 1.03	3.69 ± 0.86	**3.70 ± 0.81**	0.82	0.17	0.20	0.04

[#] Lower values represent better results
Values in **bold** depict the group with the best results for the particular subscale, whilst underlined values represent the group with the least favourable results

* Statistically significant differences ($p<0.05$)

° Moderate practical significant differences ($d \approx 0.5$)

°° Large practical significant differences ($d \approx 0.8$)

Table 2 shows that the level of experience is age dependent, as the group of very experienced rugby players at this particular level of participation (23.15 ± 0.99 years) was significantly older than the novice players (21.05 ± 0.85 years). Similarly, the group of very experienced players (15.25 ± 1.66 years) had been participating in rugby for significantly longer than their less experienced (13.57 ± 2.06 years) and novice (12.71 ± 2.70 years) counterparts respectively. The less experienced group reported the lowest scores of the three groups for the *Total Recovery-Stress Score* and all of the *General* and *Sport-Specific Stress Major Scales* and *Subscales*. The novice players had the highest *General* and *Sport-Specific Recovery Scores* of the three groups, except for the *Physical Relaxation item* and the *Personal Accomplishment subscale.* To the best of our knowledge, no studies have been published in which the REST-Q scores of athletes with different experience levels have been compared, thereby limiting the extent to which the current results can be discussed.

From Table 3 it is evident that moderate practical significant ($d \approx 0.5$) differences exist for *Sport Devaluation* between the very experienced players (who had the highest values) and the novice players. Furthermore, the very experienced group had higher *Total Burnout, Reduced Sense of Accomplishment* and *Emotional/Physical Exhaustion* scores than the other groups,

albeit insignificantly so. In this regard Creswell and Eklund (2006a), revealed that professional New Zealand rugby players with greater national level experience reported significantly ($p < 0.05$) higher *Sport Devaluation* and *Emotional/Physical Exhaustion* scores than those players without such experience. Prolonged representation at a particular level, therefore, seems to increase a player's chances of burning out.

TABLE 3. **COMPARISON OF THE ABQ AND STEMS SUBSCALES BETWEEN THE GROUPS OF VERY EXPERIENCED, LESS EXPERIENCED AND NOVICE PLAYERS**

	Group 1 Very experienced players (≥ 3years) (n = 12)	Group 2 Less experienced players (1 or 2 years) (n = 15)	Group 3 Novice players (0 years at this level) (n = 14)	Analysis of variance (ANOVA) Statistical significance (p-value)	Effect size results (Cohen's *d*-value)		
					Practical significance between Groups 1 & 2	Practical significance between Groups 1 & 3	Practical significance between Groups 2 & 3
TOTAL BURNOUT SCORE (ABQ) #	1.93 ± 0.65	**1.77 ± 0.33**	1.79 ± 0.33	0.63	0.24	0.22	0.04
Reduced Sense of Accomplishment #	2.30 ± 0.76	**2.18 ± 0.41**	2.26 ± 0.43	0.86	0.15	0.04	0.18
Sport Devaluation #	1.63 ± 0.67	1.44 ± 0.45	**1.38 ± 0.37**	0.42	0.29	0.38°	0.15
Emotional/Physical Exhaustion #	1.85 ± 0.64	**1.70 ± 0.42**	1.72 ± 0.37	0.68	0.25	0.20	0.06
TOTAL MOOD DISTURBANCE SCORE (STEMS)	-6.69 ± 11.66	**-0.11 ± 8.03**	-3.45 ± 10.37	0.25	0.56°	0.28	0.32
Tension #	3.38 ± 3.07	**1.77 ± 1.66**	2.97 ± 3.01	0.25	0.52°	0.13	0.40°
Depression #	2.61 ± 2.65	**1.11 ± 1.33**	1.77 ± 2.00	0.17	0.56°	0.32	0.32
Anger #	2.76 ± 2.21	**1.34 ± 1.35**	1.88 ± 1.91	0.14	0.64°	0.40°	0.29
Vigour	9.38 ± 2.21	9.00 ± 2.69	**9.61 ± 1.47**	0.75	0.14	0.10	0.23
Fatigue #	4.57 ± 1.63	**3.62 ± 1.83**	3.93 ± 1.29	0.32	0.52°	0.39°	0.17
Confusion #	2.76 ± 2.23	**1.27 ± 1.16**	2.52 ± 3.10	0.19	0.67°	0.08	0.40°

Lower values represent better results
Values in **bold** depict the group with the best results for the particular subscale, whilst underlined values represent the group with the least favourable results

° Moderate practical significant differences ($d \approx 0.5$)

The very experienced group consistently showed significantly greater ($d \approx 0.5$) *Total Mood Disturbance Score* and negative mood state scores (i.e., *Tension*, *Depression*, *Anger*, *Fatigue* and *Confusion*) than the less experienced group. Insignificant differences were also observed for the *Vigour* subscale, with the novice group showing the highest scores.

Previous research has shed light on the impact of players' experience levels on their burnout scores. Burnett (2003) noted that by becoming an established member of a team, a player's personal involvement deepens, resulting in stronger commitments and greater responsibility. According to Creswell and Eklund (2005), such additional responsibilities within the team include leadership roles and tactical decision making duties, which may contribute to an

imbalance between the perceived demands on the player and the capacity of the player to handle such responsibilities, thereby increasing the risk for burning out.

For the comparison involving starting status, only 23 players were included in the analysis (see the subsection on the subjects for inclusion criteria). Table 4 reveals that the regular starters were significantly older and had been playing rugby for longer than the reserves. The reserve players showed significantly better *Total Recovery-Stress* (d = 0.46), *General Recovery* (d = 0.46), *Sport-specific Recovery* (d = 0.46) and *Total Mood Disturbance Scores* (d = 0.73) scores than those in the starting line-up. In fact, the reserves had significantly better scores for all six Mood State subscales than those in the starting line-up.

The regular starters, however, had less *Sport-specific Stress* and lower *Sport Devaluation* and *Emotional/Physical Exhaustion* values than the reserves, albeit insignificantly so. Creswell and Eklund (2006a) previously found that players not in the starting line-up (2.35 ± 0.22) had significantly (p = 0.025) higher *Reduced Sense of Accomplishment* levels than those in the starting line-up (2.18 ± 0.21), but the current findings failed to substantiate these results.

TABLE 4. **COMPARISON BETWEEN REGULAR FIRST TEAM STARTERS AND NON-STARTERS (RESERVES) FOR THE RESTQ-52 SPORT, ABQ AND STEMS SUBSCALES**

	Regular 1st team starters (n = 17)	Regular non-starters/ reserves (n = 6)	*T*-test results Statistical significance (p-value)	Effect sizes Practical significance (Cohen's *d*)
Average age	22.92 ± 1.23	21.71 ± 1.98	0.09	0.61°
Average years playing rugby	14.53 ± 2.03	11.50 ± 3.94	0.02*	0.77°°
TOTAL RECOVERY-STRESS (RESTQ-SPORT)	3.56 ± 2.21	**4.58 ± 2.24**	0.34	0.46°
GENERAL STRESS MAJOR SCALE #	1.48 ± 0.82	**1.26 ± 0.56**	0.56	0.26
General Stress Minor #	1.29 ± 0.89	**1.04 ± 0.77**	0.55	0.28
Emotional Stress #	1.51 ± 1.10	**1.21 ± 0.53**	0.52	0.28
Social Stress #	1.51 ± 0.92	**1.29 ± 0.66**	0.59	0.24
Conflicts/Pressure #	2.09 ± 1.27	**1.92 ± 0.80**	0.76	0.14
Fatigue #	1.41 ± 1.00	**1.33 ± 0.97**	0.87	0.08
Item 6 - I had difficulties in concentrating #	1.56 ± 0.95	**1.25 ± 0.76**	0.48	0.33
Item 23 - I put off making decisions #	1.44 ± 1.12	**0.83 ± 0.82**	0.24	0.54°
Item 9 - I had a headache #	**0.62 ± 0.74**	0.75 ± 0.76	0.71	0.17
Item 12 - I felt uncomfortable #	1.41 ± 1.03	**1.25 ± 1.08**	0.75	0.15
GENERAL RECOVERY MAJOR SCALE	3.20 ± 0.75	**3.63 ± 0.92**	0.28	0.46°
Success	2.91 ± 0.80	**3.04 ± 1.02**	0.75	0.13
Item 2 - I laughed	3.35 ± 1.04	**3.92 ± 1.20**	0.29	0.47°
Item 8 - I had a good time with my friends	3.24 ± 1.40	**3.75 ± 1.44**	0.45	0.36°
Item 4 - I felt physically relaxed	2.59 ± 0.87	**3.25 ± 0.61**	0.10	0.76°°
Item 21 - I felt as if I could get everything done	2.91 ± 0.83	**3.17 ± 1.47**	0.61	0.17
General Well-being	3.26 ± 0.92	**3.79 ± 1.12**	0.27	0.47°
Sleep Quality	3.79 ± 0.96	**4.25 ± 1.01**	0.34	0.45°

	Regular 1st team starters (n = 17)	Regular non-starters/ reserves (n = 6)	*T*-test results Statistical significance (p-value)	Effect sizes Practical significance (Cohen's *d*)
SPORT-SPECIFIC STRESS MAJOR SCALE #	**1.28 ± 0.78**	1.35 ± 0.58	0.85	0.08
Disturbed Breaks #	**0.92 ± 0.81**	1.13 ± 0.63	0.58	0.25°
Burnout/ Emotional Exhaustion #	**0.93 ± 0.77**	0.98 ± 0.61	0.90	0.06
Injury #	1.99 ± 1.12	**1.94 ± 0.74**	0.91	0.05
SPORT-SPECIFIC RECOVERY MAJOR SCALE	3.11 ± 0.82	**3.56 ± 0.97**	0.28	0.46°
Being in shape	3.11 ± 0.85	**3.67 ± 0.97**	0.20	0.58°
Personal accomplishment	2.80 ± 0.86	**3.29 ± 1.19**	0.29	0.41°
Self-efficacy	3.23 ± 1.09	**3.63 ± 1.03**	0.45	0.36°
Self-regulation	3.31 ± 0.92	**3.67 ± 0.91**	0.42	0.39°
TOTAL BURNOUT SCORE (ABQ) #	1.81 ± 0.64	1.81 ± 0.35	0.99	0.00
Reduced Sense of Accomplishment #	2.31 ± 0.67	**2.18 ± 0.43**	0.67	0.19
Sport Devaluation #	**1.49 ± 0.71**	1.58 ± 0.47	0.77	0.13
Emotional/Physical Exhaustion #	**1.62 ± 0.69**	1.65 ± 0.41	0.93	0.04
TOTAL MOOD DISTURBANCE SCORE (STEMS)	-1.00 ± 11.25	**7.25 ± 3.17**	0.10	0.73°°
Tension #	2.15 ± 2.97	**0.92 ± 0.74**	0.33	0.41°
Depression #	1.35 ± 2.00	**0.25 ± 0.42**	0.20	0.55°
Anger #	1.35 ± 1.97	**0.50 ± 0.84**	0.32	0.43°
Vigour	8.24 ± 3.10	**10.25 ± 1.70**	0.15	0.65°°
Fatigue #	2.50 ± 2.08	**1.00 ± 1.58**	0.12	0.72°°
Confusion #	1.88 ± 2.79	**0.33 ± 0.52**	0.20	0.56°

Lower values represent better results
Values in **bold** depicts the group with the best results for the particular subscale
* Statistically significant differences ($p<0.05$)
° Moderate practical significant differences ($d \approx 0.5$)
°° Large practical significant differences ($d \approx 0.8$)

Collectively, the results from Table 4 suggest that the players in the starting line-up were subject to greater stress levels, had poorer recovery strategies and generally experienced greater negative mood state scores than the reserve players, whereas the reserves experienced greater stress of a sport-specific nature.

CONCLUSIONS

The results from this study show that playing position, experience level and starting status are related to the key characteristics of burnout, the recovery-stress balance and mood states, as significant differences in these scores were frequently observed between the various subgroups. Importantly, these differences do not imply prediction or causation.

In particular, it was observed that the forwards in the current investigation had more favourable REST-Q, ABQ and STEMS subscale scores than the backline players. The very experienced players (senior squad members) at this particular participation level showed the

least favourable REST-Q, ABQ and STEMS subscale scores throughout. Players with limited experience at this level (one or two years) had the most favourable *Total Recovery-Stress, General Recovery, Sport-specific Recovery, Burnout* and *Mood State* scores of the three groups in the comparison, whilst the novice players (first season at this level) showed the most favourable *General Recovery* and *Sport-specific Recovery* scores. Starting status were also shown to significantly affect the *Total Recovery-Stress, General Recovery Major Scale, Sport-specific Recovery Major Scale* and the *Total Mood Disturbance* scores with the reserves showing more favourable results than the regular starters.

RECOMMENDATIONS

From these findings it is recommended that different player management strategies should be developed and implemented for more experienced team members and regular starters. Playing position should also be considered when monitoring and managing rugby players regarding the possible onset and development of the overtraining and burnout syndromes.

This study used an availability sample consisting of 41 male student rugby players. The small number of participants potentially limits the ability to generalize these results to other populations, especially as this group was further divided into subgroups for the various comparisons. It is subsequently recommended that future studies include larger sample sizes comprising of players from different teams. The inclusion of players from different teams would enable comparisons between successful and less successful teams, thereby contributing to the existing knowledge of factors leading to the development of overtraining and burnout. Furthermore, it is suggested that this study is extended to professional rugby players competing at the provincial and/or international level, as these players are particularly prone to experience these syndromes due to year-round competitive seasons with short breaks in between.

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THE VALIDITY AND RELIABILITY OF THE EXERCISE BENEFITS/BARRIERS SCALE FOR TURKISH MILITARY NURSING STUDENTS

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ABSTRACT

This study aims to test the validity and reliability of the Exercise Benefits/Barriers Scale (EBBS) for female university students in Turkey. This is a validity and reliability study of the EBBS for use in a Turkish context. The study sample consisted of 409 students of a School of Nursing (97.1% of the total student body). In the study, a three-part questionnaire was used. The EBBS, developed by Sechrist (Sechrist et al., 1987), was used in the study in order to determine the participants' benefit-barrier perceptions. The EBBS validity coefficient was found to be 0.87 (re-test =0.85) for the whole scale, 0.95 (re-test=0.94) for the benefit aspect and, 0.80 (re-test=0.79) for the barrier aspect. "Physical performance" and "preventive health" were given the highest scores by the participants within the EBBS's benefit subscales. The exercise barrier subscale with the lowest score was "exercise milieu". Determining the benefits of and barriers to exercise, by using a standardized scale, plays an important role in maintaining proper levels of physical activity. The Turkish translation of the EBBS model has shown it to be an effective tool for measuring physical activity among female Turkish university students.

Key words: Adolescent health; Exercise; Health behaviours; Physical activity.

INTRODUCTION

A healthy lifestyle, being one of the 21st century's 21 health objectives, involves a simple concept, "Members of society should have adopted a healthy lifestyle by the year 2015", which emphasizes that "…healthy behaviours concerning physical activity should be considerably increased" (Aktan & Isik, 2007: 8).

Over the past 50 years, many epidemiological studies have been dedicated to improving the quality of life and public health. Physical activity has been clearly identified as a means of maintaining an individual's physical health and well-being (Morrow *et al*., 2004).

A physically active lifestyle has many measurable benefits, including the reduced risk of several severe conditions such as coronary heart disease, hypertension, stroke, noninsulin-dependent diabetes mellitus, cancer of the colon, obesity and osteoporosis. On the other side of the coin, psychological benefits include reduced levels of stress and depression, and an increased sense of well-being, heightened energy levels, improved self-confidence and

general self-satisfaction with social activities (Sechrist *et al*., 1987; Bowles *et al*., 2002; Ransdell *et al*., 2003).

The Centers for Disease Control and Prevention (CDC) and the American College of Sports Medicine (ACSM) recommend that every able-bodied adult should exercise every day for at least 30 minutes at a level of moderate intensity (Bowles *et al*., 2002). Research has shown that virtually all individuals can benefit from regular physical activity, whether or not they participate in moderate or vigorous health-enhancing physical activities (Ammouri *et al*., 2007). The recommendations emphasize that adults who incorporate sufficient physical activity into their daily routines experience health benefits (Morrow *et al*., 2004). In spite of the well-recognized benefits of physical activity, millions of people are physically inactive. More importantly, the prevalence of physical inactivity is on the rise (Reichert *et al*., 2007).

In the Surgeon General's "Report on Physical Activity and Health", inactivity was reported to be more common in women than in men, and more common among the elderly than in younger adults (Ammouri *et al*., 2007). Although the diseases attributed to, or associated with, physical inactivity typically do not manifest themselves before middle age, many experts recommend that efforts should be intensified in order to prevent chronic diseases on the part of at-risk children and adolescents (Pate *et al*., 2007).

One demographic that is disproportionately threatened by a statistical risk of inactivity is adolescent girls. Compared with adolescent boys, girls tend to be less active and display less interest with regard to participation in physical activities. Thus, to combat this trend, it is important to understand what makes participation in physical exercise less appealing to adolescent girls. Moreover, although the rate of exercising decreases with age, the decline in activity is sharper among females than among males (CDC, 1997; Ransdell *et al*., 2003; Dwyer *et al*., 2006).

Once girls reach adulthood, they face an even greater risk of drifting into a less active lifestyle. Adult women (aged 18 and above) tend to limit their participation in physical activity with age. A large proportion of adult women (43%) indicate that they do not engage in physical activity in their leisure time. Research indicates that only 20% of women participate in regular vigorous activity, while another 13% engage in moderate levels of physical activity on a regular basis (Ransdell *et al*., 2003; Ransdell *et al*., 2004).

RESEARCH PURPOSE AND QUESTION

This study aims to evaluate the validity and the reliability of the Turkish language version of the EBBS developed by Sechrist *et al.* (1987). The necessity of adapting the scale for the Turkish language arises from the perception of the benefits of exercise for girls and the perception of barriers that drive them to inactivity, and the need for future interventions in this area.

Under what headings can these interventions be grouped to ensure a more active life style for girls after determining the perceptions of benefits/barriers with regard to exercise?

METHODS

Design and Sample

This is a validity and reliability study of the EBBS for use in a Turkish context. The sample for the study consisted of 409 students in either their 1st, 2nd, 3rd or 4th years of study at a School of Nursing. The school is an all-female boarding school, providing nursing education at the undergraduate level. Graduates earn the title of military nurse and go on to work in the various health services in all branches of the Turkish Armed Forces (TAF).

Inclusion criteria. No differentiations were made between the students when including them in the study, because they were of a similar age and made up almost the same demographic, with similar ethnic characteristics and the same marital status. No inclusion criteria were involved since all the students attending the School of Nursing were included in the study. Out of 421 enrolled students, a total of 12 did not participate. Of these, six were unwilling to take part, four cited health problems as their reason for not participating and two were absent. Consequently, the remaining 409 students (97.1% of the total student body) were the subjects of this study.

Human subject protection and procedures. Students were informed of the study before they became involved. Participants were given an oral introduction to the purpose of the study by the primary investigator, and were given about 15 minutes to complete the questionnaire. Students could decline to participate in the study at any time. The questionnaire was completed anonymously.

MEASUREMENTS

In the study, a three-part questionnaire was used. In the first section there were five questions designed to determine the participants' demographic information (date of birth, class, height and weight, smoker or non-smoker, etc.).

The second section comprised 11 questions aimed at determining the participants' exercise habits. In this part, the participants were asked whether they were members of a sports club, had regular exercise habits and the type of exercise in which they participate (walking, running, volleyball, etc.).

For the third section of the questionnaire, in order to determine the participants' benefits-barrier perceptions, the Exercise Benefits/Barriers Scale (EBBS) was used (Sechrist *et al*.,1987). Since the EEBS has never been applied in Turkey before, a study of its reliability and validity had to be undertaken. The scale had been translated into Turkish by two linguists and retranslated from Turkish into English for an analysis of the meaning structures. Before being applied to the students, the Turkish version was analyzed and evaluated by a Turkish linguist in terms of its grammar and comprehensibility. Then the scale was pre-tested with 20 graduates of the same school, of the approximate age group as the participants, for comprehensibility and answerability. The pre-test graduates were not included in the study and were used only to assess the feasibility of the questionnaire.

The resulting questionnaire, including the scale, was given to the students in an observed classroom setting between April and May 2006. Before completing the questionnaire, the students were informed of the intention of the study and were reminded of the necessity of answering the entire form using the scale provided. The EBBS was reapplied two weeks later for the re-test. On average the participants finished the entire questionnaire in 15 minutes. Excellent internal consistency (Cronbach's $\alpha = 0.87$) was present for the EBBS, as well as excellent test-retest reliability ($r = 0.85$) across the two-week period. In the light of these findings, the adapted Turkish version of the EBBS is assumed to be valid and reliable for military nursing students and the results are based on this assumption.

Exercise Benefits/Barriers Scale (EBBS)

The perceived benefits and perceived barriers of engaging in physical activity were assessed by the Exercise Benefits/Barriers Scale (EBBS) (Sechrist *et al*., 1987). Each respondent was asked to rate the perceived benefits and perceived barriers on a 4-point Likert Scale ("Strongly Agree" to "Strongly Disagree"). The authors also wanted to examine changes in the various subscales of the EBBS. Specifically, benefits were divided into five areas: life enhancement, psychological outlook, physical performance, social interaction, and preventive health.

The life enhancement benefits subscale was obtained by calculating the mean rating of nine items related to disposition, sleep, fatigue, self-concept, mental alertness, carrying out normal activities, quality of work, overall body functioning and stamina. The physical performance benefits subscale was obtained by calculating the mean of 7 items related to muscular strength, physical fitness, muscle tone, cardiovascular functioning, flexibility, and endurance. The psychological outlook benefits subscale was obtained by calculating the mean of 6 items related to exercises enjoyment, personal accomplishment, mental health, relaxation, and well-being. The social interaction benefits subscale was obtained by calculating the mean of 4 items related to contact with friends, meeting people, entertainment, and increased acceptance by others. The prevention health benefits subscale was obtained by calculating the mean of 3 items related to prevention of heart attacks, high blood pressure, and longevity.

Barriers were divided into three areas: exercise milieu, time expenditure, and physical exertion. The exercise milieu barriers subscale was obtained by calculating the mean of 6 items from the original scale related to location, cost, prevalence of exercise facilities, and embarrassment about activity. The time expenditure barriers subscale was obtained by calculating the mean of 2 questions related to taking time away from family or work responsibilities (or school responsibilities in the case of the daughters). The physical exertion barriers subscale was obtained by calculating the mean of 3 items from exercise difficulty.

The possible scores on the benefits scale ranged from 29 to 116 points, with higher scores indicating greater benefits. The possible range of scores on the barriers scale was 14 to 54 points, with a higher score indicating fewer perceived barriers. A single EBBS score was calculated by the addition of benefits and barriers scores. The total benefits plus barriers score ranged from 43 to 170 points. The higher the score, the more positively physical activity benefits were perceived in relation to physical activity barriers.

In the study conducted by Sechrist *et al*. (1987) the standardized Cronbach's α reliability coefficients were found to be 0.95 for the total scale, 0.95 for the benefits scale and 0.89 for the barriers scale. Two-week test-retest reliability correlation coefficients were 0.89 for the entire scale, 0.89 for the benefits scale and 0.77 for the barriers scale.

Body Mass Index (BMI) classification of the participants was done in accordance with the World Health Organization (WHO) criteria. Smokers/non-smokers were identified based on the 'yes' or 'no' answers given by the participants to the "Do you smoke?" question.

DATA ANALYSIS

For the reliability analysis, the test-retest method was used and the Cronbach's alpha coefficients were calculated. For the validity analysis, factor analysis was used. In the assignment of the average scale points to different attributes, Kruskall Wallis and Student t-tests were used. All data were analyzed using SPSS for Windows (Version 10.1).

RESULTS

Characteristics of the study sample

All of the study participants were female students, with a mean age of 20.54 ± 1.20 years, and a range of 18 to 23 years. The majority of the participants were 4^{th}-year students, with BMIs within the normal range. There were no obese students and the majority of subjects were not members of sports clubs at the school. In all 14.7% of the students reported that they were smokers and 60.6% of them stated that they exercised regularly (Table 1). Average benefits and barrier scores of the participants and Cronbach's α values are shown in Table 2.

A comparison of the average points of the benefit and barrier subgroups with different variables revealed that those who exercised regularly were members of sport clubs and/or non-smokers, had higher benefit points and lower barrier points compared with non-regular exercisers, non-members and smokers respectively ($p<0.05$) (Table 3).

While the top-ranked benefit of exercise according the participants was "Cardiovascular functioning improvement", bottom-ranked was "The body looks better". "Places to exercise are too far away" was ranked number one among barriers, while "Exercise is hard work" was placed at the bottom (Table 4).

TABLE 1. **DISTRIBUTIONS OF THE STUDENTS ACCORDING TO VARIOUS DEMOGRAPHIC DATA**

	N	%
Ages		
18-20	190	46.5
21-23	219	53.5
Grades		
Year I	75	18.3
Year II	92	22.5
Year III	112	27.4
Year IV	130	31.8
Total	409	100.0
BMI		
< 18.50	70	17.1
18.50 - 24.99	323	79.0
≥ 25.00	16	3.9
Participating in sports clubs at the school		
Yes	102	24.9
No	307	75.1
Social Clubs		
Natural Sports/Scouting	39	38.2
Folklore	18	17.6
Basketball	15	14.7
Volleyball	14	13.7
Steppe	11	10.9
Others	5	4.9
Smoking Status		
Smoking	60	14.7
Not Smoking	349	85.3
Taking Regular Exercise		
Active	248	60.6
Non-active	161	39.4
TOTAL	409	100.0

TABLE 2. **EBBS TOTAL, BENEFITS-BARRIERS MEANS AND CRONBACH'S A VALUES**

	Mean	**SD**	**Min**	**Max**	α	**Re-test** α
EBBS Benefit	90.68	12.98	29	116	0.95	0.94
EBBS Barrier	28.66	5.50	14	54	0.80	0.79
EBBS Total	119.33	12.18	43	161	0.87	0.85

TABLE 3. **COMPARISON OF THE EBBS BENEFITS-BARRIERS SCORE MEANS OF THE STUDENTS IN TERMS OF EXERCISING, SMOKING AND PARTICIPATING IN CLUB ACTIVITIES**

	BENEFITS					**BARRIERS**				
	N	**Mean**	**SD**	**t**	**p**	**N**	**Mean**	**SD**	**t**	**p**
Exercising										
Yes	248	94.77	11.21	8.590	.001	248	27.47	5.09	-5.62	.001
No	161	84.37	13.03			161	30.48	5.61		
Smoking										
Not Smoking	349	91.36	12.17	2.587	.010	349	28.37	5.33	-2.52	.012
Smoking	60	86.70	16.52			60	30.30	6.19		
Club Membership										
Yes	102	96.36	11.20	5.270	.001	102	27.51	5.95	-2.44	.015
No	307	88.79	13.00			307	29.04	5.30		

TABLE 4. **TOP EXERCISE BENEFITS/BARRIER STATEMENTS**

Benefits	**Mean**	**SD**
Improves functioning of cardiovascular system	3.420	.58
Muscle strength increased	3.418	.58
Physical fitness level higher	3.379	.67
Decreases feelings of stress and tension	3.369	.66
Improves flexibility	3.347	.63
Stamina increased	3.330	.63
Enjoy exercise	3.310	.70
Prevents heart attacks	3.262	.61
Improves the way body looks	3.257	.67
Barriers	**Mean**	**SD**
Places to exercise too far away	2.511	.86
Exercise is tiring	2.467	.74
Too few places to exercise	2.342	.80
Exercise is fatiguing	2.325	.74
Inconvenient facility schedules	2.218	.78
Exercise is hard work	2.169	.80

Note: Classification taken from EBBS (Sechrist *et al*., 1987). There is a total of 29 benefit items on the EBBS. Scoring: 4= strongly agree; 3= agree; 2= disagree; 1= strongly disagree.

Construct and discriminant validity of the EBBS

The factor analysis conducted in this study disagrees with the original test developers' factor analysis (Sechrist *et al*., 1987). The test developers identified nine factors that accounted for 65% of the variance. Factor analysis of the resulting 43-item instrument yielded a seven-factor solution, which explained a variance of 57.1%, as shown in Table 5.

When the 43 EBBS items were examined, 29 items were loaded exclusively on one each of the seven factors. The content interpretation of each factor was straightforward and proved valid (Table 6), yielding five benefit and two barrier factors. In this study, only three (factors of 3, 5 and 6) comprised items identical to factors from the original test developers. A few items are different from the original scale in the 1^{st}, 2^{nd}, 4^{th} and 7^{th} factors.

A Kruskall-Wallis analysis demonstrated that there were significant differences between the five benefit questions associated with physical activity ($p< 0.001$). Subjects indicated that the numerically highest benefit derived from physical activity was an improvement in their physical performance (3.3 ± 0.53) (Figure 1).

It was shown numerically that subjects reported that the least beneficial aspect of physical activity was the opportunity for life enhancement (3.0 ± 0.55). In this study Cronbach's α was 0.95 (n=409) for the benefit scores.

As a result of the post-hoc analysis, the interactions between factors were found to be as follows: Factor 3, which is life enhancement, affects all three factors.

Results of the Kruskall-Wallis ANOVA indicated that there were no significant differences between the two barrier questions associated with physical activity ($x^2= 1.43$, $p>0.001$). Numerically, the largest barrier to physical activity reported by subjects was the exercise milieu involved (2.3 ± 0.62). In this study, Cronbach's α was 0.80 (n=409) for the barriers to action.

TABLE 5. **EIGENVALUES, PER CENT VARIANCE EXPLAINED, AND CUMULATIVE PER CENT VARIANCE EXPLAINED BY FACTORS ON THE EBBS (N=409)**

Factor	Factor label	Eigenvalue	Factor %	Cumulative %
1	Physical performance	13.730	31.930	31.930
2	Psychological outlook	3.435	7.989	39.919
3	Life enhancement	2.321	5.397	45.315
4	Social interaction	1.567	3.645	48.961
5	Preventive health	1.320	3.070	52.031
6	Physical exertion	1.167	2.714	54.745
7	Exercise milieu	1.038	2.414	57.159

TABLE 6. **FACTOR INTERNAL CONSISTENCY AND LOADINGS IF ITEMS FROM THE EBBS* (N=409)**

Item	Alpha	Loading value
Factor 1 - Physical performance	.88	
Stamina increased		.76
Physical endurance improved		.75
Physical fitness level higher		.74
Self-concept improved		.73
Flexibility improved		.72
Muscle strength increased		.70
Factor 2 - Psychological outlook	.87	
Mental alertness increased		.76
Feelings of well-being improved		.76
Sense of personal accomplishment given		.72
Stress and tension decreased		.71
Mental health improved		.71
Enjoy exercise		.70
Makes feel relaxed		.69
Factor 3 - Life enhancement	.75	
Sleep better		.67
Body functioning improved		.66
Normal activities carried out without tiredness		.64
Disposition improved		.61
Factor 4 - Social interaction	.71	
Enjoy exercise		.70
Good entertainment		.65
Contact with friends		.60
Factor 5 -Preventive health	.69	
Prevents high blood pressure		.60
Live longer		.60
Prevents heart attacks		.47
Factor 6 - Physical exertion	.77	
Exercise is tiring		.54
Exercise is fatiguing		.54
Exercise is hard work		.52
Factor 7s- Exercise milieu	.64	
Places to exercise too far away		.60
Inconvenient facility schedules		.50
Too few places to exercise		.49

Only moderate or greater factor loadings (.47+) are included.
Overall EBBS Cronbach's $\alpha = 0.95$

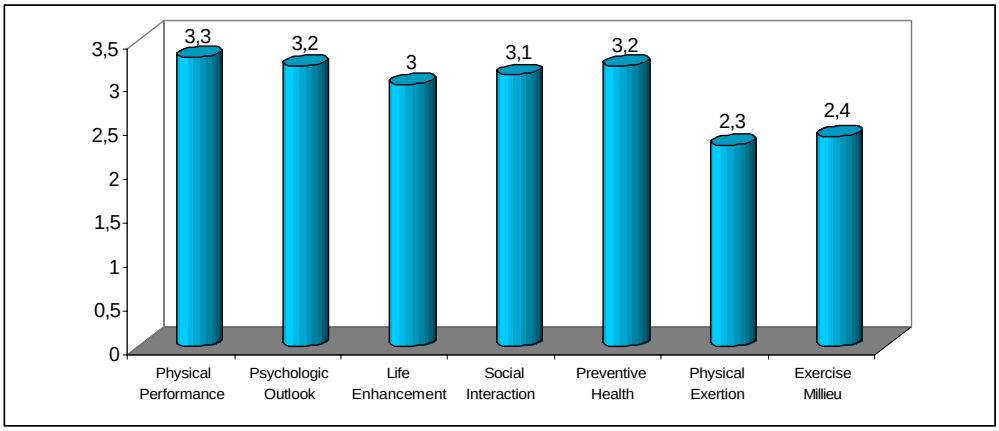

FIGURE 1. **MEAN BENEFITS/BARRIERS FACTOR SCORES (N=409). A HIGH SCORE EQUALS GREATER BENEFITS/BARRIERS PERCEPTIONS**

DISCUSSION

In this study, the exercise habits of the military nursing students were examined and the EBBS developed by Sechrist *et al*. (1987) was adapted to create a Turkish language version. Validity-reliability studies were conducted. It can be concluded that the results of this study significantly contribute to the authors' understanding of the benefit and barrier perceptions of female university students.

According to the 2003 population census, the population of Turkey is approximately 70 million. About 18.7% of the population (approximately 14 million) are between 15 and 24 years of age (Koc & Hancioglu, 2003). Cultivating patterns of healthy behaviour among such a large number of young people is a priority for the public health sector. Habits involving higher levels of physical activity are highly effective in protecting and improving the health of the younger generation.

The correlation between physical activity during adolescence (13 to 18 years) and during young adulthood (21 to 35 years) is low. It has been suggested that the highest rate of decline in physical activity occurs in late adolescence and early adulthood (those aged between 18 and 24 years) (Grubbs & Carter, 2002).

However, in Turkey there are a few studies on the frequency of physical activity and barriers to exercise on the part of the younger population, or relating to a scale for measuring the exercising conditions of the young population. Studies on the exercise habits of adolescents in Turkey offer results comparable to those in the literature. In a study of adolescents by Vaizoğlu *et al*. (2004) it was found that the energy spent in physical activities was significantly lower in girls compared to boys. In another study by Ozmen *et al*. (2007) it was found that 23.5% of females were in the habit of exercising regularly, compared to 55.0% of male students.

Another study indicated that girls were inactive, and the weekly exercise period of about three-quarters of adolescents in Turkey was inadequate (Kara *et al*., 2003).

A study performed on teachers who are expected to be role models in persuading adolescents to be more physically active, the results also did not differ much (Tokuç & Berberoğlu, 2007).

According to the results of these studies, it can be concluded that girls have a more inactive life in Turkey. It is also clear in this context that the reasons why they do not exercise and what they perceive as benefits and barriers, and the degree to which they perceive these, should be investigated. The authors of this paper are of the opinion that the results of this study may contribute to clarifying the perceived reasons for these barriers and will help to remove them.

Physical activity intervention specialists must identify age- and location-specific benefits and barriers. Health professionals need to formulate methods to increase the perceived benefits and reduce the barriers. A higher rate of success can be expected, if and when they target these specific issues (Ransdell *et al*., 2004).

It is essential that conditions for exercising, and how to determine benefit and barrier perceptions among young people in Turkey, be explored. This is why it was necessary for the EBBS scale to be translated into Turkish, and its validity and reliability studied. This Turkish adaptation could be used for different age groups by various researchers and hopefully the data extracted can be expanded.

As can be seen from Table 1, almost all of the participants were of a normal weight. In fact, weight had no discernible effect on their exercising behaviour ($p>0.05$). However, gaining weight as they become older inevitably threatens their health. This is partly due to the correlation between decreasing physical activity levels and increasing rates of obesity and overweight among young people, as well as among middle-aged adults (Page *et al*., 2003-2004). Inactivity is probably one of the most important risk factors in terms of overweight and obesity development and maintenance (Pietrobelli *et al*., 2005). The obesity prevalence value of Turkish girls (45.5%) corroborates this (Mackay *et al*., 2006a).

Responses by the participants to the EBBS were compared for their consistency on responses related to regular exercising, smoking/non-smoking and membership of sports clubs. Regular exercisers, non-smokers and club members have a higher average benefit point in the EBBS ($p<0.05$).

In similar studies, exercising participants have high average benefit points while their barrier points are low (Grubbs & Carter, 2002; Ransdell *et al*., 2004). In the study under consideration in this paper, although the rate of exercising (60.9%) seems to be high given the opportunities provided by the university in terms of current club activities and compulsory physical training course, this figure could actually be considered to be low. In Page's study, when the female students' exercise patterns of the previous week were analyzed, 45.8% were classified as "low activity" whereas only 22.8% were classified as "moderate-high activity" (Page *et al*., 2003-2004). The present study shows very similar results.

The low level of exercise benefit perception and the high level of barrier perception on the part of smokers (14.7%) show that smoking affects exercising behaviour. In Turkey, the prevalence of smoking among adolescent girls is 3.1%, while the prevalence of smoking in adult women is 17.6% (Mackay *et al*., 2006b). If exercising and quitting smoking were encouraged, it would have a direct effect on the future quality of life of those females moving from youth into adulthood.

Participation in club activities is shown to be effective in increasing exercise behaviour. Encouraging participation in such activities would increase the perception of the benefit of exercising, and could be effective in reducing the barrier perceptions (Table 3).

Consistent with expectations, the Exercise Benefits/Barriers Scale (EBBS) was generally upheld as a psychometrically sound instrument, as evidenced by good internal consistency, temporal reliability and convergent validity. The EBBS validity coefficient was found to be 0.87 (re-test =0.85) for the whole scale, 0.95 (re-test=0.94) for the EBBS benefit and 0.80 (re-test=0.79) for the EBBS barrier. This result reflected the α coefficients obtained by the original scale developers and evaluated as appropriate for use among female university students in Turkey (Table 2).

As can be seen from Table 4, students rank cardiovascular functioning improvement (3.42±0.58) and muscle strength increase (3.42±0,58) at the top in the EBBS benefit perception items in terms of point averages. In Williams' study of women (3.8) and Grubbs and Carter's study of girls and boys (3.55), "higher physical fitness level" were found to be the top-rated item (Grubbs & Carter, 2002; Williams *et al*., 2006). The younger population, instead of valuing perceptions such as "protection against chronic sicknesses", was more interested in physical performance and appearance. In the study under review, contrary to this tendency, developing cardiac health is highest placed. Although it may seem unusual for female students, their occupational tendencies as health personnel and their presence in the military may help to explain this finding. Heart disease is the leading cause of death and disability in American women (Perry & Bennett, 2006). In Turkey, on the other hand, circulatory system diseases are ranked third (16.6%) in the list of causes of death (Hacettepe University, 2006). In summary, the relative risk of coronary artery disease in sedentary individuals, in comparison with active persons, is approximately 1.9 (Blair & Conelly, 1996). Nurse practitioners (NPs) play an important role in counselling women with regard to increasing their physical activity in order to achieve the recommended levels (Perry & Bennett, 2006).

When the barrier items constituting 14 out of the total of 43 items in the EBBS are considered, the top items were found to be "places to exercise are too far away" (2.51±0.86) and "exercise is tiring" (2.47±0.74). The former barrier was addressed by moving the dormitories closer to the gym after the research had been completed. In similar studies, "exercise is tiring" was also found to be among the top barriers to exercise (Grubbs & Carter, 2002; Williams *et al*., 2006; Reichert *et al*., 2007).

In the factor analysis of EBBS, 43 items are concentrated into seven factors, explaining the scale with a 57.1% variance. As shown in Table 5, the factor analysis for the scale of this

study is different from that of Sechrist, while it is the same as that found in Brown's study (Brown, 2005). This study supports Brown's statement that the difference in his findings would be reference to other studies. As to why the physical performance factor bears the highest mean score among benefit subgroups of the EBBS, it seems to be that the physical requirements with regard to acceptance to the school, and the military nature of the institution, explain their high rates of physical activity.

Benefit Subscales of the EBBS

According to the responses of the participants, physical performance (3.3 ± 0.53) and preventive health (3.2 ± 0.53) were given the highest scores among the EBBS's benefit sub-scales. Similar results were obtained from the average points of the EBBS items. Increasing the sensitivity of the students concerning these items would constitute significant attempts to protect, sustain and improve the health, not only of themselves, but also of those with whom they deal professionally.

Although, in the interaction of the EBBS benefit subgroup factors, internal consistency and loading were in the first rank in the original study but only third in this study, life enhancement happens to be the most influential factor (Table 7). Life enhancement affects three benefit subgroups - physical performance, psychological outlook and preventive health.

TABLE 7. **THE INTERACTION OF BENEFIT FACTORS WITH EACH OTHER**

Factor	**Affecting Factors**	**p**
Physical performance (factor-1)	Life enhancement	0.0001
	Social interaction	0.003
Psychological outlook (factor 2)	Life enhancement	.001
Life enhancement (factor 3)	Physical performance	.001
	Psychological outlook	.001
	Preventive health	.001
Social interaction (factor 4)	Physical performance	.003
Preventive health (factor 5)	Life enhancement	.001

The mean difference is significant at the .05 level.

Barrier Subscales of the EBBS

The lowest exercise barrier subscale was the "exercise milieu". The problem with the remote location of the sports facilities has been solved by the school management by moving the student dormitories closer to the gym. Forming more appropriately scheduled programmes for the students with regard to exercise would also help to remove problems in terms of the "exercise milieu". Barriers relating to exercising itself (i.e. perceptions of fatigue and it being hard work) could be reduced by emphasizing the importance of exercise in other parts of the curriculum. Research has shown that those who exercise have a higher benefit perception and a lower barrier perception. Since those exercising are aware of the benefits, the hardest step would be to persuade someone to start exercising (Grubbs & Carter, 2002). Perceived barriers could slow or stop healthy behavioural changes. Physical barriers actually prevent behaviour adoption (Bowles *et al.*, 2002).

Multifaceted variables will most likely play a role in fostering increased physical activity among young people. Furthermore, the relevant composition of the variables may differ in terms of gender and across adolescence. With accumulating scientific evidence that moderate to vigorous physical activity can have positive effects on physical and mental health throughout life, the search for factors influencing the adoption of an active lifestyle must continue.

Childhood and adolescence are ideal developmental periods for fostering an active lifestyle that can be maintained throughout life (Garcia *et al*., 1998). Emphasis is currently being placed on beginning physical activity interventions early in life, preferably during the elementary school years, and continuing thorough middle and high school years.

Inactivity early in life correlates with sedentary adulthood, precursor of chronic diseases such as coronary heart disease and osteoporosis at a young age. Behaviour such as inactivity, learned early in life, persists and is difficult to extinguish. Research findings have shown that many adults who repeatedly initiate regular physical activity are unable to maintain it over time and so do not reap health benefits (Robbins *et al*., 2001).

Exercise also has some additional positive effects such as improving self-confidence and academic success, while reducing depressive symptoms related to the specific problems of the adolescent period (Kara *et al*., 2003).

LIMITATIONS

This study has several limitations. These include the fact that the study group consisted of only female students. In addition, the study group had a very narrow age range (18 to 23 years). These ages also correlate with the school year of the students. Because the school in which the study was conducted was a military school, the mandatory physical training courses may have caused the study results to show a partial deviation.

CONCLUSION

Perceived benefits and barriers continue to play an important role in physical activity. With standardized instrumentation, these variables may play a greater role in the understanding and prediction of physical activity levels.

With the translation of this scale into Turkish, it will be possible to identify the benefits-barriers perceptions of exercising in groups of Turkish males and females of many demographics.

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PHYSICAL AND MOTOR ABILITY, ANTHROPOMETRICAL AND GROWTH CHARACTERISTICS OF BOYS IN THE NORTHWEST PROVINCE OF SOUTH AFRICA: A SPORT TALENT PERSPECTIVE

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ABSTRACT

The objective of the study was to analyse age group differences among and unique to 10 to 15 year old boys of different racial groups living in the North West Province (NWP) of South Africa. Boys (N=604) between 10 and 15 years participated in the study. They were a randomized group and a proportional representation of the four different racial groups living in the NWP. The tests included the Australian Talent Search protocol, consisting of 10 parameters (four anthropometrical, one physical and five motor abilities) and four additional physical fitness parameters (abdominal, grip- and upper body strength and flexibility). The analyses were based on cross sectional data and age group comparisons for anthropometric composition, physical and motor abilities of the boys. Analysis of Variance with an age and group effect revealed growth patterns similar to other studies, although unique growth characteristics were also found in the different racial groups, suggesting population variation. Age group differences and tendencies with regard to body dimensions and physical and motor abilities were indicated. In order to achieve a distinct profile of the current and future sporting potential of a boy in his rapid growing years, it is recommended that comparison to peers from a sport talent perspective will provide a more sensitive assessment when regional or national reference data, but also racial specific growth profiles, are used. The results of this study can serve as a reference base for future comparisons in order to ensure that the most talented children are identified for sport on the basis of their own growth profile.

Key words: Growth; Maturity; Boys; Talent; Physical; Motor.

INTRODUCTION

Every athlete's ultimate goal is to excel in performance of the sport in which he/she has specialized (Reilly, 2001). To achieve this, many years of training and preparation are needed. It is indicated that it can take up to 10 years for an athlete to reach his/her full sporting potential (Woodman, 1985). Sport talent identification (TID) should therefore commence relatively early in an athlete's life for the optimalisation of sporting talent. The fact that South Africa has not been a prominent force since the 1992 return to world sport suggests that much more should be done to identify and develop potentially talented sportsmen and –women.

South African researhers (Du Randt *et al.*, 1993) conducted an extensive literature survey regarding TID, and pointed out that lack of scientifically based TID protocols and programs compromised sport development in the South African context. They also highlighted that the scientific identification and development of young talented athletes require knowledge of the biological growth and maturation processes during adolescence. It is indicated in this regard (Post *et al.*, 1997) that the onset of puberty, peak height velocity (PHV) and sexual maturation radically differ from one individual to another of the same chronological age, and different researchers (Carey, 1989; Fisher & Borms, 1990; Van Rooyen, 1993) suggest that these aspects should receive more attention. Changes in physical, motor and anthropometrical TID determinants are especially influenced by growth and maturation (Pienaar *et al.*, 1998), therefore scientists working in the field of TID should have sufficient knowledge of these processes (Schmidt, 1991). It is also maintained by researchers (Malina *et al.*, 2004) that race, ethnicity or the population group the individual belongs to, influences growth and development. Cameron and Kgampe (1993) also report that if the purpose of a comparison is to monitor the health status of a child compared to his peers, a local or national chart will provide a more sensitive assessment compared to an international norm. The same argument is true from a sport talent perspective. Studies (Du Randt, 2000; Abbot & Collins, 2002) confirmed that the Australian TID norms cannot be applied directly to South African or Scottish children, while differences were also found in a comparison of the talent-search variables of a sample of 12-15 year old Australian, South African and North West Province (NWP) boys (Viljoen *et al.*, 2004). Thus the aim of this study was to determine how boys, from different racial groups, who live in the NWP of South Africa, develop with regard to their anthropometrical characteristics, physical and motor abilities between the ages 10 to 15 years. A further aim was to determine and describe possible unique growth patterns among and unique to their anthropometrical, physical and motor abilities from a TID perspective.

METHODS

Participants

Boys (N=604) between the ages of 10 to 15 years, living in the NWP of South Africa, served as subjects in the study. Ethical approval (no. 00M07) for the study was obtained from the Ethics Committee of the NWU, and each subjects' parents signed a consent form before the child could participate in the study.

A stratified random sample, compiled by a biostatistician from the North-West University (NWU), was used to obtain the data for this cross-sectional study. To determine the sample, a list of all the schools in the NWP was obtained from the Department of Education. All these schools are grouped into 12 school districts with every district representing 4-7 regions, with approximately 20 schools (minimum 14, maximum 47) in each of the regions. Regions and schools were then randomly selected according to population density, after which the subjects were randomly selected from every school. Hence the participants in this study can be considered a proportional representation of the boys of different racial groups living in the NWP of South Africa. The research sample included 44 schools and the group composition from the various primary and high schools is indicated in Table 1.

TABLE 1. **SAMPLE SIZE (N), AGE AND RACIAL DISTRIBUTION OF THE GROUP**

	Mean age		Primary schools			Secondary schools			Sample size
	M	SD	10yr	11yr	12yr	13yr	14yr	15yr	10-15 years
Black	12.41	1.67	58	83	106	55	54	74	430
White	12.55	1.76	16	15	17	16	16	19	99
Coloured	11.76	1.59	8	10	7	4	5	2	36
Indian	12.35	1.46	6	6	6	11	8	2	39
Age group totals (n)	12.38	1.67	88	114	136	86	83	97	604

M= mean; SD= Standard deviation

Black, Coloured (a mixture of white and black groups) and to a lesser extent Indian boys (ancestry mainly from India), came from predominantly disadvantaged communities. Many of the participants included in this study live in remote (rural) areas and no or little knowledge is available concerning their growth and development, physical and motor abilities and their potential for sport. Testing conditions were not always optimal (e.g. uneven and sand surfaces) and could have played a role in the results.

Measuring instruments

The protocol used for the study was based on the Sport Search Program which is used in Australia for the identification of sports talent (Australian Sports Commission, 1995) among children 12 years and older. This protocol includes 10 tests determining four anthropometrical and six physical and motor abilities. The anthropometrical measurements for stature, body mass, relative sitting height and arm span were obtained using standard measuring procedures as described in the Australian manual (Australian Sports Commission, 1995). Sitting height is expressed as a percentage of total height. The physical and motor tests included in this protocol are the bleep, basketball throw, 40 meter sprint, 5 meter agility, vertical jump and a throw and catch for accuracy. The bleep test is a 20 meter multi-stage shuttle run with a progressive increase in pace, expressed as the number of shuttles and levels completed. The basketball throw from the chest is executed from a sitting position against a wall, and the better of two attempts is recorded. The 40 meter sprint test is executed from a standing position and the better of two attempts is recorded in seconds. The vertical jump test is performed against a wall, subtracting jumping height from reaching height. Two attempts are allowed and the best jump is recorded in centimetres. The 5 meter agility test consists of two markers that are placed 5 meter apart. The subject must complete five concecutive runs between the markers. The best time of the two attempts is recorded in seconds. The throw-and-catch task for accuracy consists of 10 underhand throws for each hand. Subjects (13-15

years) had to hit a 30 cm diameter round target against a wall, which is placed 2.5 meters away from the starting line. The Australian protocol was not designed for children younger than 12 years, therefore a pilot study was conducted and also taking the recommendations of another study (Abbot & Collins, 2002) into consideration, the distance from the target was adjusted to 1.5 meters for the 10-12 year old subjects in this study.

To obtain a more comprehensive profile of the developmental and performance status of the physical abilities of boys, four additional physical ability tests were added to the testing protocol. These tests included the seven-level sit-up test (abdominal strength) (Ellis *et al.*, 1998), hand grip strength test of the right hand (forearm and hand muscle strength) (Kirby, 1991), pull-ups (dynamic upper body strength and endurance) (Kirby, 1991) and the modified sit-and-reach test (flexibility) (Kirby, 1991). The seven level sit up test is performed in seven levels from easy to difficult (different arm positions) and a 2.5 and 5kg weight are added in levels 6 and 7 respectively. The number of levels (0-7) completed are recorded. A sucessfull pull-up was recorded when the subject pulled himself up from a straight arm hanging position to where the chin is above the bar. Grip strength was measured by the Lafayette-hand grip dynamometer held parallel with the leg and squeezed as hard as possible with the right hand, and recorded in kilograms (kg). In the modified sit-and-reach test the subject had to sit upstraight against a wall with both feet against a standard sit-and-reach box with straight arms, hands on top of each other on the measuring box. Without bending forward, the distance to the tip of his fingertips is recorded in centimeters. The subject then had to reach forward as far as possible and hold this position for three seconds without bending the knees. The difference between the two measurements is recorded.

All tests were administered during school hours. Sufficient rest was allowed between tests, and the bleep test was performed at the end of the testing procedure in small groups. Participants were familiarized with the test procedures and encouraged to do their best.

Statistical procedure

The Statistica computer processing package (Statsoft, 2007) was used to analyze the data. For descriptive purposes, increments between means of the different age groups were calculated to determine age group differences. Analyses of variance (ANOVA) and a Tukey post-hoc analysis were used to determine the statistical significance ($p<0.05$) within and between groups (Thomas & Nelson, 1996), whilst effect sizes (ES) were calculated to indicate practical significance of differences between groups (ES>0.8 indicates high practical significance. A two way ANOVA was used to construct graphs with race and age as main effects.

RESULTS

The results are discussed by *age group* and the biological variation among and unique to the four racial groups is highlighted. Analysis of within and between group effects (see Figures 1-3) indicates relatively large variation in the Coloured and Indian groups who represent relatively small numbers of participants, therefore discussion of racial effects will mainly focus on the results of the white and black groups. SD_w indicates the variability of the measurements within each race group within each age level.

Figures 1a-d and Table 2 display the cross-sectional analysis of the data for the anthropometric characteristics of the *group* (age group means for stature, body mass, relative sitting height and arm span) and in each of the racial groups separately. A gradual increase ($p<0.05$, ES>0.8) in *age group means* for stature (135.05 cm – 162.8 cm) are indicated between 10 and 15 years. The largest significant age group increase (6.60 cm) was seen between 12 and 13 years, with a similar increase ($p<0.05$) up until 15 years of age.

TABLE 2. **MEANS AND STANDARD DEVIATIONS (SD) FOR THE GROUP AND SIGNIFICANE OF AGE GROUP DIFFERENCES**

VARIABLES	10yrs		11yrs		12yrs		13yrs		14yrs		15yrs	
	M	SD	*M*	SD	*M*	SD	*M*	SD	*M*	SD	*M*	SD
Body stature (cm)	135.0	7.5	139.2♦	8.3	144♣	8.1	150.6♠	9.8	156.7 +	10.9	162.8#	9.5
Body mass (kg)	29.3	7.2	31.2	6.2	35.0♣	9.2	39.1♠	9.3	44.5 +	10.9	49.4#	11.5
Rel.sitting height (%)	51.0	2.0	50.4	2.1	50.0	2.1	49.9	1.7	50.0	2.6	50.0	1.8
Arm span (cm)	135.8	7.7	140.6♦	9.1	145.6♣	9.7	151.5♠	8.0	158.6 +	10.7	166.4#	10.9
Abdominal strength (n)	2.6	1.8	2.5	1.7	2.8	1.7	3.5	1.6	4.2	1.5	4.0	1.9
Hand grip strength (kg)	16.7	3.7	18.2	3.3	19.9	3.8	23.3♠	5.6	27.1 +	6.9	32.0#	7.7
Pull- ups (n)	2.2	2.5	2.0	2.0	1.5	1.9	2.1	2.3	3.2	3.2	4.4#	3.4
Flexibility (cm)	25.4	6.0	26.5	5.8	26.4	7.6	27.9	6.1	27.9	7.7	31.5#	7.3
Shuttles (n)	40.8	17.5	45.1	15.4	45.8	19.3	50.3	18.5	55.3	18.3	60.0	15.9
Basketball throw (m)	3.4	0.9	3.4	0.7	3.8	0.9	4.5♠	1.1	5.1 +	1.3	5.8#	1.5
Throw for accuracy (n)	10.5	4.6	11.7	4.9	13.1	4.4	9.0*	4.7	9.6	4.2	10.5	4.1
40m dash (sec)	7.7	0.9	7.8	1.2	7.7	0.7	7.4	0.7	7.2	0.8	7.0	0.8
5m agility (sec)	22.3	2.3	22.8	2.2	22.1	2.1	21.9	2.3	20.9 +	2.0	21.2	2.1
Vertical jump (cm)	23.3	5.8	23.2	7.7	23.8	5.2	26.1	5.5	29.4 +	8.5	31.6*	7.8

Statistical ($p< 0.05$) and practical significant differences (ES>0.8); ♦ = 10-11 yrs: ♣= 11-12 yrs; ♠ = 12-13 yrs; += 13-14 yrs; # = 14-15 yrs; Statistical significance= *($p<0.05$); rel. = relative

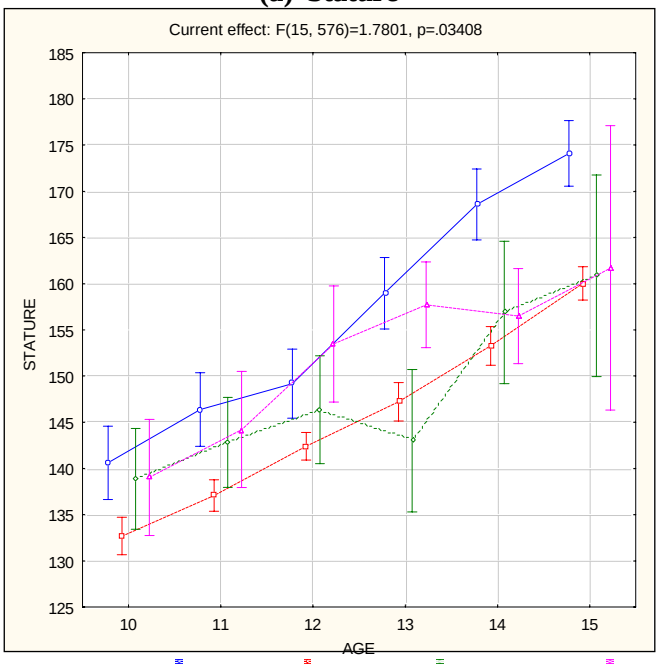
TABLE 3. **SIGNIFICANCE OF AGE GROUP MEAN DIFFERENCES BETWEEN WHITE AND BLACK BOYS**

VARIABLES		10yrs		11yrs		12yrs		13yrs		14yrs		15yrs	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Body stature (cm)	W	140.6*	4.9	146.4*	6.4	149.2*	8.2	158.9*	9.5	168.6*	8.8	174.1*	7.0
	B	132.7	6.3	137.1	7.6	142.4	7.4	147.2	7.9	153.3	9.7	160.0	8.1
Body mass (kg)	W	35.2*	10.5	38.0*	10.2	42.8*	9.9	49.4*	11.2	55.5*	12.4	60.4*	9.1
	B	27.9	5.6	29.8	4.3	32.9	6.4	35.9	6.9	41.9	9.3	46.6	10.6
Rel. sitting height (%)	W	51.9*	2.1	50.9	2.1	51.4*	2.5	50.7*	1.6	50.4	1.5	50.9*	1.88
	B	50.8	1.8	50.3	2.1	49.7	1.9	49.7	1.8	49.7	3.0	49.8	1.7
Arm span (cm)	W	137.9	7.2	145.8*	5.6	150.3*	8.1	156.6*	10.8	168.5*	7.5	175.9*	7.9
	B	133.8	6.5	138.2	8.4	143.6	8.7	149.2	9.2	156.2	10.6	164.5	10.7
Abdominal strength (n)	W	3.8*	1.7	4.0*	1.4	4.2*	1.9	4.3*	1.5	5.6*	0.8	5.2*	1.9
	B	1.9	1.6	2.2	1.6	2.7	1.6	3.2	1.6	3.9	1.4	3.7	1.7
Grip strength (kg)	W	20.0*	3.0	20.9*	2.9	22.1*	3.5	28.3*	6.3	34.3*	6.7	41.0*	4.4
	B	15.9	3.8	17.6	2.8	19.4	3.6	21.9	4.5	24.9	5.2	30.0	6.6
Pull- ups (n)	W	3.8*	2.9	3.5*	1.7	2.3	1.9	3.6*	3.6	5.9*	3.2	7.8*	3.5
	B	1.9	2.4	1.8	1.9	1.4	1.6	1.8	1.9	2.0	2.4	3.6	2.8
Flexibility (cm)	W	25.3	6.9	23.5*	5.4	24.1	6.2	25.8*	6.5	25.2*	9.5	27.4*	7.4
	B	26.2	5.9	27.6	5.8	27.3	7.6	29.6	5.6	29.6	7.1	32.8	6.7
Shuttles (n)	W	42.1	18.7	53.5*	21.9	51.6	15.8	44.8	22.5	55.1	12.1	55.6	16.1
	B	39.2	15.6	42.9	15.3	45.1	19.0	46.7	17.5	48.2	17.1	55.1	19.5
Basketball throw (m)	W	4.7*	1.3	4.5*	0.9	5.5*	0.6	5.7*	1.2	6.8*	1.1*	7.8*	1.3*
	B	3.2	0.6	3.3	0.6	3.7	0.8	4.1	0.8	4.6	0.9	5.2	1.0
Throw for accuracy (n)	W	14.5*	3.8	13.3	4.7	15.3	3.6	9.8	5.0	12.6*	2.6	12.7*	3.7
	B	9.9	4.4	11.5	4.9	12.9	4.4	9.2	4.9	8.6	4.2	9.9	4.2
40m dash (sec)	W	6.5*	0.8	6.8*	0.3	6.9*	0.5	6.6*	0.7	6.5*	0.7*	6.3*	0.5
	B	7.8	0.8	7.9	1.3	7.7	0.7	7.5	0.7	7.4	0.7	7.2	0.7
5m agility (sec)	W	20.3*	1.8	21.5	0.9	20.4*	1.9	21.1	2.4	19.3*	1.8	20.2*	2.0
	B	22.3	2.2	22.9	2.2	22.3	2.1	22.2	2.4	21.3	1.8	21.4	2.0
Vertical jump (cm)	W	30.8*	6.2	25.3	4.5	29.1*	2.1	27.9	6.8	37.9*	8.7	38.7*	5.5
	B	22.2	4.9	23.0	7.9	23.3	5.1	25.3	5.2	26.2	5.8	29.6	7.2

*Significant difference between white (W) and black boys (B), $p<0.05$

Height at 15 years was 174.1 cm (white), 160.0 cm (black), 160.8 cm (Coloured) and 161.7 cm (Indian) (Table 3 and Fig. 1a). A 33.48 cm gain in stature where found among the white boys over the period from 10 to 15 years, compared to 27.36 cm (black), 21.97 (Coloured) and 22.69 cm (Indian). White boys displayed the largest age group means for stature (158.9, 168.6, 174.1), body mass (49.4, 55.5, 60.4) and arm span (156.6, 168.5, 175.9) from the age of 13 years (Table 3) and a largest significant maximal growth difference in stature (9.78 cm) was evident between the 12 and 13 year old groups with another big difference between the 13 and 14 year olds (9.61 cm). With the exception of the 13 year old Coloured boys, the black children were the shortest in all the age groups, and the largest significant maximal growth difference in stature (6.76 cm) was found between the 14 year and 15 old groups. They also displayed significantly lower stature values compared to the white boys in all age groups (Table 3). Age group increases were observed between 13 and 15 years (143.0, 156.87, 160.85) of age in the Coloured group (Fig. 1a), although none of these differences were significant. A lower age group mean for stature among 13 year old Coloured boys (143 cm), compared to 12 year olds (146 cm) is seen, although this could be a result of the cohort effect. Among the Indian group, the biggest age group difference was found between the 11 (144.21) and 12 year (153.46) old boys.

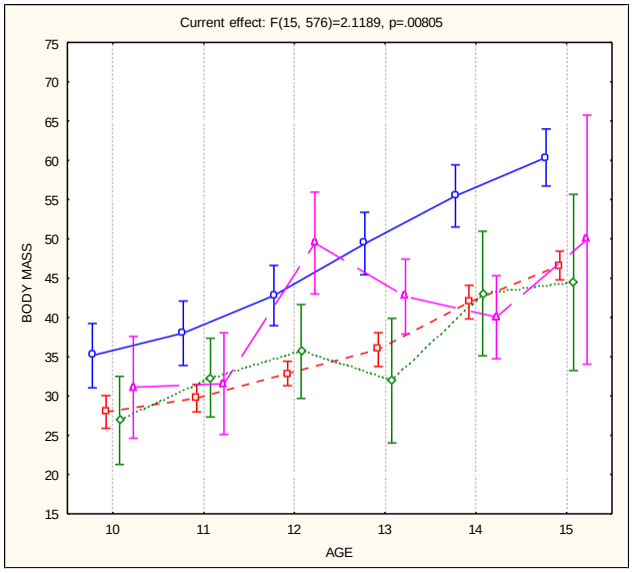
(a) Stature



a. $SD_w = 7.87$ White; Black; Coloured; Indian

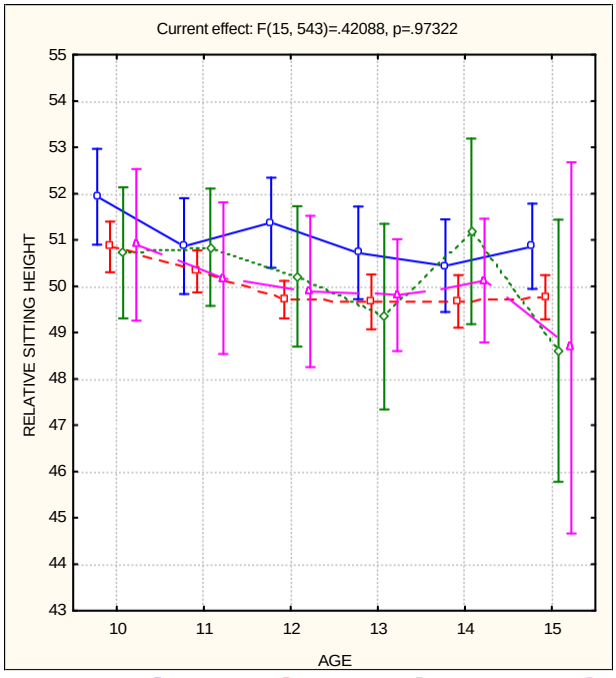
FIGURE 1a-d. **THE RACE BY AGE INTERACTION OF THE ANTHROPOMETRICAL CHARACTERISTICS; SD_w ROOT MEAN SQUARE FROM ANOVA**

(b) Body mass



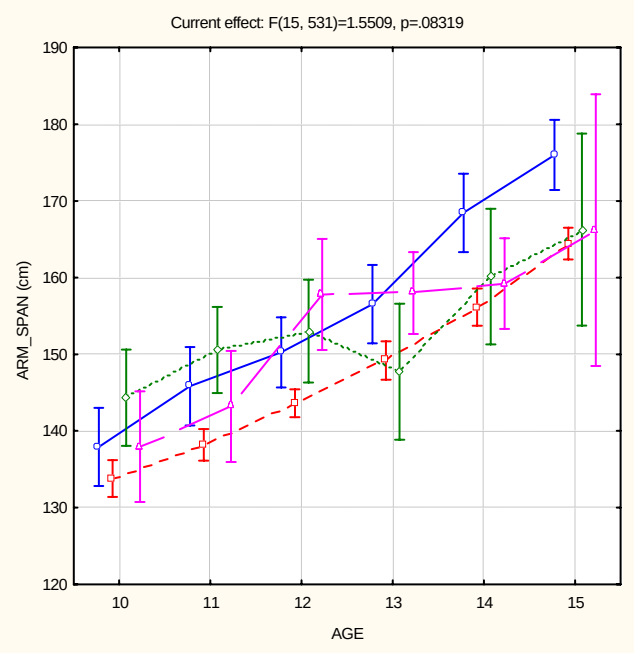
b. SD_w = 8.09 White; Black; Coloured; Indian

(c) Relative sitting height



c. SD_w = 2.05 White; Black; Coloured; Indian

(d) Arm span



d. SD_w = 9.0 White; Black; Coloured; Indian

Regarding body mass (Figure 1b), age group differences contributed to increases from 29-49 kg in the *group* up until 15 years of age, with the increases from 11 to 15 years (31.2, 35.0, 39.1, 44.5, 49.4) being significant ($p<0.05$, ES>0.8; Table 2). The largest age group difference (5.37 kg, $p<0.05$) was found between 13 and 14 years, and occurred after a largest increase in age group means for stature. Figure 1b shows that the body mass of the white boys was higher compared to the other racial groups, and significantly higher than the black group in all the age groups (Table 3). Figure 1b further indicates that the body mass increase in the white, black and Coloured boys between ages 14 and 15 years were less than earlier.

Sitting height (Figure 1c) made up 51.0% of the total stature at 10 years of age; a percentage gradually decreasing up until 12 years (50.0%), and thereafter showing a levelling off tendency to 15 years (50.0%). No significant age *group* differences were found with regard to a change in the relative sitting height percentage with increasing age. White boys displayed the highest relative sitting height of all the race groups with significantly higher values compared to black boys at the ages of 10, 12 13 and 15 years.

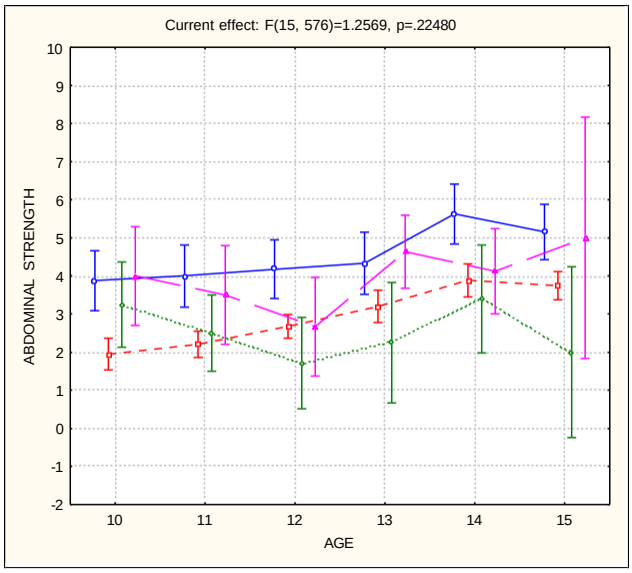
Arm span showed considerable, significant increases ($p<0.05$, ES>0.8) from 10 to 15 years in the *group* (Table 2, Figure 1d). These increases became larger from 13 to 14 years, with the largest difference (7.82 cm, $p<0.05$) seen between 14 and 15 years; approximately a year later than the largest increase in age group means for stature. In the different racial groups, the largest age group differences in arm span were seen for both white (11.89 cm) and Coloured boys (12.4 cm) between ages 13 and 14 years. This difference of 11.88 cm among the 13 and

14 year old white boys was statistically significant ($p<0.05$). Among the black boys, the largest differences in arm span (8.28 cm, $p<0.05$) was seen between 14-15 years, and among the Indian boys (14.58 cm, $p>0.05$) between the 11-12 year old groups. The maximal increase in arm span of the white boys occurred approximately a year later than an observed maximal increase in stature (12-13 years, 9.77 cm), while the maximal stature and arm span increases occurred in the same year for the other racial groups. Compared to the white boys and to a lesser extent the Indian boys, the black and Coloured boys had relatively longer arms in relation to their body stature. The arm span means of the black boys in all the age groups indicated longer lengths compared to their average height, while such a tendency was only seen among the 15 year old white boys (table 3).

Age group differences were found in abdominal muscle strength, indicating gradual improvement until the age of 14 years (Figure 2a and Table 2) — a trend which was also apparent in both the white and black groups. At the age of 15, the *group*, as well as the whites, blacks and Coloureds, showed poorer age group means compared to the 14 year old group. The grip strength of the right hand showed gradual increases with significant increases from 12 year onwards (Figure 2b and Table 2).

The mean number of pull-ups increased from 1.54 to 2.2 ($p<0.05$) in 10 to13 year olds, to 3.20 and 4.42 in the 14 to 15 year old *groups* ($p<0.05$, Figure 2c). This increase in dynamic upper body strength among 14 and 15 year olds also coincides with the period of immense weight gain in this group (Figure 1b). The highest age group means for pull-ups was found in the group of white boys (M = 3.81 at 10 years; M = 7.79 at 15 years), whilst these values varied between the other racial groups, namely from 0.69 (10 year old Indian boys) to 4.40 (14 year old Coloured boys). Significant differences were found between white and black boys (white boys superior) in abdominal strength, grip strength and upper body strength (pull ups) in all the age groups except for pull ups among the 12 year old group (see Table 3).

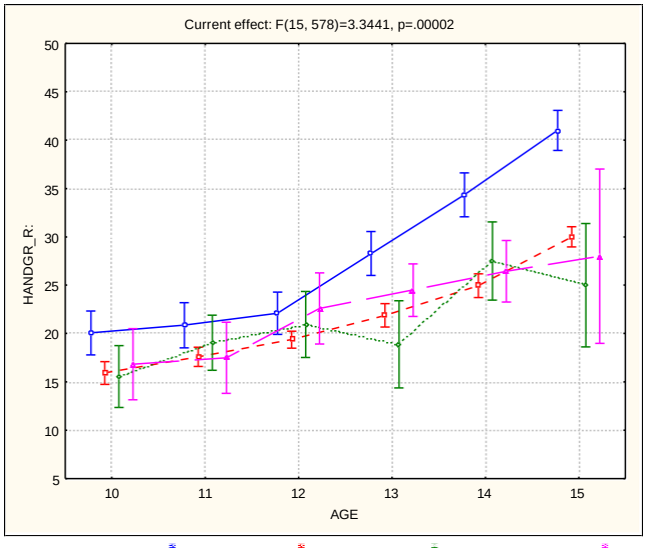
(a) Abdominal strength



a. SD_w= 1.60 White; Black; Coloured; Indian

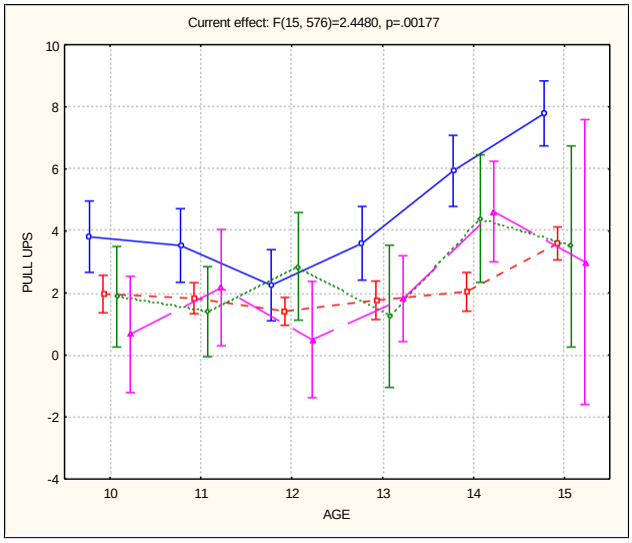
FIGURE 2a-e. **THE RACE BY AGE INTERACTION OF THE MOTOR ABILITIES; SD_w ROOT MEAN SQUARE ERROR FROM ANOVA**

(b) Grip strength R



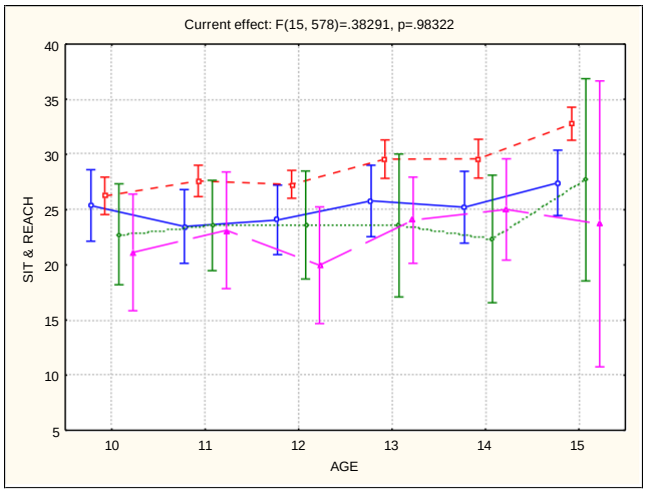
b. SD_w = 4.59 White; Black; Coloured; Indian

(c) Pull ups



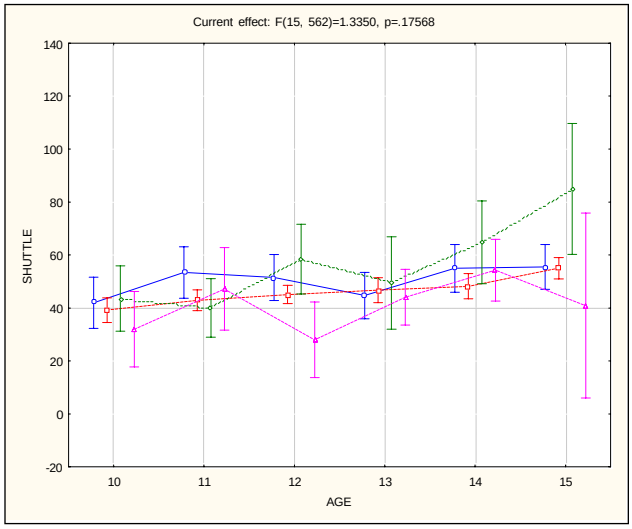
c SD_w = 2.33 White; Black; Coloured; Indian

(d) Sit and reach



d SD_w = 6.59 White; Black; Coloured; Indian

(e) Bleep



e. SD_w = 17.77 White; Black; Coloured; Indian

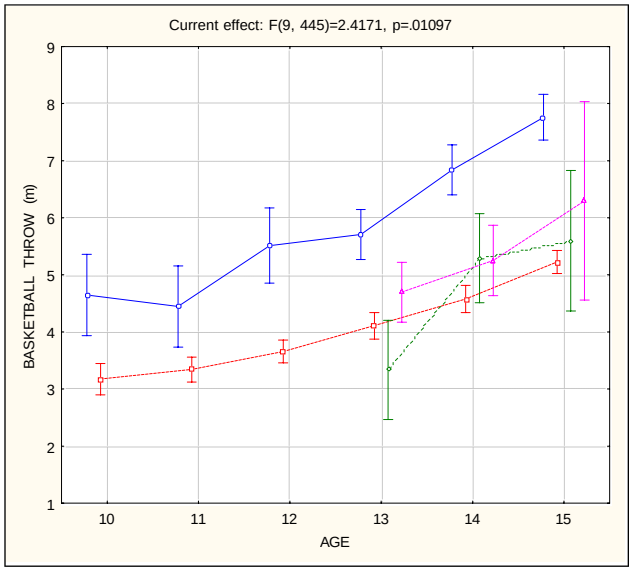
Age group differences in flexibility values between 10 and 15 years indicate an increasing trend in the flexibility of the pelvic girdle and thigh muscle (Figure 2d), with a significant difference among the 14-15 year old age *groups* (Table 2). The results (Figure 1c) regarding relative sitting height indicated considerable leg length increases until the age of 12 years, after which it stabilised. This could have influenced relative sitting height and possibly have contributed to the notably better flexibility of the older age groups. Black boys displayed higher flexibility values compared to white boys in all the age groups which were significant in the 11 year and 13 to 15 year old groups (Table 3).

Constant, although non-significant, increases in aerobic endurance are observed for the *group* (Figure 2e), with a significant increase among the 13-15 year old groups (Table 2 and Figure 2e). Parallel to this a maximal stature increase occurred between the ages of 12 and 14 years in the group (Figure 1a). Maximal stature increases were slightly different in each racial group, although the increases in VO_2-max relative to stature increases were similar. Although the white boys had higher mean age group values than the black boys, no significant differences were indicated between the two groups, except for in the 11 year old group (Table 3).

Figure 3a-e represents the age *group* differences in the motor abilities of the boys. Figure 3a and Table 2 show that the age group means for explosive arm strength of the group, as measured by the basketball throw, constantly, but non-significantly, improved between 10 and 12 years of age. From 13 to 15 years of age the improvement is significant and runs parallel to maximal stature increase, body mass acceleration and an increase in arm span. When all the age groups' means are compared, results indicate that white boys have the best explosive arm strength which was also significantly higher than that of the black boys.

The throw and catch for accuracy of the *group* (Figure 3b) increased gradually between 10 and 12 years. The mean for the 13 year old age group was significantly poorer compared to the 12 year old mean ($p<0.05$), although slight, but non-significant, increases ($p>0.05$) were evident from 13 to 15 years. The test for accuracy was adjusted for the 10–12 year olds by allowing them to stand slightly closer (1.5 m) to the target than the 13–15 year olds (2.5 m) which could possibly explain the lower age group means at 13 years. However, the throwing skills for distance improved at a constant rate from 13 years onwards.

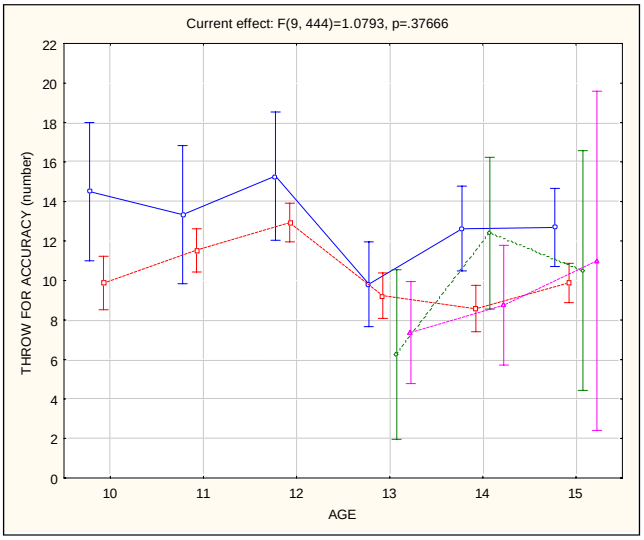
(a) Basketball throw



a. $SD_w = 0.88$ White; Black; Coloured; Indian

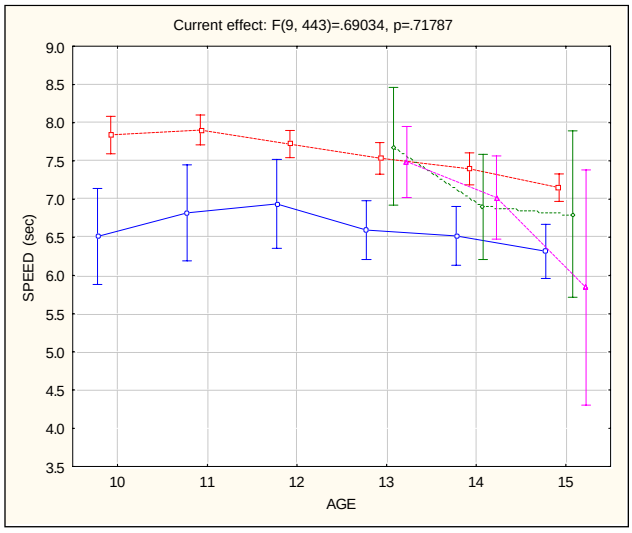
FIGURE 3a-e. **THE RACE BY AGE INTERACTION OF THE PHYSICAL ABILITIES; SD_w ROOT MEAN SQUARE ERROR FROM ANOVA**

(b) Throw and catch



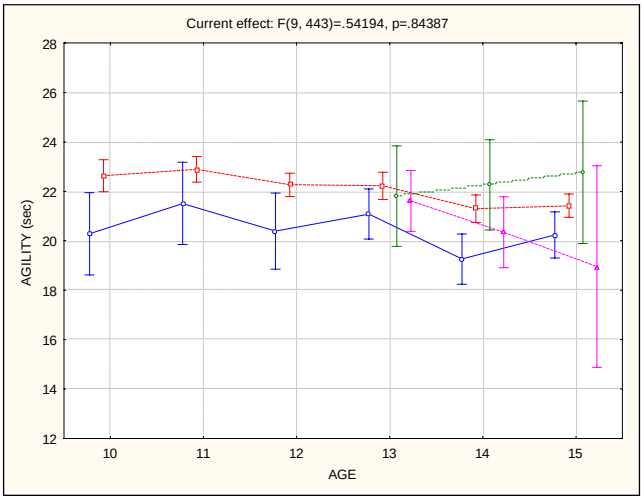
b. SD_w =4.36 White; Black; Coloured; Indian

(c) Speed



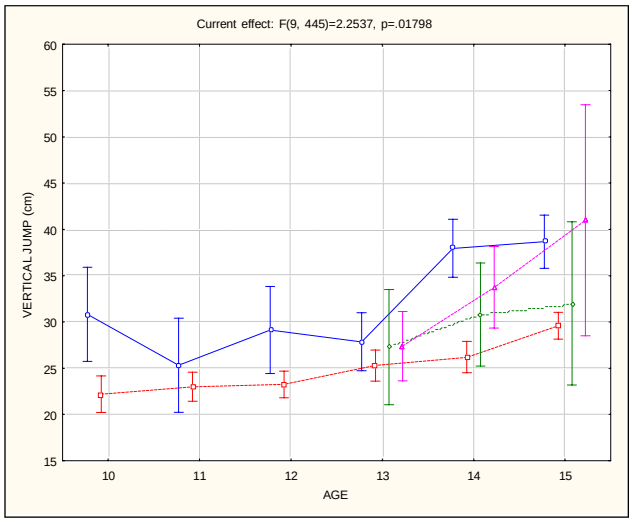
c. SD_w = 0.78 White; Black; Coloured; Indian

(d) Agility



d. SD_w =20.7 White; Black; Coloured; Indian

(e) Explosive strength



e. SD_w = 6.35 White; Black; Coloured; Indian

Age *group* means for speed (Figure 3c) showed a gradual increase ($p>0.05$, Table 2) from 11 to 15 years of age. Slightly lower speed values were recorded for the 11 year olds, compared to the 10 year olds (7.67 sec to 7.81 sec). In general, the white boys tested best for speed and the black boy's worst with a significant difference between them in all the age groups. The Indian boys showed the best times over 40 meters at the age of 15 years, which is in agreement with their results in the vertical jump where they also achieved the highest age

group mean. Similar to speed, agility (Figure 3d) showed a decline between 10 and 11 years of age, after which a gradual (non-significant) improvement in mean scores up until 14 years was observed. Between ages 10 and 14 years, the white boys performed best, and the Indian boys at 15 years. The black boys, as with speed, had the weakest results, and they displayed significantly lower values than the white boys in three age groups.

The explosive leg strength of the *group*, tested by means of the vertical jump, hardly showed any changes between 10 and 12 years, with a gradual increase occurring between 12 and 15 years (Figure 3d). The white boys predominantly performed best, with the Indian boys performing best at 15 years. Differences favouring the white boys compared to the black boys were significant in 3 age groups, especially in the older groups (Table 3).

DISCUSSION

Researchers (Malina *et al.,* 1988) compared different studies and reported that age at Peak Height Velocity (PHV) occurs at approximately 14.2 years (13.7-14.3) in boys. Although speculative in nature as PHV cannot be determined from cross sectional data, it seems approximately two years later than what can be considered as a PHV in the NWP group (12-13 years). Furthermore, researchers (Malina *et al.,* 1988; Malina *et al.,* 2004) estimate PHV in stature to be around 9 cm/year for boys (8.2-10.3), although evidence of such a magnitude (6.60 cm) was well below in the NWP sample. This result can possibly be explained by the fact that each racial group achieved their largest increase in stature at different ages, a trend which was observed in Figure 1a. In confirmation to this, delayed adolescence in rural and urban black children as well as a reduced magnitude in peak velocity among them are reported (Cameron & Kgampe, 1993). A possible cohort effect should however, also be kept in mind when interpreting this result.

A study on predominantly white boys in the Durbanville area (Visagie, 1981) showed clear age group differences in stature between 10 and 11 years (7.9 cm), and the largest differences (11.2 cm) between 13 and 14 years. This researcher also indicates that the difference in stature between 14 and 15 year olds decreased to only 2.9 cm, which is in agreement with similar tendencies (5.53 cm) found in this study among the white boys. Compared to a study done on Belgian boys (Beunen *et al.,* 1988) the white boys in the NWP showed a much earlier accelerated growth in stature than that of the Belgian boys, whose accelerated growth phase was between ages 14 and 15 years (7.8 cm). The average stature of the 15 year old Belgian boys is also 8.9 cm shorter (Beunen *et al.,* 1988) than that of the 15 year old white boys. Also, rapid growth in stature of white boys in the NWP was earlier than what was reported twenty years earlier in another region of South Africa (Visagie, 1981).

The black children were the shortest in all the age groups. A comparison with the results obtained on black children living in South Africa (Hennenberg & Louw, 1998) revealed that the measurements of urban Coloured group greatly exceed that of the black group, with similar or slightly higher measurements than those of the rural black children. The results are also in agreement with findings indicating that black children from rural areas are shorter than those living in urban areas (Monyeki, 2000).

Non significant age group increases in stature were observed between 13 and 15 years of age among Coloured boys. A lower age group mean among 13 year olds (143 cm), compared to 12 year olds (146 cm) was seen, which could be a result of a cohort effect. However, a cross-sectional analysis of mixed longitudinal data (Hennenberg & Louw, 1998) also indicated longer heights among 18 year old compared to 19 year old Coloured boys. The heights reported by them for Cape Coloured boys between 10 and 15 years indicated maximum increases between 11 and 14 years and an overall increase of 136.4 to 163.8 (27.1 cm) in the group with higher socio-economic status (SES). In the lower SES group, the increase was only 24.9 cm (127.5 to 152.4 cm) and maximum increases were observed between 13 and 15 years.

The body mass increases of the boys in the NWP tend to be similar to findings by other researchers (Beunen *et al.,* 1988; Van Rooyen, 1993). However, the size of the increase was smaller for the NWP boys. This smaller increase might be explained by findings where the body weight of rural Coloured children was 20%-25% lower than that of their urban peers during pre-puberty and puberty (Hennenberg & Louw, 1998). The largest increase in body mass occurred after a largest increase in stature which is similar to other research findings (Siedentop *et al.,* 1984; Beunen & Malina, 1996).

The long arm span relative to total height of the black children corresponds to findings indicating that black people have long extremities, and that longer forearms contribute to this tendency (Malina, 1996). The results obtained for relative sitting height agreed with that of researchers (Malina *et al.,* 2004) who found that accelerated growth of the lower limbs is a characteristic of the early adolescent acceleration growth phase. Hence the growth rate may be slower in early adolescence for sitting height relative to that of the lower limbs. A similar tendency [(51.38% (10 yrs), 51% (11 yrs), 50.58% (12 yrs), 50.99% (13 yrs), 50.74% (14 yrs) and 50.53% (15 yrs)] was reported in another study (Visagie, 1981).

Increased abdominal strength was seen up until 14 years, while poorer age group means were found in the group, as well as among the whites, blacks and Coloureds at age 15, compared to at age 14. This tendency can possibly be ascribed to well-documented decreases in activity levels at this age among children (Malina *et al.,* 2004). It is however stated (Hennenberg *et al.,* 2001) that factors which can be attributed to socio-economic conditions, such as a lack of energy levels and mineral content (calcium and potassium) of the muscles, can have an influence on muscle strength. Gradual increases were found in the grip strength of the right hand from 10 to 15 years of age ($p<0.05$) which is in agreement with the findings of this researchers (Hennenberg *et al.,* 2001). These increases can also possibly ascribed to the fact that boys of this age rapidly become taller and heavier, especially if one considers that there is a relation between muscle mass and body mass during the different growth phases (Rowland, 1996). Upper body strength also increased gradually from 10 years onwards. Researchers (Beunen *et al.,* 1988; Malina *et al.,* 2004) indicate that increases in strength, especially in the upper limbs, run parallel to an increase in body mass for boys. Furthermore, it is indicated that strength increases linearly with age, while peak strength is attained 0.5–12 months later than peak height velocity (Beunen *et al.,* 1988). The same trend of a gradually increasing flexibility was also seen in the group, with a significant increase among the older boys. In line with this finding, researchers (Malina *et al.,* 2004) report that when flexibility is measured by means of the sit and reach test, it linearly increases from a low point at 12 to 13

years up until 18 years of age. Furthermore, this low point coincides with the adolescent growth phase of the lower extremities. From this it can be concluded that when the skeletal and muscle systems become more stable, the flexibility of the child will improve as a result of the muscles that grow in proportion to the bone. The results regarding relative sitting height (Figure 1c) indicated considerable leg length increases until the age of 12 years, after which it stabilised, which could have influenced relative sitting height and possibly have contributed to the notably better flexibility of the older age groups.

Constant increases in aerobic endurance were observed which was significant among the 13-15 year old groups. It is confirmed by researchers (Malina *et al.,* 2004), that aerobic endurance shows a linear increase until 16 years of age, after which it drastically increases. These researchers also state that boys clearly show a peak in VO_2-max values in the same period during which peak stature and body mass acceleration occur. A maximal stature increase occurred between the ages of 12 and 14 years in the group (Figure 1a) and a similar tendency of increased aerobic endurance among the 13-15 year old groups is visible (Table 2 and Figure 2e). Maximal stature increases were slightly different in each racial group, although the increases in VO_2-max relative to stature increases were similar. From a TID perspective, it seems better to determine aerobic capacity for boys after the spurt in stature.

The throwing skills for accuracy improved at a constant rate from 13 years onwards. Ball handling skills of boys were studied by researchers (Brodie, 1985) and a similar tendency of improvement until puberty with a levelling off thereafter was found. Researchers (Arnot & Gaines, 1986) are also of the opinion that the environment in which a child grows up plays a significant role in motor abilities such as coordination. The white boys, who showed the best hand-eye co-ordination between ages 10 and 15 years, participate in sports such as rugby and cricket, and this exposure, might have contributed to the development of these skills. However, this is not the case with the other subjects in this study, as the majority of the children came from remote rural areas. Street soccer is played, but will probably contribute less to hand-eye coordination when compared with a sport such as cricket. Adjustment of the test for the 10–12 year olds by allowing them to stand slightly closer (1.5 m) to the target could possibly explain the lower age group means at the age of 13 years.

No spurt in speed improvement was found which is substantiated by other research findings (Malina *et al.,* 2004) indicating that running speed increases linearly in boys from five to seventeen years, without any indication of accelerated growth having an influence on running speed from a stationary position. Slightly lower speed values were recorded for the 11 year olds, compared to the 10 year olds. Physical awkwardness at this age (Malina *et al.,* 2004) or a possible cohort effect could have contributed to this result. Agility showed similar tendencies to what was found in speed. This result agrees with a statement that agility is influenced by dynamic strength, explosive power and the speed of the muscle fibre contractions (Badenhorst & Pienaar, 2000). Gradual improvement in explosive strength was seen from 12 year onwards. Researchers indicate that it is associated with an improvement in speed from 12 years of age (Arnot & Gaines, 1986).

The composition of the South African nation and those living in the NWP are unique because they represent four different racial groups. As a group, the growth rates appear to be in agreement with other studies. However, when growth was studied in each racial group,

unique differences appeared. These research findings can therefore be used as a reference base for future comparisons in order to ensure that the most talented children are identified for sport on the basis of a unique growth profile. Indian and white boys, for example, reached their accelerated growth phase early, compared to the black and Coloured boys who reached it much later. Therefore, where stature and body mass are important performance indicators at a later age, the interpretation of this race specific growth information for adult stature prediction must be taken into consideration.

South Africa also has an age based school competition system where chronological age and not maturational age are taken into consideration for selection purposes. The information obtained by this study can therefore be valuable for selectors. It is indicated in this regard that skeletal maturity is significantly related to several motor components at 13-16 years therefore performance advantages due to earlier skeletal maturity might be advantagous to the racial groups with earlier maturity. Early maturation can confound talent selection; therefore such problems can be addressed in a way with data of this nature.

Furthermore, other race specific characteristics were also seen which can be valuable in the TID and development process. A lower sitting height in relation to total body stature was found among the black boys and, similar to Coloured boys, they had a long arm span in relation to their body stature, characteristics which make them more suited for specific sports where a long arm span is an advantage. The white boys showed good strength, speed and agility characteristics, while black boys displayed a high degree of flexibility, and especially endurance characteristics which might be promising from a talent development perspective. Indian boys posessed good explosive and agility characteristics, while Coloured boys had reasonably good endurance and explosive power in their arms.

CONCLUSION

The results of this study were gathered by means of a cross-sectional method, therefore certain limitations are evident. It thus should be taken into consideration that the results do not reflect age related changes, but rather age group differences and tendencies with regard to growth of body dimensions and physical and motor abilities of boys. Possible cohort effects were also seen among certain racial groups which could have been caused by socio-economic circumstances, and which could have clouded the results. The different racial groups were also proportionally represented in the sample, contributing to small numbers of certain groups in certain age groups. However, this study contains valuable information regarding the growth, maturity and performance status of 10-15 year old boys who live in the NWP of South Africa. This study also confirmed that uniqueness within a nation consisting of diverse population groups may occur. It must, however, be kept in mind that the performance of especially the black and Coloured children in this study could have been hampered by poor nutrition and other factors resulting from the rural environments in which most of them live. In addition, testing conditions were not always optimal (e.g. uneven and sand surfaces) and could also have played a role in the results. It is therefore suggested that the norms for each racial group should be interpreted separately in some cases, but also in conjunction with the group norm in order to make a more transparent decision concerning the performance potential of a boy living in the NWP. Further similar studies in other provinces of South Africa and especially studies of a longitudinal nature are recommended in this area. In

conclusion, this study provides data regarding the growth of 10-15 year old boys in South Africa which might be helpful in selection decisions.

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MEASURING SUCCESS OF A WINE FESTIVAL: IS IT REALLY THAT SIMPLE?

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ABSTRACT

One of the country's largest wine festivals, the Wacky Wine Festival, is held annually in Robertson, South Africa. Forty-eight wine farms participate actively in the Robertson Valley that forms part of the wine route and festival, which makes this wine festival unique. This paper presents the results of a survey that was conducted during the festival in June 2009, where visitors completed 424 questionnaires. The questionnaire consisted of three sections, namely (A) socio-demographic information, (B) travel behaviour and (C) statements pertaining to the management aspects of the event. The aim was to conduct a management appraisal based on the premise that different markets have different requirements. To achieve this aim, a factor analysis and an ANOVA were used to determine the significance of each visitor group (market) in relation to the key success factors of the event. Cross-tabulation identified the visitors' factor scores for each key success factor, where the Anderson-Rubin method was used to generate a score with a zero mean. A contrast test was used where the significance did not assume equal variances. The findings indicated that different visitor groups or markets had different perceptions of the key success factors contributing to the success of the wine festival. The implication is that a general evaluation by visitors gives a distorted view of the success of the event, since different markets have different requirements.

Key words: Wacky Wine Festival; Management; Key success factors; Factor analysis; Wine tourism

INTRODUCTION

Wine tourism has emerged as a strong and growing area of special interest tourism and can be seen as an increasingly important component of the tourism product of most wine-producing countries and regions (Hoeksema, 2009). Tourism trends are changing and are fuelled by changes in the needs of tourists. Although some wineries have had meaningful results, the South African wine industry, in general, has not been too successful in fully optimising tourism opportunities (Loubser, 2004). The problem with wine tourism in South Africa, according to Loubser (2004), is that wine makers are interested in cellar door sales, whereas visitors are looking for a total experience, also referred to as a new experience. The total or new experience consists of a combination of interactions at the attractions, in restaurants, and with local people. It furthermore also includes an event programme that offers visitors a variety of entertainment and activities.

Additionally, wine tourism has grown rapidly in recent years as visitors search for the opportunity to experience wine products at the cellars (Getz, 2000). According to Hoeksema (2009), wineries combine their wine products with various other products to offer the new experience. Some wineries, for example Spier, Skilpadvlei and Fairview in the Western Cape, have moved away from producing and selling wine only. Their new approach entails, in the case of Spier, a wide variety of tourism products that include different restaurants, a five-star hotel, a hotel school, an amphitheatre (drama or opera), a country club and a cheetah park (Loubser, 2004). Fairview, on the other hand, combines food – especially cheeses and wine – while Skilpadvlei combines accommodation, a restaurant and wine tasting. These are just a few examples to indicate a change in the way business is conducted in the wine industry. Other wineries combine spas, game farms and conferencing to remain competitive. Hoeksema (2009) posits that the tourism industry, and therefore wine farms, can no longer afford to offer the ordinary, especially in a very competitive world. The latter has prompted the Robertson Valley to host a wine festival with a difference.

The Wacky Wine Festival at Robertson in the Western Cape is one of the country's largest wine festivals. The Festival started in 2004 with just 2 500 visitors and grew to 16 049 visitors by 2008 (Anon, 2009). This festival is unique in the sense that the festival takes place along the Robertson Wine Route. This Route shows the complexity of wine tourism as it consists of 48 wine farms, each producing their own wine and taking part in the wine festival. For the Festival, each wine farm hosts its own entertainment programme and all wine farms offer wine tasting. Most other wine festivals are held in a confined venue or location. Activities offered by the different wine farms, include food tasting, stalls selling arts and crafts, musical performances, bottling of the tourists' own wine, children's activities and even adventure activities, such as skydiving (Saayman & Krugell, 2010). In support of the latter, the number of activities has grown from 57 in 2004 to more than 600 in 2008 (Anon., 2009).

The Wacky Wine Festival takes place over a large geographical area involving and depending on many role-players (wineries) for its success. Hence the aim of this study is to conduct a management appraisal based on the premise that different markets have different requirements.

LITERATURE REVIEW

The tourism industry is an extremely competitive environment and includes the event and festival sectors. The competitive environment is created by an increase in tourism products (events) and markets. Additionally, visitors also expect quality services and attend festivals and attractions for different reasons (Kruger, 2009). In general, visitors visiting a festival want to meet new people, to socialise, to be interactive, to relax and to be entertained (Pissoort, 2007). In addition, the most basic goals of event and festival tourism are the creation of tourist attractions and the ability to generate travel demand and satisfy tourists' needs (such as escape, relaxation and curiosity). Therefore, event organisers need to take these aspects into consideration when hosting an event.

Most events have a selection of products or services, all of which are used to create an experience for the visitor (Bowdin *et al*., 2001). The hosting of a successful event such as a wine festival requires the effective and efficient management of various aspects that include

friendly and competent staff, adequate parking at wine farms, adequate information being available, an effective programme, high levels of hygiene, quality products and services, a variety of entertainment and activities and wine farms that are easily accessible (Saayman, 2006; Van der Westhuizen, 2003; De Witt, 2006). Kreitner (1989) defines management as the process of working through and with others to achieve organisational objectives in a changing environment. The goal of the Wacky Wine Festival is to position the event as South Africa's leading wine tourism event and to provide the visitors with a quality wine and lifestyle experience to increase wine sales and knowledge of the Robertson Valley (Anon., 2009).

The organisers of the Wacky Wine Festival must therefore focus on management skills to achieve the goal mentioned above. Key to the success of any event is the managers' or organising committees' ability to measure or evaluate (Cronje *et al*., 2004; Saayman, 2006). Evaluation or control is defined by Certo and Certo (2009) as ensuring that an event occurs as it was planned to occur. Reasons for evaluation are therefore to determine the success of the event based on the goals that have been achieved, ensure quality services, remain competitive, determine whether the visitors' needs are met and whether the event programme satisfies all role-players involved. Also to determine the overall satisfaction of the visitors, and whether there are gaps and how these gaps will be addressed (Van der Westhuizen, 2003; De Witt, 2006; Goodman *et al*., 2007; Daft & Marcic, 2009).

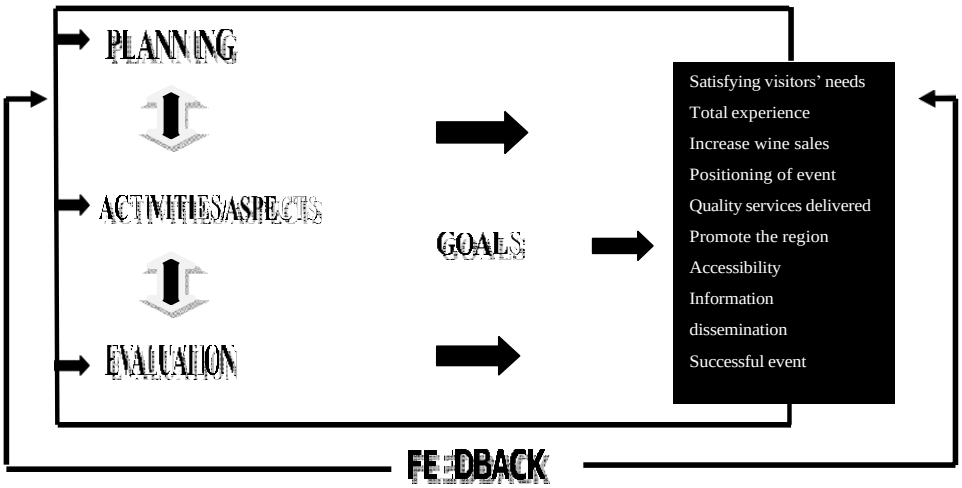

FIGURE 1. **RELATIONSHIP BETWEEN PLANNING AND EVALUATION**

Cronje *et al*. (2004) state that control (evaluation) is the final step in the management process. However, it is also seen as feedback for a new cycle of management activities and is therefore a very important part of the management cycle. Based on the relationship indicated in Figure 1, it is clear that managers' plans have to be evaluated based on their achievements (Saayman, 2006). The feedback from visitors is vital in determining the level of success as well as giving input to organising the following year's events. However, the literature review recognises that visitors differ in their needs, tastes, lifestyles, motives and requirements.

These aspects therefore have to be taken in consideration when determining the success of the event.

Slabbert (2002) stresses that tourists and visitors are becoming highly involved in making travel decisions based on the expectation of experiencing quality services. In this context, the author supports the notion that evaluation should be applied to better understand visitors. Information concerning visitors and their needs and requirements will help to determine target markets. Target markets usually include the identification and assessment of different tourist characteristics, such as demographics, geographic location, socio-economic factors and psychographic characteristics (Moutinho, 2000; Bloom, 2005). Attitudes have changed, and motivation research into festival attendance is now seen as invaluable to the success of the wine tourism industry, helping to provide event organisers with a better understanding of consumers' behaviour (Weiler *et al*., 2004). Therefore, each target market has its individual needs, expectations and requirements – which is the premise for this research. The reason for this is that most tourism products and events apply some form of survey to get feedback from visitors and tourists. Examples of this are to be found in all sectors of the tourism industry – in accommodation establishments, at filling stations, in restaurant and conference venues. The results, however, are seldom or never analysed based on the fact that while some visitors or tourists might be satisfied with one aspect of the event, others might differ significantly due to different requirements. Results in most cases are generalised, which could give a distorted view. It might even create a perception that all is well when, in fact, there may be serious management issues that need to be addressed concerning certain markets. To offer quality services and to remain competitive, it is important to ensure visitors' needs and requirements are catered for in an effective and efficient manner.

Various management studies have been conducted in event tourism. These include research by Getz (1997), Bowdin *et al.* (2001), Van der Westhuizen (2003), Shone and Parry (2004), Van der Wagen (2005), De Witt (2006), Kruger (2006), and Hoeksema (2009). These studies focused on management aspects that contribute to the success of an event and were done primarily from a supply side. If one does an analysis of research related to the managing of wine festivals, only a few were found (see Table 1).

The literature study revealed that although an array of studies was conducted in the wine industry, none addressed the issue of the success of events related to the wine industry. This study attempts to address this gap.

METHOD OF RESEARCH

Research design

Exploratory research was conducted by means of a structured questionnaire that was completed by visitors during the Wacky Wine Festival in the Robertson Valley. In total, 450 questionnaires were distributed over a period of four days (4 June 2009 - 7 June 2009) of which 424 were used for statistical analyses.

TABLE 1: **MANAGEMENT RESEARCH IN WINE TOURISM**

Hall	2000	Wine tourism around the world: development, management and markets
Weiler *et al.*	2004	Visitor profiles and motivations for visiting an Australian wine festival
Tassiopoulos, Nuntsu & Haydam	2004	Wine tourists in South Africa: A demographic and psychographic study
Alant & Bruwer	2004	Wine tourism behaviour in the context of a motivational framework for wine regions and cellar doors
Galloway, Mitchell, Getz, Crouch & Ong	2008	Sensation seeking and the prediction of attitudes and behaviours of wine tourists
Hall & Sharples	2008	Food and wine festivals and events around the world: development, management and markets
Hoeksema	2009	A marketing strategy for the Northern Free State Wine Route

Sampling method

Availability or convenience sampling was applied to determine the sample size (N=450). The survey comprised a self-administered questionnaire. According to Cooper and Emory (1995), for any population of 100 000 (N), the recommended sample size (S) is 384. Since a total of 16 000 visitors attended the Wacky Wine Festival in 2009 (Anon, 2009), the number of completed questionnaires (424) was found to be acceptable. In order to ensure that one gets 384 properly completed, it was decided to increase the survey to 450 questionnaires. The sample was distributed over the four days where 80 questionnaires were distributed on day one and this was gradually increased, since more visitors visited the festival over the weekend (Day 2: 100, Day 3: 120, Day 4: 150).

Questionnaire and survey

The questionnaire was based primarily on questions used by Van der Westhuizen (2003), De Witt (2006) and Kruger (2006). The questionnaire was divided into three sections, where Section A included the demographic profile of the wine visitor; Section B included questions about the travel behaviour of visitors. Section C consisted of key success factors for managing a festival. Both open-ended and closed-ended questions were used in the questionnaire. A five-point Likert scale was used where Totally disagree; 2= Partially Disagree; 3=Neutral; 4=Agree and 5=Totally agree.

The survey took place at several wine farms that formed part of the Festival. Fieldworkers distributed questionnaires based on the recommendation of the event organisers. The following wine farms were selected since more than 90% of visitors visit at least one of these wine farms. These are: Graham Beck, Bon Courage, Cloverfield and Van Loveren. The questionnaires were completed by the festival attendees themselves and did not contain any questions that could identify a specific respondent.

Data analysis

Data from 424 usable questionnaires were captured on Microsoft Excel. Statistical Package for the Social Sciences (SPSS) in full 16.0 (SPSS Inc, 2007) was used to analyse data. Two factor analyses were carried out to determine the key success factors and, to determine the three different markets or visitor groups attending the wine festival.

A cross-tabulation was done to determine the way that different markets or visitor groups rate the managerial aspects of the Festival in terms of agreement and disagreement. As mentioned above, the managerial aspects were identified by means of a factor analysis. Thereafter, an ANOVA was applied. An ANOVA, called an *F*-test, is closely related to the *t*-test. The major difference is that, where the *t*-test assesses the difference between the means of two groups, an ANOVA assesses the difference between the means of two or more groups. The purpose of an ANOVA is therefore to test whether there is a statistically significant difference in the population means of more than two groups (Eiselen *et al*., 2005). The ANOVA was carried out to determine whether there are significant differences between the different visitor groups and the key success factors. The contrast test also indicates whether there are significant differences between the different visitor groups. Results of the cross-tabulation, the ANOVA and the contrast test of the Wacky Wine Festival are given in the section below.

RESULTS

Profile of visitors

Results indicate that approximately 41% of visitors were male and 59% were female. Some 60% of the respondents were Afrikaans speaking and 38% were English speaking. The age distribution shows that 40% of the respondents are between 19 and 30 years of age and another 23% between 31 and 40 years of age. In terms of occupation, most of the respondents were either professionals (30%), in management (16%), self-employed (13%) or students (10%).

Approximately 12% of the visitors were residents of Robertson and the rest were from the Western Cape, followed by those from Gauteng and those from the Eastern Cape. Seven key success factors were identified from the factor analysis, namely quality and good management, wine farm attributes, effective marketing, route development, festival attractiveness, entertainment and activities and accessibility. The seven factors accounted for 64% of the total variance. All factors had relatively high mean values ranging between 3.81 (the lowest) and 4.22 (the highest). Moreover, all items loaded onto a factor with a loading greater than 0.3. The Cronbach values vary from 0.62 to 0.8, which is acceptable since they have a value higher than 0.5. The Cronbach value per factor is as follows:

Factor 1: Quality and good management (0.8720, Factor 2: Wine farm attributes (0.895), Factor 3: Effective marketing (0.846), Factor 4: Route development (0.871), Factor 5: Festival attractiveness (0.843), Factor 6: Entertainment and activities (0.623) and Factor 7: Accessibility (0.852).

An exploratory factor analysis was done on the motives visitors have for attending the Wacky Wine Festival. Three factors were found that allowed the identification of three types of visitor groups based on their reasons for attending the Wacky Wine Festival. The three groups (*festinos, epicureans and the social adventurers*) were identified. The '*festinos*' motive is a satisfying lifestyle with the experience of good wine. Their reasons for attending the Festival focus on the social elements, relaxing, spending time with friends, meeting new people and value of quality products. The '*epicureans*' are the connoisseurs who attend mainly for the wine and food offered at the Festival. The third visitor group identified is the

'*social adventurers*'. Their motives include spending time with family and benefits for children combined with the good food and wine (Saayman & Krugell, 2010:6). Their mean values are as follows: the *festinos* (1.576.05), the *epicureans* (1.661.85) and the *social adventurers* (1.204.14).

Table 2 presents a cross-tabulation of the three types of visitor groups and their views on the key success factors in the management of the Festival. To determine whether, for example, the *festinos* agree that wine farm attributes are a key success factor, the factor scores were recorded to a simple agree or disagree measure and cross-tabulated with the respondent's type category. The factor scores were calculated using the Anderson-Rubin method, which produces a score with a zero mean. Positive scores indicate agreement and negative scores disagreement.

TABLE 2: **CROSS-TABULATION**

3 Groups	**Quality & good management**		**Wine farm attributes**		**Effective marketing**		**Route development**	
	Agree	Disagree	Agree	Disagree	Agree	Disagree	Agree	Disagree
Festinos	**63.2%**	36.8%	**55.9%**	44.1%	39.7%	**60.3%**	51.5%	48.5%
Epicureans	**53.1%**	46.9%	49.9%	51.0%	51.0%	49.0%	44.9%	**55.1%**
Social adventurers	42.9%	**57.1%**	**61.2%**	38.8%	**67.3%**	32.7%	**67.3%**	32.7%
3 Groups	**Festival attractiveness**		**Entertainment & activities**		**Accessibility**			
	Agree	Disagree	Agree	Disagree	Agree	Disagree		
Festinos	51.5%	48.5%	45.6%	**54.4%**	**57.4%**	42.6%		
Epicureans	51.0%	49.0%	**65.3%**	34.7%	36.7%	**63.3%**		
Social adventurers	**71.4%**	28.6%	**55.1%**	44.9%	**71.4%**	28.6%		

The cross-tabulation (Table 2) identified that each of these three groups has different perceptions regarding the seven key success factors that need to be managed at the Wacky Wine Festival.

Festinos rated quality and good management, wine farm attributes and accessibility as important. The *epicureans* also identified quality and good management, entertainment and activities as more important The *social adventurers* identified the key success factors as wine farm attributes, effective marketing, route development, festival attractiveness, entertainment, activities and accessibility.

From the above, the *epicureans* can be seen as a specialist market. Their main motive to attend the Wacky Wine Festival is to taste wine and combine it with different foods. The *social adventurers* are more demanding and they focus on a greater variety of managerial aspects. The managers need to take this into consideration to satisfy each visitor group's needs analysis of variance (ANOVA) was then carried out to determine whether there are significant differences between the different wine festival visitor markets (*festinos, epicureans, and the social adventurers)* and the seven key success factors. Using SPSS, a one-way ANOVA was applied as indicated in Table 3.

TABLE 3: **ANOVA ANALYSIS OF THE WACKY WINE FESTIVAL**

Success factors		Sig.	Mean square	F
Quality and good management	Combined	**.004**	5.468	5.842
	Unweighted	**.001**	10.892	11.636
	Weighted	**.001**	10.930	11.677
	Deviation	.932	.007	.007
	Within groups		.936	
Wine farm attributes	(Combined)	.193	1.658	1.664
	Unweighted	.558	.294	.295
	Weighted	.700	.148	.149
	Deviation	.076	3.168	3.180
	Within groups		.996	
Effective marketing	(Combined)	**.021**	3.559	3.949
	Unweighted	**.019**	5.134	5.634
	Weighted	**.013**	5.687	6.341
	Deviation	.200	1.511	1.658
	Within groups		.911	
Route development	(Combined)	.137	1.982	2.014
	Unweighted	.090	2.868	2.914
	Weighted	.110	2.540	2.580
	Deviation	.231	1.425	1.448
	Within groups		.984	
Festival attractiveness	(Combined)	.169	1.600	1.794
	Unweighted	.158	1.796	2.014
	Weighted	.195	1.511	1.695
	Deviation	.171	1.689	1.894
	Within groups		.892	
Entertainment and activities	(Combined)	**.010**	3.542	4.789
	Unweighted	**.014**	4.560	6.166
	Weighted	**.009**	5.145	6.958
	Deviation	.107	1.938	2.621
	Within groups		.740	
Accessibility	(Combined)	.152	1.917	1.904
	Unweighted	.332	.953	.947
	Weighted	.414	.674	.670
	Deviation	.078	3.159	3.139
	Within groups		1.006	

The seven key success factors, their significance, mean square and F-values are reported. The between-group effect is labelled *Combined* and indicates whether there are overall differences between the three types of visitor groups' view on whether, for example, quality and good management is a key success factor of the Festival. Values smaller than 0.05 indicate significant differences at the 5% level.

Quality and good management, effective marketing and entertainment and activities were significant. At this stage, it is not clear how the success factor differed between the groups of visitors. Tables 4 to 5 present the contrasts tests used to examine such differences. Contrast tests are undertaken after conducting an ANOVA to find out which groups differ (Field, 2005:325).

TABLE 4: **CONTRASTS COEFFICIENTS**

	Type of festivalgoer by reason for visit	Type of festivalgoer by reason for visit	Type of festivalgoer by reason for visit
CONTRAST	**FESTINOS**	**EPICUREANS**	**SOCIAL ADVENTURERS**
1	**-2**	**1**	**1**
2	**0**	**-1**	**1**

Table 4 indicates the way the contrasts between the groups are set up. Contrast 1 is between the *festinos,* the *epicurean*s and *social adventurers*. Contrast 2 is only between the *epicureans* and *social adventurers*. To draw conclusions from the contrasts, it is necessary to first conduct Levene's test, which tests the hypothesis that the variances in the groups are equal.

TABLE 5: **TEST OF HOMOGENEITY OF VARIANCES**

Key success factors	Levene statistic	df1	df2	Sig
Quality and good management	.559	2	163	.551
Wine farm attributes	1.611	2	163	.203
Effective marketing	1.352	2	163	.262
Route development	.258	2	163	.773
Festival attractiveness	.904	2	163	.407
Entertainment and activities	.897	2	163	.410
Accessibility	2.650	2	163	.074

Table 5 shows the results of Levene's test of the homogeneity of variance. The null hypothesis is one of the homogeneity of variance of the three types of visitor groups' views of the key success factors. The significance values in excess of 0.05 indicate that one cannot reject the null hypothesis. In Table 6 (below), the contrasts should thus be interpreted assuming equal variances.

Table 6 shows the following results: Assuming equal variances, contrast 1 indicates a significant difference between *festinos*' and the other two groups' agreement that Quality and good management are key success factors in managing the Festival. Contrast 2 shows that there is no significant difference between how *epicureans* and *social adventurers* regard Quality and good management. In the case of Wine farm attributes, there is not a significant difference between the *festinos* and the rest, but the difference between *epicureans* and *social adventurers* is significant at the 10% level. For *social adventurers,* wine farm attributes are clearly important. Effective marketing is significant for the *festinos,* but was not found to be significant for the *epicureans* and the *social adventurers*. In the case of Route development, there is no significant difference between the *festinos* and the two other groups, but there is a significant difference between the *epicureans* and *social adventurers*. Festival attractiveness is a significant success factor for the *epicureans* compared to the *social adventurers*. There is also a significant difference for Entertainment and activities between the *festinos* and the rest of the groups. The last factor, Accessibility, showed no significant difference between the *festinos* and the rest, but the difference between the *epicureans* and the *social adventurers* is significant. Therefore, Accessibility is important for the *epicureans*, when compared to the *social adventurers.*

TABLE 6: **CONTRAST TEST OF KEY SUCCESS FACTORS AND VISITOR GROUPS**

Key success factors		Contrast	Value of contrast	Significance (two-tailed)
Quality and good management	Assumes equal variances	1 2	-.9135587 -.3232904	.003 .100
	Does not assume equal variances	1 2	-.9135587 -.3232904	**.003** .115
Wine farm attributes	Assumes equal variances	1 2	-.1517256 -.3548855	.631 .080
	Does not assume equal variances	1 2	-.1517256 -.3548855	.638 **.068**
Effective marketing	Assumes equal variances	1 2	.8468787 .0023097	.006 .990
	Does not assume equal variances	1 2	.8468787 .0023097	**.007** .990
Route development	Assumes equal variances	1 2	.2721047 .3626010	.386 .072
	Does not assume equal variances	1 2	.2721047 .3626010	.394 **.063**
Festival attractiveness	Assumes equal variances	1 2	.1547092 .3475640	.604 .070
	Does not assume equal variances	1 2	.1547092 .3475640	.607 **.067**
Entertainment and activities	Assumes equal variances	1 2	.8380337 -.0377667	**.002** .828
	Does not assume equal variances	1 2	.8380337 -.0377667	.003 .825
Accessibility	Assumes equal variances	1 2	-.0292311 .3951101	.927 .053
	Does not assume equal variances	1 2	-.0292311 .3951101	.993 **.008**

FINDINGS AND IMPLICATIONS

From the results a few implications are evident. Firstly, the analysis indicated that the three different visitor groups or markets (*festinos*, the *epicureans* and the *social adventurers)* had different ratings regarding the key success factors of managing a wine festival. Therefore, this research confirms the notion that different markets have different needs and therefore have different requirements as to what is important from a managerial point of view to host a successful event. In fact, there were significant differences between the three markets. The implication is that results from a typical visitor survey cannot and should not be generalised. It therefore implies a more in-depth analysis is needed to ensure that the needs of different markets are catered for. This also has a serious implication for the instrument used in the evaluation. The instrument may require more detailed information from visitors.

Secondly, niche markets such as the *epicureans*, are more critical of the key success factors that affect their need to taste and experience food and wines. Therefore, their concern with issues related to food and wine supersedes all other key success factors, such as accessibility and effective marketing. Hence, the more specialised the market, the less concerned it is with the general aspects of the event and *vice versa*. The implication is that, firstly,

organisers/managers need to understand the main needs or motives of visitors attending an event and, secondly, they need to understand the requirements of different markets. This can be achieved by conducting proper visitor surveys and implies that the so-called quick service surveys would not suffice in this regard.

CONCLUSIONS AND RECOMMENDATIONS

The aim of this study was to determine whether different markets have different requirements in terms of the key success factors of the Wacky Wine Festival. Seven key success factors were identified by means of a visitor survey applying a factor analysis. The visitors rated each of the key success factors based on their own requirements of a successful event.

Three different visitors groups were identified in this study, the *festinos*, *epicureans* and the *social adventurers.* This innovative approach, which entailed a factor analysis and an ANOVA of travel motives as well as key success factors, revealed that each group or market rated the key success factors differently. Hence, this research confirms that different markets have different requirements. Therefore, it is important for event organisers to know how visitors experienced the event and how to satisfy their needs and meet their expectations and requirements. The research also highlights the fact that evaluation is an important management activity and managers and event organisers need to understand visitors' reasons for attending an event. Managers also need to understand visitor requirements, which prove that determining the success of an event, especially through the eyes of the visitor, is not as simplistic as it seems. The research clearly indicated that this approach should be applied regularly, because if organisers used the data as is, it would give them a distorted view of the reality. Evaluation of the success of an event should thus be seen in a more serious light, since it gives input to next year's event and management cycle. Results from this and similar research will assist event organisers to address gaps, which is vital in order to remain competitive.

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RELATIONSHIP BETWEEN RESISTANCE TRAINING AND SELF-REPORTED HABITUAL MACRONUTRIENT AND ENERGY INTAKE

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ABSTRACT

Obesity is reaching epidemic proportions and more effective treatments are required to prevent the expansion of this disease. Treatments should focus on creating a negative energy balance either via increasing energy expenditure or by decreasing energy intake, or preferably both. Therefore, the purpose of this study was to investigate whether resistance training can influence feeding behaviour as determined by self-reported habitual macronutrient and energy intake. The effect of eight weeks of resistance training (n = 13) on self-reported macronutrient and energy intake was compared to a non-exercising control group (n = 13) in inactive males using a computer-based software program. Similar to the non-exercising control group, resistance training resulted in no significant (p > 0.05) changes in the habitual intake of daily intake of total kilocalories, carbohydrates, proteins and fats. In conclusion, eight weeks of resistance training is not an effective mode of training to promote an improvement in macronutrient and energy intake and despite studies demonstrating that exercise itself, in the absence of counseling, may affect feeding behaviour, it may be that resistance training as a mode of training may not be an effective mode of exercise to promote overall physical activity in an attempt to modify the patterns of macronutrient and energy intake. As such, negative energy balance would solely be due to the energy expenditure during this mode of exercise.

Key words: Diet; Exercise; Feeding behaviour; Physical activity.

INTRODUCTION

With the rising incidence of co-morbid diseases stemming from inactive lifestyles and an over-consumption of energy-dense foods (Olivares *et al.*, 2004; Sallis, 1993; Sclicker *et al.*, 1994), physical activity has been promoted as an invaluable tool in long-term weight management due to its ability to promote not only an increased energy expenditure through exercise but also changes in nutrient intake (Ambler *et al.*, 1998; Sallis, 1993; Sclicker *et al.*, 1994; Tremblay & Almeras, 1995). This is due to the fact that physical activity has been shown to alter macronutrient metabolism and/or stores and affect neuro-systems, such as the Leptin hypothalamic signaling pathway, involved in the control of food intake (Tremblay & Almeras, 1995). In this regard, voluntary energy intake can increase in response to an increased exercise volume (Janssen *et al.*, 1989) possibly due to compensation for the

increased energy expenditure during exercise. Also, finding an exercise programme that can both reduce macronutrient and energy intake and increase energy expenditure may prove an invaluable tool in the prevention of overweight and obesity.

However, fitness levels and gender may influence the affect that exercise has on feeding behaviour and Ambler *et al*. (1998) found that fitness levels are associated with increased energy intakes in males while females increase their fat intake in response to exercise. Similarly, Titchenal (1988) found that novice marathon runners increase their carbohydrate intakes by 3 to 4% in response to exercise while Janssen *et al*. (1989) found unchanged carbohydrate intakes in champion marathon runners. With regards to gender, previous research has also shown that protein intake increases acutely in males following two hours of vigorous exercise but carbohydrate intake increases acutely when considering both males and females together following two hours of vigorous exercise (Verger *et al.*, 1992; Verger *et al*., 1994). In this regard, it has been suggested that males maintain or decrease their energy intake in response to exercise more so than females (Donnelly & Smith, 2005, Janssen *et al*., 1989). Furthermore, females are more likely to compensate for the increased energy expenditure through exercise by increasing their energy intake (Donnelly & Smith, 2005). Further, the body composition of an individual may influence how exercise affects nutritional behaviour. Titchenal (1988) found that the energy intake of obese individuals remained unchanged following exercise. It has also been pointed out that the mode of exercise may too influence feeding behaviour (Shaw *et al.*, 2008). However, relatively few studies have investigated the effects of resistance training on macronutrient and energy intake (Shaw *et al*., 2008) and as such no definitive conclusions can be drawn to either disregard or prescribe this mode of training to alter macronutrient and energy intake. Therefore, the purpose of this study was to investigate the association between resistance training and self-reported habitual macronutrient and energy intake.

METHODS

A random sample of 30 inactive male subjects (mean age 28 years and seven months) were recruited to take part in the eight-week study (Table 1). The study was approved by the Institutional Review Board at the Rand Afrikaans University (now University of Johannesburg). All subjects gave written informed consent and underwent standardized medical screening. Subjects were included in the study if they were previously inactive, free of pre-existing disease and not on any prescribed diet or supplement which could have altered their macronutrient and energy intake or energy expenditure.

TABLE 1. **SUBJECT DESCRIPTIVE DATA**

	Non-exercising Control Group (NE) (n = 15)	**Resistance Training Group (RT) (n = 13)**
Height (centimeters)	179.02 ± 6.01	178.53 ± 4.35
Body mass (kilograms)	85.17 ± 5.69	77.78 ± 5.48
Percentage body fat (%)	27.94 ± 1.68	26.83 ± 1.52

Values are means ± standard deviation

Pre- and post-training estimated three-day food records were successfully collected from 28 of the initial 30 subjects specifying the type and quantity of food and fluids consumed. Portion sizes were estimated with the aid of measuring cups, glasses, bowls and food items. The dietary records were analyzed for total kilocalories, carbohydrates, proteins and fat intakes using the Dietary Manager® computer-based software programme (Dietary Manager, Program Management, South Africa).

All subjects underwent a standardized anthropometric evaluation which included the assessment of body mass which was measured to the nearest 0.1 kilogram on a calibrated medical scale (Mettler DT Digitol, Mettler-Toledo AG, Ch-8606 GreiFensee, Switzerland) wearing light running shorts and without shoes. Percentage body fat was also assessed using the seven-skinfold method of Jackson and Pollock (1978).

The subjects were randomized by standard random number technique into two groups that received no dietary intervention or advice. The non-exercising control group (NE) ($n = 15$) was instructed not to participate in any exercise and remain inactive and the resistance training group (RT) ($n = 13$) participated in an eight-week structured and supervised exercise training program which consisted of progressive resistance training exercises three times weekly. Each session was started by performing a five minute warm-up and concluded with stretching and a five minute cool-down. Each session required that each RT subject complete three sets of 15 repetitions per exercise. Each workout of the RT group was designed according to National Strength and Conditioning Association (NSCA) guidelines (Baechle *et al.*, 2000a; Earle & Baechle, 2000). The resistance exercises included shoulder shrugs; lateral shoulder raises; seated chest presses; latissimus dorsi pulls; seated rows; bicep curls; triceps extensions; crunches and leg press. For crunches, each subject had to perform three sets of 60% of the maximum number of repetitions that he performed during testing.

Levene's test was used to determine if the NE and RT groups were heterogeneous or homogenous at the start of the eight-week period. The macronutrient and energy intake records were analyzed using a mixed factorial analysis of variance and $p \leq 0.05$ was selected as being indicative of statistical significance. Values are expressed as means ± standard deviation (SD). To calculate test-retest reliability the control group's self-reported macronutrient and energy intake was used by establishing the intraclass correlation coefficient (ICC).

RESULTS

The NE and RT groups were found to be homogenous at the start of the experimental period in terms of total kilocalories, carbohydrate, protein and fat intakes (Figures 1-4). Total kilocalories for the NE group remained relatively unchanged over the eight-week period (2543.85 ± 831.59 kilocalories (kcal) to 2406.38 ± 616.12 kcal ($p = 0.324$)). Even though the RT group decreased their total kilocalories from 2685 ± 975.49 kcal to 2238.13 ± 819.71 kcal, it was found not to be significant ($p = 0.242$). Both the NE and RT groups demonstrated no significant differences in their carbohydrate intake from the pre- to post-training (NE: 300.14 ± 120.13 grams (g) to 268.63 ± 116.50 g ($p = 0.134$); RT: 293.66 ± 107.53 g to 242.14 ± 47.65 g ($p = 0.246$)). The NE group increased their protein intake from 105.71 ± 42.93 g to 111.36 ± 36.68 g, while the RT group decreased their protein intake from 121.70 ± 42.93 g to

103.75 ± 34.26 g. However, neither of the changes in the NE or RT were significant (p = 0.512; p = 0.137, respectively). Similarly, the differences observed in the fat intake of the NE group (107.61 ± 43.43 g to 103.06 ± 27.30 g) and the RT group (104.39 ± 44.18 g to 103.21 ± 36.71 g) were found not to be significant (p = 0.589; p = 0.945, respectively).

The body mass of both the NE and RT group remained unchanged from the pre- to post-training (NE: 85.17 ± 22.05 kilograms (kg) to 85.76 ± 21.62 kg (p = 0.063); RT: 77.78 ± 19.75 kg to 78.23 ± 19.57 kg (p = 0.240)). The percentage body fat of the NE group decreased slightly from 27.94 ± 6.52 % to 27.55 ± 6.19 %, but was found not to be significant (p = 0.548), while the RT group decreased significantly from 26.83 ± 5.47 % to 23.33 ± 6.25 % (p = 0.000).

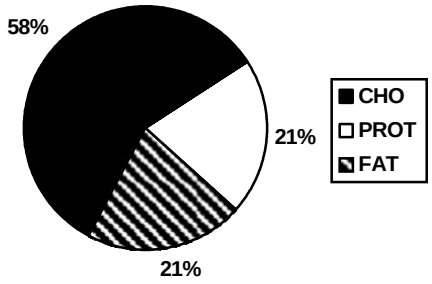

Figure 1 Pre-training Macronutrient Intake of NE

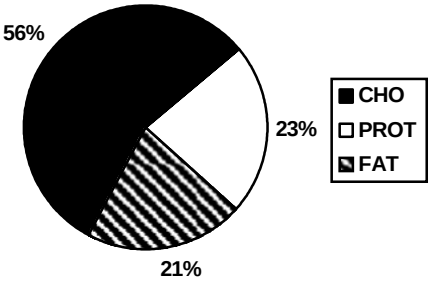

Figure 2 Post-training Macronutrient Intake of NE

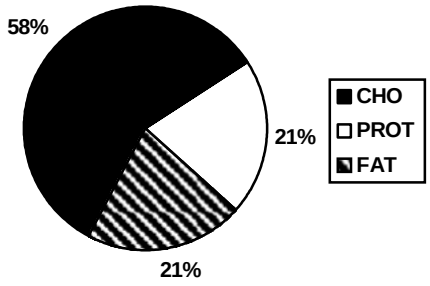

Figure 3 Pre-training Macronutrient Intake of RT

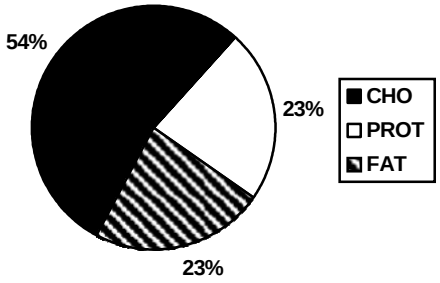

Figure 4 Post-training Macronutrient Intake of RT

DISCUSSION

The results of the present study revealed that RT is an ineffective mode of training at altering macronutrient and energy intake in inactive males over an eight-week period. This finding is in contrast to the efforts to promote physical activity in an attempt to modify the patterns of nutrient intake. This is supported by Shaw *et al*. (2008) who pointed out that the mode of exercise may too affect nutritional behaviour. This is since Shaw *et al*. (2008) found that 16 weeks of aerobic training and 16 weeks of resistance training did not affect feeding behaviour, but that a combination of aerobic and resistance training reduced the intake of total kilocalories, carbohydrates, proteins and fats in previously inactive males. The finding that a single exercise modality may not affect feeding behaviour is supported by Costill *et al*. (1988) who found that 10 days of swimming did change carbohydrate intake. According to Shaw *et al*. (2008), a combination of aerobic and resistance training may more effectively influence feeding behaviour due to the composition of the fuel mix oxidized during this mode of exercise having a direct effect on a specific neurosystem influencing feeding behaviour.

The data of this study also indicated that the subjects in the study consumed more carbohydrates and protein than the recommended daily allowance (RDA) of 50% and 20% respectively, but less fat than the RDA of 30% (Baechle *et al.*, 2000b). This might be due to these subjects perhaps already being aware of taking a prudent diet with lower fat intake in favor of carbohydrates (Janssen *et al*., 1989). The ineffectiveness of resistance training to

alter macronutrient and energy intake may be related to the already reduced daily intake of kilocalories of the subjects and it appears that this sample would benefit from increasing their kilocalorie intake especially in light of their exercising status (from a post-test value of 2406.38 ± 616.12 to a minimum of 3151.29 kcal for the NE and from a post-test value of 2238.13 ± 819.71 to a minimum of 2877.86 kcal for the RT) as based on age and gender norms (Manchester City Council, 2008). It is also evident that the further decrease in kilocalories seen following resistance training was derived primarily from a decrease in carbohydrate, perhaps indicating a decreased reliance on carbohydrate or glycogen stores. Although not significant, this change in carbohydrate intake may physiologically reflect this mode of exercise utilizing carbohydrates as its primary fuel source and thus slightly inhibiting short-term eating via increased levels of carbohydrates being broken down and released into the blood stream (Glucostatic theory) leading to an decreased preference for carbohydrates.

The results of self-reported macronutrient and energy intakes might be questionable since people tend to either underreport macronutrient and energy intake or report the intake that may more closely resemble perceived norms than actual intake (Hoidrup *et al.*, 2002; Schoeller, 1990). However, since the subjects in the present study were well trained on how to keep nutrient records and the records reviewed from each subject and the lack of change in self-reported macronutrient and energy intake in the non-exercising control group suggests that the subjects were consistent in their macronutrient and energy intake recording, regardless of the tendency for people to underreport macronutrient and energy intake. This was substantiated by the test-retest reliability using the control group's macronutrient and energy intake which indicated that the intraclass correlation coefficient was not significant ($p \leq 0.05$) for total kilocalories (ICC = 0.736), carbohydrate intake (ICC = 0.608), protein intake (ICC = 0.610) and fat intake (ICC = 0.597). As such, under intraclass correlation coefficient average measures, the scores of the macronutrient and energy intake measures (re-test) are highly reliable.

The results of the study suggest that when physical activity is promoted to reduce macronutrient and energy intake, more specific and appropriate training regimes should be specified. In addition, the effect of exercise should be assessed in combination with healthy changes in eating behaviour and appropriate counseling from a dietician. This is because, not all forms of exercise will bring about changes in macronutrient and energy intake in all people. The findings of the present study suggest that resistance training alone does not induce macronutrient and energy intake changes and this may be related to this mode of training not creating sufficient energy deficits and appropriate changes in metabolism. As such, the negative caloric balance from this mode of exercise would solely be due to the energy expenditure during this mode of exercise and not as a result of macronutrient and energy intake changes.

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INTERNSHIP AS A MECHANISM FOR PROFESSIONAL PREPARATION OF SPORT MANAGEMENT PERSONNEL: AN EMPIRICAL STUDY OF STUDENTS' PERCEPTIONS

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ABSTRACT

The labour market in South Africa (SA) has been characterized by very high and increasing rates of unemployment and an acute shortage of skilled workers. Consequently, finding competent people who will fit in with an organisation's culture, vision and strategic goals has been challenging. As a result, the recruitment drives of many organisations currently focus heavily on attracting skills as well as experience. One of the ways in which the skills shortage and lack of experience could be addressed would be by including an internship in the curricula of different programmes offered at Higher Education Institutions. The current study seeks to articulate from a student's perspective the value of internship in the professional preparation of sport management personnel and attempts to contribute to research in education by providing empirical evidence on the usefulness of internships and make recommendations thereon. A 47-item questionnaire was administered to 300 interns at three universities which offered sport management programmes with internship as a compulsory component. Analyses were performed using the Statistical Package for Social Sciences (SPSS – version 17). Principal component analysis (PCA) was conducted on the data. A final model consisting of seven factors which accounted for 77.80% of the overall variance in the scale item scores was produced. The factors were professional development (five items), personal development (five items), marketability (thee items), adaptability (thee items), relevance (thee items), opportunity for growth (two items) and networking (two items). The study found internships to be a valuable component in the sport management curriculum. Emanating from the findings several recommendations were made.

Key words: Internship; Labour; Professional development; Personal development; Marketability; Relevance.

INTRODUCTION

Higher Education Institutions (HEIs) face diverse challenges in their effort to deliver the best possible educational experience to their students (Domask, 2007). Traditionally, higher education was delivered through a lecture-centric approach. However, in the current higher education scenario this approach appears to have limitations with regard to the preparation of

students for the workplace. As a result, HEIs are compelled to modify their approach to meet the demands of industry. One of the ways that this was addressed was by including an experiential learning component in their curricula. Experiential learning includes elements such as field-based coursework, internships, service learning, guest speakers and site visits (Domask, 2007). In the professional preparation of sport management personnel, experiential learning commonly exists as field experience in the form of internships (Verner *et al*., 2001).

The increasing importance of practical work experience gained through internships cannot be overemphasized since, in recent times, there has been a significant reliance on acquiring practical skills in the workplace (Billet, 2001). Internships have become increasingly popular as a means to bridge the transition from the classroom to the work situation (Callanan & Benzing, 2004). They have long been an integral component in the educational preparation of students in disciplines such as finance (Knemeyer & Murphy, 2001; Callanan & Benzing, 2004), hospitality and tourism (Harris & Zhao, 2004; Lam & Ching, 2007), education and medicine (Jaschinski & De Villiers, 2008).

There are various definitions of internships. Knemeyer and Murphy (2001) describe internships as all work programmes that are designed to supplement a student's academic coursework. McMahon and Quinn (1995) define internship more specifically as a supervised work experience during which students are under special guidelines and attention while Taylor (1988) describes it as structured and career-relevant work experiences gained by students prior to graduation from an academic programme. For the purpose of this study internship is regarded as a process during which sport management students work as trainees to gain practical experience in sport management related activities in a sport organisation. The internship would normally be taken during the senior year of study, be of a minimum duration of three months in total and the student would receive credit for the completion of the internship. Sport management internships provide sport management students with an important introduction to their career paths (Moorman, 2004).

Verner *et al.* (2001) describe the internship as a triangular relationship entered into by three parties, namely the student, the university and the sponsoring organisation. All three parties help define the internship relationship in terms of the expectations of each party, the duration and the assessment criteria. Overall internships, which offer each party the potential to benefit from this unique educational opportunity, can be viewed as a win-win proposition for students, education institutions and employers. It assists in connecting the academic with the practice, evaluating the course content of curricula, linking students to work experience and job opportunities and engaging and empowering students (Domask, 2007). Greenhaus *et al*. (2000) posit that internships are the first formal introduction to the workplace for graduates. As such, internships contribute significantly towards shaping their careers and establishing a sound foundation in the workplace.

For students in particular, internship is an alternative learning method that helps them develop a realistic understanding of the profession that they have chosen and demonstrates the relevance of academic and technical skills needed on the job. It allows students to experience "real world" problem solving (Dodge & McKeough, 2003; Verner *et al.*, 2001) and increases the opportunity for possible full time employment upon graduation (Sharma *et al*., 1995; Cannon & Arnold, 1998; Knemeyer & Murphy, 2001). It increases their practical

knowledge and skills (Williams *et al*., 1993), improves their self confidence, self concept and social skills (Knouse *et al.*, 1999), provides an opportunity to perform as a professional and experience an organisational culture (Verner *et al*., 2001). In addition, Knouse *et al*. (1999) suggest that those students who have completed internships are placed more quickly in jobs than those without internship experience. Furthermore, students are more satisfied with their career choices and jobs (Hiltebeitel *et al*., 2000; Ton & Hansen, 2001), experience greater job stability (Richards, 1984), experience improved performance (Tziner *et al*., 2002), acquire job relevant skills (Garavan & Murphy, 2001) and receive job experiences that are valued by prospective employers (Callanan & Benzing, 2004).

From a university viewpoint, the university is able to help students reinforce the connection between theory and practice. The sponsoring organisation can help strengthen the profession by enhancing the workforce through developing more competent entry-level employees (Verner *et al*., 2001). In addition, internship provides for the engagement of academics with industry. It creates opportunities for academics to collaborate with industry partners, build and strengthen relationships, develop research contacts with industry professionals and update information regarding the needs of industry as well as the community (Pauline & Pauline, 2008). For HEIs internship may be viewed as a positive strategy to compete for a larger intake of students by promoting a comprehensive curriculum with an attractive internship programme (Lam & Ching, 2007). Internships form an essential part of quality sport management education since it enables students to link the classroom to professional environments through observations, exploration and participation (Cuneen & Sidwell, 2007).

For employers, internship provides an excellent source for recruiting new employees (Maskooki *et al*., 1998) and reducing uncertainty in the hiring process (Lam & Ching, 2007). It also provides the opportunity for organisations and interns to get to know each other better (Knemeyer & Murphy, 2001). It also helps organisations in their induction process and places them in a better position to retain their employees and foster their performance (Waryszak, 1999). Furthermore, it provides a 'tried and tested' method for organisations to evaluate prospective employees and to ensure a steady stream of motivated individuals who cost the organisation less than full time employees (Hodgson, 1999).

RATIONALE FOR THE STUDY

The labour market in South Africa (SA) has been characterized by very high and increasing rates of unemployment and an acute shortage of skilled people (Kanye & Crous, 2007). Consequently, finding competent people who will fit in with an organisation's culture, vision and strategic goals has been a challenge. Statistics released by the Human Sciences Research Council (HSRC) in 2006 revealed that only 33.6% of graduates were successful in entering the job market (Umsobomvu Youth Fund, 2007), indicating merely obtaining an academic qualification does not always guarantee one a job. According to the Accelerated and Shared Growth Initiative for South Africa (ASGISA) which engaged with organisations, policymakers and government, skills shortage was one of the most common obstacles to growth in SA (ASGISA, 2006). Dias and Posel (2006) support this finding by commenting that firms identified skills shortage or the availability of technical and vocational skills as a constraint in individuals procuring employment. They concluded that the reasons for the high

and increasing unemployment in SA are often sought on the supply-side of the labour market. The supply-side of the labour market includes HEIs.

The Umsobomvu Youth Fund (2007) cited South Africa's past political and social imbalances, which denied most black graduates opportunities to gain life, professional and technical skills, as one of the reasons for their lacking access to economic opportunities. Akoojee *et al*. (2005) concluded that the National Qualifications Framework (NQF) and South African Qualifications Authority (SAQA) focused too narrowly on qualifications, expecting this to bring about revolutionary change. This, however, had a negative effect on vocational training in the further education and training system in the country.

Pauw *et al*. (2006a) commented that evidence exists that large SA companies experience constant problems with the quality of graduates at all levels of the higher education system and that there are major labour market outcomes from the shortage of quality skilled individuals. Pauw *et al*. (2006b) are of the view that the majority of unemployed individuals possess limited skills while organisations increasingly demand highly-skilled workers. They posit that the pressure to become technologically more advanced have further increased the demand for highly-skilled workers. As a result the recruitment drives of many organisations currently focus heavily on attracting skills as well as experience. One of the ways in which the skills shortage and lack of experience could be addressed would be by including an internship in the curricula of different programmes offered at HEIs.

Many studies in South Africa have investigated the role of education in affecting the labour market (Dias & Possel, 2006). Among these were research on the relationship between education and earnings (Schultz & Mwabu, 1998), globalization and skill bias of occupational employment (Edwards, 2001), shifts in labour demands and youth employment and education (Bhorat & Hodge, 1999). More recently the focus has shifted to investigating the role of education in influencing the employment chances of graduates. At the 2008 South African Society for Cooperative Education (SASCE) Conference, the common thought was that HEIs in South Africa were failing to produce sufficient students who are adequately prepared for the working world, contributing to the growing skills shortage. Here it was suggested that one of the main reasons for increasing numbers of graduates struggling to find employment was the glaring mismatch between tertiary qualifications and the requirements of industry (Manganye, 2008).

The area of sport management has experienced the professionalisation of sport and leisure services throughout the world, including South Africa. This has created the need for personnel with knowledge and skills that are specific to the sport industry (Williams, 2004). The result was a proliferation of tertiary level sport and leisure programmes which, in turn, has placed increased demands on sport personnel in respect of specialized management knowledge and skills (Martin & Leberman, 2005; O'Shea & Watson, 2007). Despite an expanding body of literature and research in other disciplines there is a vacuum regarding research on the use of internships in sport management, especially in the South African context. Most of the studies conducted in the past on experiential learning were conducted in disciplines other than sport.

An examination of the sport management curricula of the different universities in South Africa that offer sport management revealed that the curriculum is made up of three components, namely academic coursework providing subject-matter knowledge, field practicals and work experience during internships. Most universities used the logbook system to monitor the progress of interns.

Limited research regarding the usefulness of internships for sport management personnel in the South African context has been conducted. It is expected that recommendations emanating from this study could in some way address the significant skills gap in the sport industry. The perceptions of interns were used to make suggestions to improve both the undergraduate as well as the internship experiences of students. Although internships and other forms of experiential learning have grown in popularity among different universities in different programmes, there is limited academic literature and research that reports empirically on the contributions of such approaches to academic and employment goals. This study has particular relevance to the South African labour market which is characterized by a very high and increasing rate of unemployment and skill shortage. Inputs from students who have completed their internship may prove beneficial to HEIs, students, and prospective employers. The significance of this study is that it attempts to fill a void by exploring the perceptions of sport management students who have completed an internship and managers or mentors, who manage sport management students who have completed their internship, regarding the usefulness of internships in preparing sport management personnel for the workplace.

PURPOSE OF STUDY

The current study seeks to articulate from a student's perspective the value of internship in the professional preparation of sport management personnel. This paper attempts to contribute to academic research in education by providing empirical evidence on the usefulness of internships and making recommendations thereon.

METHODS AND PROCEDURES

A quantitative research design was used in the current study. A comprehensive study of the literature on internships both nationally and internationally was undertaken. Arising from the literature study, a 47-item questionnaire was developed. Items in the questionnaire were scored on a 5-point Likert scale anchored at 1 (strongly agree), 3 (neither agree nor disagree), and 5 (strongly disagree). Items in the questionnaire focused specifically on the perceptions of sport management interns who had completed their internships. Senior sport management lecturers at three different South African universities who coordinated Sport Management internships were invited to review the instrument for content validity and comment on the items in the questionnaire. Cronbach alpha was used to assess the reliability of the instrument. The instrument returned a Cronbach α value of 0.949 indicating high internal consistency of the instrument. The questionnaire was pre-tested by six sport management graduates. Based on their responses no modifications to the instrument were necessary. Questionnaires were administered at three of the nine universities which offered a sport management qualification with internship being a compulsory component. Coordinators of the internship component administered the questionnaires to the interns. Participants were

informed about the purpose of the study and were told that completion of the questionnaire was voluntary and they could discontinue the completion of the questionnaire at any stage. They were also assured of confidentiality and anonymity. Of a total of 300 questionnaires that were administered 201 (67%) usable questionnaires were returned.

Participants

Purposive sampling method was used to select the participants for the current study. A purposive sample constitutes participants with specific characteristics (Patton, 1990) and is constructed to serve a very specific need or purpose. In the current study which, participants comprised students who had completed their internship at a sport organisation not more than three years prior to them completing the questionnaire. This approach was used to ensure that the data collected was current and relevant.

Data Analysis

Analyses were performed using the Statistical Package for Social Sciences (SPSS – version 17). All 47 items in the questionnaire were included in a principal component analysis to reduce the items to a smaller number of variables. Varimax rotation, which reapportions variance among factors so that they become relatively equal in importance, was used to simplify factors by maximizing the variance loadings across variables (Gillespie *et al*., 2007). Principal component analyses were performed with items in the scale being removed until a simple structure in which several variables correlated highly with each other and only one factor correlated highly with each variable was achieved. Cronbach alpha coefficients were then calculated for each of the extracted factors to determine internal reliability.

RESULTS

Demographics

One hundred and eight (53.5%) male and 93 (46.5%) female interns completed the questionnaire. Most internships (65.3%) were of a three to six months full time duration. Majority of interns (81.7%) were completing a diploma qualification in Sport Management. The balance was made up of students studying towards the Bachelors degree in Sport Management (9.4%) and the Honors degree in Sport Management (8.9%). The main jobs that interns performed during their internship were administration, coaching, public relations and facility management. In many instances it was a combination of two or more of the aforementioned jobs. The different ways in which the internship was monitored included logbook entries, both logbook and telephonically, on site visits by university staff, field supervisor's written report, logbook and on site visits by university staff. In most instances (178, 88%) interns applied on their own for internship positions as opposed to being placed by the university. The majority of interns (125, 62%) did not go through an orientation or internship preparation before the internship. Most interns (178, 88%) did not get any financial assistance from the institution and were responsible for their own expenses for the duration of the internship.

Principal component analysis

Principal component analysis (PCA) with varimax rotation was applied to the 47 items. Previous studies (Bahia & Nantel, 2000; Papadimitriou & Karteroliotis, 2000; Dhurup *et al*., 2006; Gillespie *et al*., 2007) used varimax rotation in order to minimize the number of variables with high loadings on a factor and enhance the interpretability of the extracted factors. Using a minimum eigenvalue of 1, the PCA extracted 11 factors. An examination of the rotated component matrix revealed that 11 items that loaded within 0.20 of each other on more than one factor. These items were removed to reduce ambiguity in the interpretation of the factors (Tabachnick & Fidel, 2001). The iterative process was re-run a further three times until a clear factor structure was achieved. The final PCA was performed on 23 items producing a final model consisting of seven factors. These factors accounted for 77.80% of the overall variance in the scale item scores with two to five loadings on each factor. These factors included professional development (five items), personal development (five items), marketability (three items), adaptability (three items), relevance (three items), opportunity for growth (two items) and networking (two items). The rotated components matrix is presented in Table 1.

TABLE 1. **ROTATED FACTOR LOADING MATRIX**

ITEM	**Factor 1** Prof. develop-ment	**Factor 2** Personal develop-ment	**Factor 3** Market-ability	**Factor 4** Adapt-ability	**Factor 5** Relevance	**Factor 6** Opportunity for growth	**Factor 7** Net-working	**Means**
Improved my job satisfaction	0.782							1.76
Helped me discover my professional self	0.783							1.81
Helped me build professional relationships	0.811							1.77
Helped me develop my professional self	0.539							1.87
Increased my commitment	0.693							1.62
Given me more insight of the sport industry		0.831						1.77
Improved my self confidence		0.878						1.72
Improved my self-concept		0.638						1.98
Improved my managerial skills		0.653						1.67
Taught me to		0.712						1.81

work in a team								
Made me more marketable			0.744					1.81
Developed in me an understanding of the purpose of work activities			0.813					1.70
Provided more extensive networks for finding jobs			0.856					1.84
Improved my performance				0.669				1.71
Improved my coping skills				0.811				1.76
Helped me to work under pressure				0.854				1.49
Helped me to evaluate the quality of my educational programmes					0.708			1.81
Helped me learn new skills					0.579			1.72
Given me greater job stability early in my career					0.747			1.69
Provided me access to increasingly complex tasks						0.791		2.05
Provided me with authentic learning experiences						0.655		1.96
Enabled me to establish an early professional reputation							0.811	2.07
Helped me launch my professional networks							0.816	2.23
Eigenvalue	8.106	2.468	1.806	1.674	1.508	1.194	1.139	
% of variance	35.244	10.729	7.850	7.279	6.556	5.191	4.954	

explained								
Cumulative %	35.244	45.973	53.823	61.103	67.658	72.849	77.803	
Cronbach Alpha	0.887	0.875	0.813	0.765	0.678	0.746	0.746	

Cronbach alpha was used to evaluate item reliability for each extracted factor. The factors' internal consistency ranged from 0.678–0.887, which were close to or greater than the recommended significance level of 0.70 (Nunnally & Bernstein, 1994) indicating an acceptable correlation of ranked values among parameters.

DISCUSSION

The benefits of a well-planned and executed internship are well documented (e.g. Parkhouse, 1987; Parks, 1991; Cuneen, 2004; Young & Baker, 2004; Ayers, 2007). The current study provided an opportunity to sport management students who had completed their internship the opportunity to evaluate and report on their internship experiences. Results from the study indicate that internship is an important pedagogical tool that contributes significantly to the holistic development of sport management interns.

There are indications that internships promote professional development, personal development, marketability and adaptability in addition to being relevant to the programme being pursued and providing opportunities for growth as well as developing networks and increasing the adaptability of interns. This implies that internships contribute to deeper learning.

Martin and Leberman (2005) highlighted the importance of personal development in the area of management education. Similar to the findings of the current study, Leberman and Martin (2004) found personal development to be crucial to the work situation. The findings suggest that, in addition to job-specific skills, individuals need interpersonal skills to deal with a range of challenges in the workplace. These interpersonal skills contribute towards the development of professional skills which in turn contributes to the holistic development of the individual. Mihail (2006) found that students who completed their internships were more optimistic and confident about their career prospects after they completed their internships. Jaschinski & De Villiers (2008) found that when interns are placed in a problem-based learning environment where they were allowed to apply their skills, they developed greater confidence since these situations called upon interns to recall theory learnt in the classroom situation.

The internship plays a pivotal role in assessing the applicability of the coursework to the positions that are available. It also provides the opportunity for both the intern as well as the academic (lecturer) to evaluate the programme during internship visits. Relevant placement is also important from the student's viewpoint in that the student is able to apply coursework rather than to go through a new learning process in the organisation. Internships create sources to impress potential employers thereby making it easier for students who have internships to get jobs after graduation than those without internships (Knemeyer & Murphy, 2001; Mihail, 2006). Harvey (2000) posits that potential employers prefer people who can

adapt quickly to the workplace culture and fit quickly into the job situation. The hands-on experience that interns gain help develop their adaptability and coping skills. Interns are able to understand the work environment and the pressures associated with the job. Within a relevant internship environment students are exposed to various problem-solving situations which contribute to the development of their coping skills. Zopedol (2007) comments that employability or unemployability is directly linked to the skills that one acquires at tertiary level, contending that graduates should not only acquire skills but that such skills should be relevant.

The current study identified developing the marketability of interns as a significant spin-off of internships. Having a job or internship creates value in the minds of prospective employers (Ayers, 2007), makes interns more marketable and enhances their chances of placement in appropriate jobs (Knemeyer & Murphy, 2001). This is because it contributes to interns having the essential ingredients – a general body of knowledge, a strong theoretical foundation and practical experience – sought by prospective employers.

Another important factor that emerged in the study was the development of networks by interns. Being in the job situation provides interns with access to various networks which assists in gaining knowledge about other organisations and making career choices. Networking also increases the chances of interns being better known by other organisations thereby increasing their employment possibilities. Sullivan (2007) identified networking as a necessary component in internship to gain access to employment and advancement in the sport industry. Similar findings were reported by Harris and Zhao (2004) in their study on industry internships.

CONCLUSION

This inquiry suggests that internship in Sport Management is of value to students. It provides the student with an opportunity to apply theoretical knowledge gained in lecture-centric situations to practical job situations. It also creates the settings in which students are able to experiment in a professional environment under guidance and support. Under these circumstances students are able to critically evaluate their potential in the job situation.

RECOMMENDATIONS

Emanating from the findings of the study are several recommendations. The positive responses of interns suggest that internship should be an integral part of the Sport Management programme and should be included as a compulsory component of the curriculum.

The current study found that most interns did not receive any remuneration. Research (Parks, 1991) found that most interns in other countries were remunerated during their internship. It is therefore recommended that at least a stipend should be included in the internship contract to motivate interns. Harris and Zhao (2004) posit that financial rewards for participation in the internship could make it more meaningful and effective. The authors are of the opinion that local employers gain from the relationship, and should therefore compensate interns for their daily expenses at least.

Results of the study also indicate that there is scope for improvement regarding internship visits and feedback. These need to be developmental, structured, meaningful and consistent. It should also be well defined and cohesive (Lam & Ching, 2007). Internship programmes should be rigorously conceptualized and planned. It should encompass guidelines for expected outcomes and mechanisms for evaluation. In this way both the organisation and the intern could work towards common objectives. Jones (2006) opined that the design of the internship programme should allow interns to learn by doing and focus on personal career goals and objectives.

While it is important for students to experience the search and application for internship positions, internship coordinators should ensure that the internship position is relevant to the coursework studied. It is recommended that both interns as well as mentors undergo an orientation so that both parties are aware of each others' expectations of the internship. It is important for employers to be aware that interns are not a substitute for labour shortage but individuals who need to be structured and developed. HEIs need to form partnerships with industry so that students obtain market-relevant qualifications.

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DIE FISIEKE EN MOTORIESE ONTWIKKELING VAN VOORSKOOLSE KINDERS VANUIT VERSKILLENDE SOSIO-EKONOMIESE OMSTANDIGHEDE: THUSANO-STUDIE

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ABSTRACT

Literature indicates a negative impact of socio-economic circumstances on gross and fine motor development of children. The aim of this study was to analyse the possible differences between physical and motor development of pre-school children within poor and higher socio-economic status (SES). A group of 67 children between four months and 71 months were identified according to a random stratified sample of 50 families from a poor socio-economic background and were evaluated using measurements of height, weight and skinfolds (triceps, subscapular and calf). The Peabody Developmental Motor Scales - 2 (PDMS-2) was used to determine motor developmental status. The same procedure was followed with a group of 34 pre-school children (age = 48-73 months) from higher socio-economic status. Co-variance of analysis, adjusted for age, showed that children from higher SES performed predominantly better regarding some motor skills compared to the children from poor SES. Statistical and practical significant differences ($p \leq 0.05$, $Eta^2 > 0.01$) that were found indicated poorer development in the poor SES group regarding their locomotor, visual motor and fine motor standard scores, percentiles and gradings, and regarding their gross motor quotient, although the results indicated that the gross motor development of children living in higher SES also needs attention. The balance and object control of the low SES group were however better ($p<0.05$, $Eta^2 > 0.01$) compared to the high SES group. These results substantiate that the motor development of children living in poor socio-economic conditions are hampered by their environment, and that they should receive additional attention to prevent deficiencies in this regard.

Key words: *Pre-school children; Fine motor; Gross motor; Socio-economic status; Physical development.*

INLEIDING

Menslike ontwikkeling word beskryf as ’n voortdurende proses van verandering wat by bevrugting begin en eers met die dood eindig (Winnick, 2000). Motoriese ontwikkeling verwys na progressiewe veranderinge in bewegingsgedrag regdeur die lewensiklus, wat voortdurende aanpassing ten opsigte van veranderinge in ’n persoon se bewegingsvermoëns behels in ’n poging om motoriese kontrole en bewegingsbevoegdheid te verkry en te behou (Pienaar, 2009).

Lejarraga *et al.* (2002) dui aan dat die omgewing waarin kinders grootword 'n betekenisvolle rol in die motoriese ontwikkeling van kinders speel en dat die effek groter word soos wat kinders ouer word en meer aan die omgewing blootgestel word. Navorsing toon in dié verband dat minderbevoorregte kinders ontwikkelingsagterstande ten opsigte van fundamentele vaardighede ondervind (Goodway & Branta, 2003) en dat hulle minder aan verskillende verbale en taalkonsepte blootgestel word (McPhillips & Sheehy, 2004). Ausebel se navorsing (soos aangehaal deur Richmond & Aliotti, 1977) toon verder dat sodanige kinders ook 'n agterstand in hul skoolloopbaan ten opsigte van perseptueel-motoriese take toon wanneer hulle met hulle ouderdomsgroep vergelyk word. Robinson en Goodway (2009) se studie rapporteer dat die swak omstandighede waaraan kinders vanuit minderbevoorregte gemeenskappe in hulle studie blootgestel was, tot swak motoriese behendigheid bygedra het, en dat hierdie kinders gevolglik as risiko kandidate vir ontwikkelingsagterstande en gesondheidsprobleme beskou word. Illingworth (1983) is voorts van mening dat kinders uit arm omgewings minder aan visuele stimulering blootgestel word. Richmond en Aliotti (1977) se navorsing bevestig dat bevoorregte kinders beter vaar in die uitvoer van perseptueel-motoriese take as minderbevoorregte kinders, terwyl Kattouf en Steele (2000) en Richmond en Norton (1973) 'n verband tussen lae sosio-ekonomiese status en visueel-perseptuele agterstande bevestig. In 'n studie uitgevoer deur Bowman en Wallace (1990) het kinders uit goeie sosio-ekonomiese omstandighede ook beter punte met betrekking tot visueel-motoriese integrasie verkry wanneer hulle vergelyk word met kinders uit swak sosio-ekonomiese omstandighede. Solan en Mozlin (1997) meen ook dat kinders wat in armoedige omstandighede woon, visuele probleme ontwikkel as gevolg van die faktore wat met armoede gepaard gaan, terwyl Orfield (2001) aantoon dat kinders in armoedige omstandighede 'n hoë vlak van funksionele visuele probleme ondervind wat 'n struikelblok vir akademiese sukses kan wees. In 'n studie deur Walker *et al.* (2007) oor kinderontwikkeling in ontwikkelende lande toon die resultate dat daar in sommige lande 40-50% van kinders onder die ouderdom van vyf jaar is wie se groei belemmer is.

Literatuur ten opsigte van voorskoolse kinders se motoriese ontwikkeling, asook die verband tussen motoriese en fisieke ontwikkeling van kinders wat binne swak sosio-ekonomiese omstandighede grootword, is egter beperk. In 'n land soos Suid-Afrika waar die groter meerderheid van kinders uit swak sosio-ekonomiese status (SES) kom is dit van kardinale belang dat daar navorsing gedoen word oor die invloed wat hierdie omstandighede op die ontwikkelende kind uitoefen. Die doel van hierdie studie is derhalwe om die fisieke en motoriese ontwikkeling van voorskoolse kinders binne swak sosio-ekonomiese omstandighede te ontleed en dit te vergelyk met soortgelyke ontwikkeling by kinders vanuit hoër sosio-ekonomiese omstandighede.

METODE

Navorsingsontwerp

Die studie maak deel uit van die Thusano-projek waarin 300 gesinne in die Kuruman-distrik finansieël deur die Nelson Mandela Kinderfonds ondersteun word en waarin die kinders deur maatskaplike werkers aan programme, twee keer per week vir 45 minute, blootgestel word om hulle optimaal vir hul skoolloopbaan voor te berei. Die studie is multidissiplinêr van aard

deurdat Kinderkinetici en maatskaplike werkers by die insameling van data betrek is. Hierdie studie is deur die Etiekkomitee van die Noordwes-Universiteit goedgekeur (nr. 04M11).

Ondersoekgroep

Die Statistiese Konsultasiediens van die Noordwes-Universiteit was verantwoordelik vir die samestelling van die steekproef. Wat die proefpersone vanuit die lae SES betref, is 'n ewekansige trossteekproefneming uitgevoer op die 300 huisgesinne wat deel van die Thusano-projek ('n projek vir vroeë kinderontwikkeling) uitmaak en binne die sewe gemeenskappe van die Kuruman-distrik woon. Hiervolgens is 50 huisgesinne, wat elk as 'n eenheid beskou word, ongeag die grootte van die huisgesin, volgens die grootte van die betrokke distrikte ewekansig vir die studie geselekteer. Alle kinders (N = 69) binne die gekose gesinne, vanaf vier tot en met 71 maande, is by die groep ingesluit. Die gemiddelde ouderdom van die groep was 43.28 maande, ± 9.28 maande. Twee kinders in die groep was jonger as 12 maande, maar hulle resultate is buite rekening gelaat aangesien onvolledige inligting oor hulle ingesamel is. Die groep het gevolglik uit 67 proefpersone bestaan. Wat die proefpersone uit die hoë SES betref, is die kinders (N = 34) vanuit twee kleuterskole en uit gesinne met middel- tot hoë sosio-ekonomiese status in die Potchefstroom omgewing geselekteer op grond van die gemiddelde inkomste van die gesin. Die ouderdomme van dié groep het tussen 48 en 73 maande gewissel met 'n gemiddelde ouderdom van 59.18 maande ± 7.86 maande. Die groep het uit 16 seuns en 20 dogters bestaan.

Meetinstrumente en apparatuur

Fisieke metings

Ontwikkelingsinligting met betrekking tot die liggaamsamestelling van die proefpersone is verkry deur van verskillende antropometriese metings, naamlik lengte, massa, velvoue van die triseps, subskapulêr en kuit asook vetpersentasie (seuns = 0.735 x (trisepsvelvou + kuitvelvou) + 1.0, dogters = 0.610 x (trisepsvelvou + kuitvelvou) + 5.1) en LMI (liggaamsmassa in kg/(liggaamslengte m)^2 gebruik te maak (Slaugther *et al*., 1988). Die metings is volgens standaardprosedures geneem, soos deur die "International Society for the Advancement of Kinanthropometry" uiteengesit (ISAK, 2001).

"Peabody Developmental Motor Scales - 2" (PDMS-2)

Die PDMS-2, wat gebruik word om die motoriese ontwikkeling van kinders tussen 0 en 71 maande te bepaal, is deur Folio en Fewell (2000) as 'n betroubare en geldige meetinstrument verklaar. Die toets-hertoetsbetroubaarheidskoëffisiënt is > 0.90, terwyl die interne geldigheid tussen 0.90 en 0.96 wissel. Daar is ook bevind dat die toetsbattery geskik is vir gebruik by enige geslag en ras. Die toets bestaan uit ses subtoetse waaraan elk 'n afsonderlike punt toegeken word. Die punte van die verskillende subtoetse word bymekaar getel om die *grootmotoriese* (reflekse (tot 12 maande) balans, lokomotories en objek-manipulasie (vanaf 12 maande)), *fynmotoriese* (handgreep en visueel-motories) en *totale motoriese ontwikkeling* van die kind te bepaal. Die hoofkomponente van die meetinstrument waarin die kind 'n agterstand toon, kan dus bepaal word. Die toets dui ook 'n ontwikkelingsouderdom vir elke subtoets aan waarmee die chronologiese ouderdom vergelyk kan word om sodoende agterstande in maande te kan bepaal. Die standaardtelling is 'n geskikte aanduiding van die

proefpersoon se uitvoeringsvermoë met betrekking tot elke subtoets. Dié telling, wat vanaf die routelling verwerk word, word gebaseer op 'n normaalverspreiding van tien en 'n standaardafwyking van drie en stel die navorser in staat om vergelykings tussen die verskillende subtoetse te kan tref. Die motoriese kwosiënt word veral gebruik as gevolg van die hoë betroubaarheidsfaktor daarvan en reflekteer die proefpersoon se status met betrekking tot die verskillende motoriese afdelings. Die gradering van al die komponente word soos volg weergegee: (1) Baie swak, kwosiënttelling 35-69; (2) Swak, kwosiënttelling 70-79; (3) Ondergemiddeld, kwosiënttelling 80-89; (4) Gemiddeld, kwosiënttelling 90-110; (5) Bogemiddeld, kwosiënttelling 111-120; (6) Uitstekend, kwosiënttelling 121-130; (7) Superieur, kwosiënttelling 131-165.

PROSEDURE

Navorsingsprosedures

Die proefpersone van die geselekteerde huisgesinne is almal binne een week getoets. Die huisgesinne, wat in sewe distrikte woonagtig is, is binne hulle betrokke areas in 'n sentrale lokaal getoets. Hierdie lokaal was binne bereik van die meeste gesinne en dié wat wel buite loopafstand van die lokaal was, is per bussie na die betrokke gebou vervoer. Alle geselekteerde gesinne het ingeligtetoestemmingsvorms onderteken voordat hul kinders aan die studie deelgeneem het. Slegs kinders binne hierdie huisgesinne wat hul samewerking gegee het, is getoets. Die hulp van omgeewerkers wat met die betrokke gesinne in die Thusano-projek werk en aan die kinders bekend is, is gebruik om die toetse aan die kinders te help verduidelik. Sodoende is verseker dat die kind die toetsinstruksies verstaan, wat insgelyks die geldigheid van die navorsing verhoog. Kinders wat onseker en bang was, is gedurende die toets deur hul moeders vergesel ten einde emosionele implikasies uit te skakel.

Die proefpersone wat in die Potchefstroom-omgewing geselekteer is vir die studie, se ouers is vir ingeligte toestemming gevra en nadat dit verkry is, is hulle binne een week by die kleuterskool wat bygewoon is, getoets.

Statistiese prosedure

Die Statistica-rekenaarverwerkingspakket (Statsoft, 2007) is gebruik om die ingesamelde data te verwerk. Beskrywende statistiek is aan die hand van rekenkundige gemiddeldes ($\overline{X}$), standaardafwykings (sa), asook maksimum en minimum waardes ontleed. 'n Ko-variansie analise is uitgevoer om te korrigeer vir verskille tussen ouderdomme van die proefpersone in die onderskeie groepe om sodoende statistiese betekenisvolle verskille ($p \leq 0.05$) asook praktiese betekenisvolle verskille ($Eta^2 = 0.01$ (klein), $Eta^2 = 0.06$ (medium), $Eta^2 = 0.14$ (groot) tussen die groepe te kon bepaal.

RESULTATE

Uit Tabel 1, wat die resultate met betrekking tot die ontwikkelingsouderdom teenoor die chronologiese ouderdom van die groep, asook hoë en lae SES groepe afsonderlik soos bepaal deur die PDMS-2 meetinstrument ontleed, wil dit voorkom of die groep in die geheel se totale waarde in die swak graderingskategorie geval het met betrekking tot die evaluering van

hulle motoriese ontwikkeling. Hulle uitvoeringsvlak van balansering, objekmanipulasie en visueel-motoriese kontrole was tot so veel as vier maande swakker as wat vir kinders van hulle chronologiese ouderdom verwag word. Die groep het in beide fynmotoriese (handgreep en visueel-motories) en grootmotoriese vaardighede (balans, lokomotories en objekmanipulasie) swak gevaar. Ontwikkelingsverskille van tussen 2.68 en 3.42 maande is by fynmotoriese ontwikkeling gevind, terwyl verskille van tussen 1.89 en 4.72 maande by grootmotoriese ontwikkeling voorgekom het.

TABEL 1: **BESKRYWENDE STATISTIEK MET BETREKKING TOT MOTORIESE ONTWIKKELING**

	Groep (N=101)			**Hoë SES (n=34)**			**Lae SES (n=67)**		
	CO	**OO**	**Verskil**	**CO**	**OO**	**Verskil**	**CO**	**OO**	**Verskil**
Grootmotories	$\overline{X}$	$\overline{X}$		$\overline{X}$	$\overline{X}$		$\overline{X}$	$\overline{X}$	
Balans	48.63	44.90	-3.73	59.18	54.30	-4.88	43.28	39.69	-3.59
Lokomotories	48.63	46.74	-1.89	59.18	58.17	-1.01	43.28	40.39	-2.89
Objek M	48.63	43.91	-4.72	59.18	47.93	-11.25	43.28	41.50	-1.78
Fynmotories									
Handgreep	48.63	45.21	-3.42	59.18	57.73	-1.45	43.28	38.38	-4.90
Visueel-M	48.63	45.95	-2.68	59.18	58.60	-0.58	43.28	38.93	-4.35

* $p < 0.05$, CO = chronologiese ouderdom in maande; OO = ontwikkelingsouderdom in maande; Objek-M = objek-manipulasie; Visueel-M = visueel-motories

Dit blyk verder uit Tabel 1 dat die hoë SES groep (n = 34) swakker as die lae SES groep (N = 67) in die uitvoering van twee van die grootmotoriese komponente, naamlik balans en objekmanipulasie gevaar het. Die hoë SES groep se ontwikkeling was verder tussen 1.01 en 11.25 maande swakker as hulle chronologiese ouderdom, terwyl dit by die lae SES groep tussen 1.78 en 3.59 maande is. Die lae SES groep se ontwikkelingsverskille met betrekking tot fynmotoriese vaardighede is egter groter as dié van die hoë SES groep en wissel tussen 4.35 en 4.90 maande ten opsigte van hulle chronologiese ouderdom, terwyl dit by die hoë SES groep tussen 0.58 en 1.45 wissel. Geen betekenisvolle verskille is egter deur middel van t-toetsing ($p \leq 0.05$) tussen die twee groepe se chronologiese en ontwikkelingsouderdom gevind wanneer die bogenoemde resultate met mekaar vergelyk word nie.

Tabel 2 beskryf die liggaamsamestelling van die proefpersone. Dié resultate dui aan dat die lae SES groep minder weeg ($\overline{X}$ = 12.87) en korter ($\overline{X}$ = 0.94) is as die hoë SES groep, maar ook dat die groep jonger ($\overline{X}$ = 43.28 maande), as die ander groep ($\overline{X}$ = 59.18 maande) was wat as 'n moontlike rede vir die laer vetpersentasie ($\overline{X}$ = 13.59) en LMI ($\overline{X}$ =14.91) van dié groep aangevoer kan word.

TABEL 2: **FISIEKE EIENSKAPPE VAN KINDERS IN HOË EN LAE SES**

	Groep (N=101)			**Lae SES (n=67)**			**Hoë SES (n=34)**		
	N	$\overline{X}$	sa	N	$\overline{X}$	sa	N	$\overline{X}$	sa
Ouderdom	101	48.63	17.97	67	43.28	19.28	34	59.18	7.86
Massa	100	14.76	3.74	65	12.87	2.79	35	18.27	2.54
Lengte	99	0.99	0.13	64	0.94	0.13	35	1.09	0.06
Vet%	94	14.52	2.89	62	13.59	2.40	32	16.33	2.93
LMI	98	15.07	2.25	63	14.91	2.67	35	15.35	1.15

Wanneer dié waardes egter beoordeel word aan die hand van persentielskale volgens die gemiddelde ouderdom van die onderskeie groepe kan egter gesien word dat die kinders uit die lae SES groep op ongeveer die vyfde persentiel vir lengte en massa val vergeleke met kinders vanuit hoë SES wat gemiddeld op die 50ste persentiel val (Gallahue & Ozmun, 1995).

Tabel 3 verskaf die groottotale, standaardtellings, persentiele en graderings van al die onderskeie subkomponente van die PDMS-2, asook die betekenisvolheid van verskille tussen kinders vanuit hoë en lae sosio-ekonomiese omstandighede. Uit die graderingskaal wat in die tabel aangedui word, blyk dit dat die groep (lae en hoë SES) in die geheel ondergemiddeld tot gemiddeld in al die komponente van die toets gevaar het. Volgens die ontleding van die standaardtellings en graderings het die groep ’n grensgemiddeld (tussen swak en gemiddeld) vir al die onderskeie subkomponente verkry, waar hulle die swakste in objekmanipulasie en die beste in lokomotoriese vaardighede getoets het. Die persentiele vir die onderskeie subkomponente is 37.81 vir balans, 38.73 vir lokomotories en 30.20 vir objekmanipulasie, terwyl die persentiele vir handgreep 39.82 en visueel-motories 38.54 is.

TABEL 3: **BESKRYWENDE STATISTIEK MET BETREKKING TOT MOTORIESE ONTWIKKELING EN BETEKENISVOLHEID VAN VERSKILLE IN SES IN DIE GROEPE**

	$\overline{X}$	**sa**	**Min**	**Maks**	$\overline{X}$	**sa**	**Min**	**Maks**	$\overline{X}$	**sa**	**Min**	**Maks**
Grootmotories												
Balans – standaard	8.87	2.21	2	15	8.89	2.07	5	15	8.83	2.46	2	13
Balans – persentiel	37.81	23.01	1	95	37.15	22.53	5	95	39.0	24.21	1	84
Balans – gradering	2.74	0.66	1	5	2.81	0.65	1	5	2.60	0.67	1	4
Lokomotories – standaard	8.95	2.22	5	14	8.44	2.04	5	13	9.87	2.26	6	14
Lokomotories – persentiel	38.73	24.03	5	91	33.20	21.88	5	84	48.67	24.88	9	91
Lokomotories – gradering	2.79	0.64	1	4	2.67	0.61	1	4	3.00	0.64	2	4
Objek-manipulasie -												

	$\overline{X}$	sa	Min	Maks	$\overline{X}$	sa	Min	Maks	$\overline{X}$	sa	Min	Maks
Grootmotories												
Standaard	8.23	1.76	5	13	8.60	1.84	5	13	7.60	1.43	5	11
Objek-manipu-lasie – persentiel	30.20	19.16	5	84	34.30	20.40	5	84	23.37	14.82	5	63
Objek-manipu-lasie –gradering	2.55	0.57	1	4	2.68	0.55	1	4	2.33	0.55	1	3
Grootmotories – standaard	26.01	4.10	16	35	25.85	4.13	16	35	26.30	4.10	18	35
Grootmotories – kwosiënt	93.15	14.39	61	127	89.56	12.55	67	115	99.40	15.41	61	127
Grootmotories – persentiel	31.10	18.44	2	77	30.28	18.40	2	77	32.53	18.75	4	77
Grootmotories – gradering	2.46	0.70	1	4	2.38	0.71	1	4	2.6	0.67	1	4
Fynmotories												
Handgreep – standaard	8.78	2.85	1	15	8.42	2.90	1	15	9.43	2.66	2	12
Handgreep – persentiel	39.82	25.84	1	95	35.84	25.98	1	95	47.13	24.31	1	75
Handgreep – gradering	2.60	0.83	1	5	2.53	0.92	1	5	2.73	0.64	1	3
Visueel-motories – standaard	8.94	2.88	1	17	8.15	2.29	4	15	10.37	3.30	1	17
Visueel-motories – persentiel	38.54	27.69	1	99	30.06	22.96	2	95	53.80	29.26	1	99
Visueel-motories – gradering	2.77	0.87	1	5	2.57	0.77	1	5	3.13	0.94	1	5
Fynmotories – standaard	17.71	4.74	7	29	16.56	4.11	9	25	19.80	5.14	7	29
Fynmotories – kwosiënt	91.27	8.80	70	111	90.78	8.88	70	111	92.10	8.76	74	111
Fynmotories – persentiel	37.56	27.45	1	97	29.89	23.23	1	84	51.36	29.39	1	97
Fynmotories – gradering	2.51	0.98	1	5	2.30	0.94	1	4	2.90	0.92	1	5
Totale motories – standaard	43.74	7.68	27	60	42.35	7.40	27	58	46.10	7.70	30	60
Totale motories – kwosiënt	91.19	10.63	68	113	89.14	10.30	68	111	94.53	10.49	73	113
Totale motories – persentiel	31.93	21.46	1	81	27.84	20.30	1	77	38.87	21.89	3	81
Totale motories – gradering	2.41	0.80	1	4	2.27	0.80	1	4	2.63	0.87 0.76	1	4

Wat die groot-, fyn- en totale motoriese komponente betref, dui die graderings en kwosiënte van die komponente aan dat die groep grensgemiddelde waardes in al hierdie komponente behaal het. Die persentiele dui egter aan dat die groep ondergemiddeld ten opsigte van die bogenoemde komponente gevaar het. Die groep lê op die 31.10ste persentiel vir grootmotoriese vaardighede, op die 37.56ste persentiel vir fynmotoriese vaardighede en op die 31.93ste persentiel vir algehele motoriese vaardighede.

Dit blyk verder dat die lae SES kinders oor die algemeen swakker as die hoë SES kinders gevaar het wanneer die twee groepe afsonderlik ontleed word, behalwe in die geval van die subkomponente balans en objekmanipulasie waar die hoë SES kinders se standaardtellings vir hierdie twee subkomponente onderskeidelik 8.83 en 7.60 was teenoor die lae SES kinders se standaardtellings van 8.89 en 8.60. Ten opsigte van die persentiele kan waargeneem word dat die lae SES groep slegs in een subkomponent, objekmanipulasie, beter as die hoë SES groep gevaar het met die tellings onderskeidelik 34.30 en 23.37. In al die ander subskale wat getoets is, is die standaardtellings en persentiele beter in die hoë SES kinders teenoor die lae SES kinders.

Met betrekking tot die totale grootmotoriese persentiele van die twee groepe, lê die lae SES kinders op die 30.28 persentiel terwyl die hoë SES kinders op die 32.53 persentiel lê. Die lae SES kinders lê verder onderskeidelik op die 29.89 en 27.84 persentiel vir fyn- en algehele motoriese vaardighede, terwyl die hoë SES kinders onderskeidelik op die 51.36 en 38.87 persentiel lê.

Die lae SES kinders se kwosiënte vir fynmotoriese ontwikkeling is 90.78, vir grootmotoriese ontwikkeling 89.56 en vir algehele motoriese ontwikkeling 89.14, teenoor dié waardes by die hoë SES kinders wat onderskeidelik 92.10, 99.40 en 94.53 is, wat beteken dat die hoë SES groep volgens die graderingskaal ‘n gemiddelde gradering behaal het en ook beter as die lae SES groep gevaar het in al drie totale. Die lae SES groep het ‘n ondergemiddelde gradering in al drie subskale behaal.

Tabel 4 dui die waardes van ’n kovariansie-analise aan waar daar vir ouderdom gekorrigeer is omdat daar ’n redelike ouderdomsverskil tussen die twee SES groepe was (hoë SES, $\overline{X}$ = 59.18, lae SES $\overline{X}$ = 43.26). Aangepaste gemiddelde waardes is gevolglik vir elke groep bereken en hierdie verskille is met betrekking tot betekenisvolheid vergelyk.

Dié resultate toon dat die verskil in ouderdom tussen die twee groepe wel ’n invloed op twee van die subkomponente sowel as die groot motoriese kwosiënt van die grootmotoriese skaal uitgeoefen het. Die persentiel vir die lokomotoriese standaard ($p = 0.01$, $Eta^2 = 0.08$) die lokomotoriese persentiel ($p = 0.01$, $Eta^2 = 0.08$) asook die grootmotoriese kwosiënt ($p=0.01$, $Eta^2 = 0.09$) het verskille tussen die groepe opgelewer. In al hierdie gevalle het die hoë SES groep betekenisvol beter gevaar. Die standaardtellings vir objekmanipulasie ($p = 0.04$, $Eta^2 = 0.05$), die persentiele vir objekmanipulasie ($p = 0.04$, $Eta^2 = 0.05$), asook die gradering van objekmanipulasie ($p = 0.01$, $Eta^2 = 0.08$) sowel as die persentiel vir balans ($p = 0.04$, $Eta^2 = 0.05$), het ook betekenisvol verskil, maar hier het die lae SES groep betekenisvol beter gevaar.

Betekenisvolle verskille is ook tussen die lae SES en hoë SES groep gevind wat betref verskeie fynmotoriese subkomponente wanneer vir ouderdom gekorrigeer is. Die visueel-motoriese standaardtelling ($p = 0.00$, $Eta^2 = 0.12$), visueel-motoriese persentiel ($p = 0.00$, $Eta^2 = 0.15$) en visueel-motoriese gradering ($p = 0.01$, $Eta^2 = 0.08$ asook die fynmotoriese standaard ($p = 0.01$, $Eta^2 = 0.09$), persentiel ($p = 0.01$, $Eta^2 = 0.11$ en gradering ($p = 0.02$, $Eta^2 = 0.07$) het betekenisvol tussen die groepe verskil. Die hoë SES groep het hier telkens beter gevaar.

TABEL 4: **GEKORRIGEERDE GEMIDDELDE WAARDES VAN DIE MOTORIESE ONTWIKKELING EN DIE BETEKENISVOLHEID VAN VERSKILLE TUSSEN DIE GROEPE**

	GROEP 1 (Lae SES)			**GROEP 2 (Hoë SES)**			**Praktiese betekenisvolheid**			
Grootmotories	N	$\overline{X}$	sa	N	$\overline{X}$	sa	gvv	F	P	Eta^2
Balans-Standaard	54	8.89	2.07	30	8.83	2.46	1	0.35	0.55	0.00
Balans-persentiel	54	37.15	22.53	30	39.0	25.64	1	4.45	0.04*	0.05
Balans-gradering	54	2.81	0.65	30	2.60	0.64	1	0.70	0.40	0.01
Lokomotories-standaard	54	8.44	2.04	30	9.87	2.26	1	6.60	0.01*	0.08
Lokomotories-persentiel	54	33.20	21.88	30	48.67	24.88	1	7.03	0.01*	0.08
Lokomotories-gradering	54	2.67	0.61	30	3.00	0.64	1	2.23	0.14	0.03
Objek-manipulasie-Standaard	50	8.60	1.84	30	7.60	1.43	1	4.47	0.04*	0.05
Objek-manipulasie-persentiel	50	34.30	20.40	30	23.37	14.82	1	4.41	0.04*	0.05
Objek-manipulasie-gradering	50	2.68	0.55	30	2.33	0.55	1	6.40	0.01*	0.08
Grootmotories- standaard	53	25.85	4.13	30	26.30	4.10	1	0.06	0.81	0.00
Grootmotories- kwosiënt	52	89.56	12.55	30	99.40	15.41	1	7.66	0.01*	0.09
Grootmotories- persentiel	53	30.28	18.40	30	32.53	18.75	1	0.06	0.81	0.00
Grootmotories- gradering	53	2.83	0.71	30	2.60	0.67	1	1.14	0.29	0.01
Fyn Motories										
Handgreep-standaard	55	8.42	2.90	30	9.43	2.66	1	1.90	0.17	0.02
Handgreep-persentiel	55	35.84	25.98	30	47.13	24.31	1	2.84	0.10	0.03
Handgreep-gradering	55	2.53	0.92	30	2.73	0.64	1	1.75	0.19	0.02
Visueel-motories- standaard	54	8.15	2.29	30	10.37	3.30	1	10.80	0.00*	0.12
Visueel-motories- persentiel	54	30.06	22.96	30	53.80	29.26	1	14.23	0.00*	0.15
Visueel-motories- gradering	54	2.57	0.77	30	3.13	0.94	1	6.75	0.01*	0.08
Fyn-motories standaard	53	16.56	4.11	30	19.80	5.14	1	7.97	0.01*	0.09
Fynmotories-kwosiënt	51	90.78	8.88	30	92.10	8.76	1	0.24	0.63	0.00
Fynmotories- persentiel	54	29.89	23.23	30	51.36	29.39	1	10.47	0.00*	0.11
Fynmotories- gradering	54	2.30	0.94	30	2.90	0.92	1	5.92	0.02*	0.07
Totale-motories standaard	51	42.35	7.40	30	46.10	7.70	1	3.28	0.07	0.04
Totale-motoriespersentiel	51	27.84	20.30	30	38.87	21.89	1	3.55	0.06	0.04
Totale-motories-gradering	51	2.27	0.80	30	2.63	0.76	1	2.77	0.10	0.03
Totale-motories-kwosiënt	49	89.14	10.30	30	94.53	10.49	1	3.67	0.06	0.05

gvv= vryheidsgrade; $p < 0.05$ *, $Eta^2 = 0.01$ (klein), $Eta^2 = 0.06$ (medium), $Eta^2 = 0.14$ (groot)

BESPREKING VAN RESULTATE

Hierdie studie het ten doel gehad om die moontlike verskille ten opsigte van motoriese en fisieke ontwikkeling van voorskoolse kinders as ’n groep, maar ook afsonderlik volgens verskille in sosio-ekonomiese omstandighede te ontleed. Die lengte en massa gemiddelde waardes wat in die groepe behaal is, dui daarop dat die kinders vanuit die lae SES groep op ongeveer die vyfde persentiel vir lengte en massa val vergeleke met kinders vanuit hoë SES wat gemiddeld op die 50ste persentiel val (Gallahue & Ozmun, 1995). Hierdie resultate is in ooreenstemming met dié van Walker *et al.* (2007), wat groeibelemmering by kinders in ontwikkelende lande aandui. Hierdie agterstande wat by die kinders vanuit swak sosio-ekonomiese omstandighede gevind is, behoort aandag te kry in die vorm van voedingskemas, en meer navorsing oor die aard van voedingstekorte by hierdie kinders word ook aanbeveel.

Uit die resultate van die studie blyk dit dat die lae SES groep swakker gevaar het wat betref die evaluering van hulle motoriese ontwikkeling vergeleke met die hoë SES groep, ongeag die feit dat hulle wel hulp gekry het deur twee keer per week aan opvoedkundige programme blootgestel word (wat motoriese ontwikkeling ook hanteer) en deur maatskaplike werkers gemonitor word. Hulle uitvoeringsvlak was oorwegend swakker in al die subkomponente, uitgesonder balansering en objekmanipulasie. Die beter waardes wat hulle in hierdie subkomponente behaal het kan moontlik toegeskryf word aan die feit dat dié kinders nie in so ’n groot mate blootgestel word aan die tegnologiese era nie, en dalk meer gereeld buite speel waar daar ook groter ruimte is om met balle skop- en vangvaardighede te kan uitvoer. Buite omgewings met natuurlike hindernisse waarop kinders kan klim en klouter leen hulle ook meer tot grootspieraktiwiteite wat balans verg en kan verbeter. Die objekmanipulasie van kinders uit hoë SES het veral beduidende ontwikkelingsagterstande getoon (11.25 maande), en kan waarskynlik daaraan toegeskryf word dat hierdie kinders meer binneshuis vertoef.

Die hoë SES groep se ontwikkelingsouderdom toon beter fynmotoriese vaardigheids-ontwikkeling as dié van die lae SES groep. Die groep se visueel-motoriese en fynmotoriese vaardighede was betekenisvol swakker as die van die hoë SES groep. Hierdie resultate stem ooreen met verskeie navorsers se bevindinge (Kattouf & Steele, 2000; Orfield, 2001; Richmond & Norton, 1973) wat ’n verband tussen lae SES en visueel-perseptuele agterstande gevind het. Die agterstande wat binne hierdie groep gevind is kan moontlik toegeskryf word aan die beskikbaarheid van hulpbronne in die kleuterskole van die hoë SES groep en dalk ook verdere stimulasie in dié verband by die huis. Kinders in die beter sosio-ekonomiese omstandighede het meestal beter toegang tot skêre, inkleurpotlode en akademiese leertake as dié vanuit swakker sosio-ekonomiese omstandighede wat moontlik kon lei tot die voorsprong in dié spesifieke area.

Alhoewel die motoriese ontwikkeling van die kinders vanuit lae SES swakker was as die van die hoë SES groep, het beide groepe se motoriese ontwikkeling aandag nodig aangesien hulle onderskeidelik ’n ondergemiddelde en gemiddelde gradering daarvoor ontvang het. Die verskil tussen die ontwikkelingsouderdom en chronologiese ouderdom van die kinders in die hoë SES groep het gewissel van 1.01 tot 11.25 maande laer as hulle chronologiese ouderdom, terwyl hierdie verskille tussen 1.78 and 3.57 maande in die lae SES groep was. Die lae SES groep se ontwikkeling lê onderskeidelik op die 30ste persentiel vir grootmotoriese en op die 29ste persentiel vir fynmotoriese vaardighede, en op die 27ste persentiel vir algehele

motoriese vaardighede teenoor die 32.53, 51.36 en 38.87 van die hoë SES groep onderskeidelik. Hierdie resultate stem ooreen met Goodway en Branta (2003) se navorsing wat aantoon dat minderbevoorregte kinders ontwikkelingsagterstande ten opsigte van fundamentele vaardighede ondervind.

GEVOLGTREKKING

Navorsers beskou die vroeë kinderjare as dié tydperk wanneer fundamentele motoriese vaardighede, wat as die boublokke vir meer gevorderde beweging beskou word, ontwikkel behoort te word (Goodway & Robinson 2006; Robinson & Goodway, 2009). Daar word in die verband aangedui (Clarke, 2007) dat fundamentele motoriese vaardighede die basiese motoriese behendigheid aan ’n kind bied om ten volle te kan funksioneer in die omgewing op kognitiewe, sosiale en motoriese gebied en ook wat fisieke groei betref. Effektiewe beweging is ook nodig vir suksesvolle deelname aan verskeie vorme van sport en fisieke aktiwititeit en word met gesondheid tydens volwassenheid verbind. Daar word verder aangedui dat fundamentele motoriese vaardighede nie van nature goed ontwikkeld is nie, en dat dit soos enige ander vaardighede aangeleer, geoefen en ingeoefen moet word, terwyl die rol van kundige persone wat vir hierdie ontwikkeling by die kind verantwoordelik is, ook beklemtoon word. Die feit dat die kinders in die lae SES omgewing wel blootstelling aan motoriese ontwikkeling gekry het as deel van ‘n algemene program waaraan hulle blootgestel is, maar steeds swakker gevaar het as die kinders uit hoër sosio-ekonomiese omgewings, bevestig die belang van kundige aanbieding tydens hierdie tipe programme. Hierdie studie se resultate is gevolglik belangrik vir onderwysers en opvoeders wat met kinders vanuit lae SES gebiede of areas werk asook vir die Departement van Onderwys, veral in provinsies waar daar groot areas van swak SES gebiede voorkom. Die resultate vestig ook die aandag op die feit dat daar wel verskille tussen die motoriese en fisieke ontwikkeling van kinders vanuit verskillende SES omstandighede is, en dat voorskoolse kinders se motoriese ontwikkeling volgens hierdie verskille aandag moet kry. Só byvoorbeeld kan basiese opleiding aan onderwysers in lae SES gemeenskappe gegee word oor die motoriese ontwikkeling van kinders en watter tipe aktiwiteite gedoen kan word om die verkryging daarvan te bevorder, of te optimaliseer. Die Departement van Onderwys kan voorts aangemoedig word om te begroot vir apparaat vir hierdie kinders wat motoriese en fisieke vaardighede bevorder. Fynmotoriese en visueel-perseptuele vaardighede van kinders uit lae SES moet veral aandag kry, alhoewel al hulle vaardighede ontwikkelingsagterstande toon. Alhoewel kinders uit hoë SES effens beter gevaar het, dui die resultate aan dat hierdie kinders se ontwikkeling ook aandag moet kry, veral hulle grootmotoriese ontwikkeling. Die resultate van hierdie studie moet egter beoordeel word in die lig van die feit dat ’n klein groepie proefpersone gebruik is. Derhalwe word aanbeveel dat soortgelyke navorsing op ’n groter proefgroep gedoen moet word en dat daar meer indringend na die rol wat ras en beter sosio-ekonomiese omstandighede speel, ondersoek ingestel moet word.

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SUMMARY

The physical and motor development of pre-school children in different socio-economic environments : Thusano study

Research findings indicate that poor socio-economic status (SES) has a negative effect on gross and fine motor development of children. The aim of this study was to analyse the possible differences between physical and motor development of pre-school children within poor SES and higher SES. A group of 67 children between four and 71 months were identified according to a random stratified sample of 50 families in the Thusano project with a poor socio-economic status. A group of 34 pre-school children, aged between 48 and 73 months from better socio-economic backgrounds were also used in the study.

The physical development of the group was evaluated using measurements of height, weight and skinfolds (triceps, subscapular and calf). The “Peabody Developmental Motor Scales - 2*”* (PDMS-2) measuring instrument was used to determine the motor developmental status (fine motor, gross motor and overall motor development) of the children.

The results indicated that children from the lower SES group were shorter and weighed less although they were younger than the children from higher SES. Age group percentiles for mass and stature, however, indicate that the mean mass and stature of the poor SES group correspond with the 5th percentile, compared to the high SES group who fell upon the 50th percentile, indicating growth deficiencies in the poor SES group. Regarding the gross and fine motor development of the different groups, the developmental age was firstly compared with chronological age and the results showed that the developmental age of children with higher SES status were between 1.01 and 11.25 months lower than their chronological age, compared to differences which ranged between 1.78 and 3.57 in the lower SES group. The results further indicated that the group (low SES and high SES) fared average to below average in all the components of the test, obtaining the lowest grading in object manipulation and the highest in locomotor abilities. Children from lower SES generally performed worse than those from higher SES except in the subcomponents balance and object manipulation. Because of slight differences in age between the two groups, a co-variance of analysis, adjusted for age differences was computed, which indicated that children from better a better socio-economic environment performed predominantly better regarding most of the motor skills compared to the children growing up in poor socio-economic environments, although the motor development of both groups needs attention. Statistical and practical significant differences ($p \leq 0.05$, $Eta^2 > 0.01$) indicated poorer development in the low SES group regarding their locomotor, visual-motor and fine motor standards, percentiles and gradings and the gross motor quotient. Their balance and object manipulation were, however, better compared to the children in the low SES group. The results found in this study are in

agreement with other research findings (Kattouf & Steele, 2000; Orfield, 2001; Goodway & Branta, 2003). These results substantiate that the motor development of children living in poor socio-economic conditions are hampered by their environment, and that they should receive additional attention to prevent deficits in this regard. The gross motor development of children from higher socio-economic circumstances should, however, also receive attention.

Similar studies using larger samples are recommended to substantiate the findings of this study, while more in-depth analysis should also be made of the influences and relationships that were found in this study in regard to the physical, fine and gross motor development of children.

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DIE EFFEK VAN GROEI EN RYPING OP MOTORIESE EN FISIEKE VERMOËNS, ASOOK RUGBYVAARDIGHEDE VAN VROEË-, MIDDEL EN LAAT ONTWIKKELENDE RUGBYSPELERS: 'N LONGITUDINALE ONDERSOEK

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ABSTRACT

The aim of this study was to determine the effect of growth and maturation over a period of three years on the physical and motor abilities and rugby skills of talented young rugby players aged 15 to 18 years. Differences between early developers (ED) (n = 4), average developers (AD) (n = 13) and late developers (LD) (n = 1) were also assessed over the three-year period. Flexibility, leg and back strength, muscle endurance, speed and aerobic endurance were measured using different standardized tests. Differences over the three-year period were analysed within and between groups using descriptive statistics, repeated measurements over time and two-way Analysis of Variance. An analysis adjusting for race and playing position was also performed to evaluate the role of these characteristics in the results. Results indicated no significant differences in physical and motor abilities or rugby skills of players between ages 15 and 18 years, although significant improvement was seen in flexibility and explosive strength of early and average developers. Furthermore race showed an effect on strength measurements (especially leg strength), and player position on leg strength and aerobic endurance, while the effect of late development seems to shrink as boys grow older.

Key words: Early developers; Average developers; Late developers; Motor abilities; Physical abilities; Maturation.

INLEIDING

Kompetisiesport speel 'n belangrike rol in die samelewing (Anderson & Ward, 2002). Dit is algemene praktyk om kinders met dieselfde chronologiese ouderdom in amateursport teen mekaar te laat deelneem. Fisieke vermoëns hou verband met biologiese ryping gedurende die manlike adolessensiefase (Spamer, 2009), en hierdie verband is meer opvallend wanneer seuns van verskillende rypingsgroepe met mekaar vergelyk word (Philippaerts *et al*., 2006). Navorsers (Bloomfield *et al.*, 1994; Malina *et al.* 2004) dui aan dat die tydperk tussen nege en 16 jaar die fase is waartydens die duidelikste variasies sal voorkom in grootte, fisieke liggaamstelling, krag en motoriese prestasie as gevolg van individuele fisieke veranderinge wat met groei gepaard gaan. Volgens literatuur kan seuns met dieselfde chronologiese ouderdom in hierdie tydperk tot soveel as vyf tot ses jaar van mekaar verskil met betrekking

tot biologiese ouderdom (Woodman, 1985; Noakes & Du Plessis, 1996). Literatuur wys daarop dat vroeë ontwikkelende seuns (VO) langer, swaarder en sterker is as laat ontwikkelaars (LO) en sodoende op skoolvlak gewoonlik meer suksesvol in kompetisiesport is, veral in dié sportsoorte waar krag 'n vereiste is (Bloomfield *et al.*, 1994; Docherty, 1996; Kemper *et al.*, 1997; Malina *et al.*, 2004). Dit blyk egter dat dit nie altyd hierdie vroeë ontwikkelaars is wat later as provinsiale of nasionale spelers suksesvol is nie, maar dikwels eerder die laat ontwikkelaar (Abbot & Collins, 2002). Noakes en Du Plessis (1996) skryf hierdie verskynsel toe aan die feit dat vroeë ontwikkelaars op 'n vroeë ouderdom ophou groei. Die aanvanklike kleiner en ligter skoolseuns wat na skool aanhou groei, is gevolglik dié wat dikwels die langer lengtes en groter massas bereik – eienskappe wat belangrik is vir sukses in internasionale rugby (Bloomfield *et al.*, 1994). 'n Speler kan gevolglik op 'n jong ouderdom uitstaan as 'n talentvolle speler as gevolg van vroeë ontwikkeling, maar sal nie noodwendig wanneer alle seuns van sy ouderdom volwasse status bereik het, steeds die beste vertoon nie.

Die doel van hierdie studie is gevolglik om die effek van groei en ryping, oor 'n tydperk van drie jaar (tussen 15 en 18-jarige ouderdom) op die fisieke vermoëns, motoriese vermoëns asook rugbyvaardighede van vroeë, gemiddelde- en laat ontwikkelende talentvolle rugbyspelers afsonderlik te bepaal. Die moontlike verskille in die vermoëns tussen vroeë-, gemiddelde- en laat ontwikkelaars sal ook oor die driejaartydperk ontleed word.

METODE VAN ONDERSOEK

Navorsingsontwerp

Hierdie navorsing is gebaseer op 'n driejaar- longitudinale navorsingsontwerp. Die Etiekkomitee van die Noordwes-Universiteit het die studie goedgekeur (nr. 01M12). 'n Inligtingsbrief wat die doel van die projek verduidelik het, waarna ingeligte toestemming deur die speler / ouer gegee moes word, is vooraf aan elke speler oorhandig. Slegs spelers wat ingestem het of wie se ouers toestemming verleen het, is in die studie ingesluit.

Proefpersone

Seuns uit skole in die Noordwes Provinsie is op 15- of 16-jarige ouderdom deur verskeie rugbykeurders as talentvolle rugbyspelers geïdentifiseer. Hierdie spelers (n=23) is op chronologiese ouderdom van 15-16 jaar geïdentifiseer en is vervolgens vir 'n tydperk van drie jaar blootgestel aan topvlakafrigting ten einde op 18-jarige ouderdom (2005) 'n goed gekondisioneerde span in die provinsie op te lewer. Van die groep spelers (n=23) wat in 2003 geïdentifiseer is, het vyf (n=5) in 2005 nie meer deel uitgemaak van die groep nie. Die mees algemene rede vir die uitval van spelers was beserings gedurende die drie jaar, wat aanleiding gegee het tot onvolledige data. Die oorblywende 18 spelers is oor 'n tydperk van drie jaar heen aan herhaalde metings onderwerp terwyl toetsgeleenthede eenmaal per jaar plaasgevind het. Skeletale sowel as seksuele rypheidstatus, motoriese en fisieke vermoëns asook sportspesifieke en psigologiese vaardighede is tydens hierdie toetsgeleenthede getoets. Die agtien spelers is geklassifiseer as vier vroeë ontwikkelaars (VO), 13 gemiddelde ontwikkelaars (GO) en een laat ontwikkelaar (LO) (sien metode hieronder).

Bepaling van skeletale ouderdom

'n X-straalplaat van die linkerhand-gewrig van elke proefpersoon is een keer per jaar van 2003 tot 2005 geneem. Skeletale ouderdom soos beskryf deur die GP (Greulich-Pyle)-metode (Malina *et al*., 2004) is bepaal deur 'n radioloog en dié evalueerder is vir die volle duur van die studie gebruik. Die uitslag van die x-straalplate is deur die radioloog volgens die GP atlasmetode (gebaseer op halfjaar intervalle) ontleed en die ouderdom wat die meeste daarmee ooreengestem het, is genoteer as die proefpersoon se beenouderdom. Volgens die resultate van die beenouderdom is die groep in vroeë, gemiddelde- en laat ontwikkelaars verdeel. Die proefpersone met 'n beenouderom wat meer as een jaar groter as die chronologiese ouderdom was, is as vroeë ontwikkelaars geklassifiseer, terwyl dié wat met minder as een jaar (groter of kleiner) van die chronologiese ouderdom verskil het, in die gemiddelde-ontwikkelaarsgroep geklassifiseer is. Die proefpersone met 'n beenouderom wat meer as een jaar laer as die chronologiese ouderdom was, is as 'n laat ontwikkelaar geklassifiseer (Malina *et al.*, 2004)

Fisieke evaluering deur standaardtoetse

Fisieke en motoriese vermoëns is geëvalueer. Lengte is genoteer as die meting van die grond af tot by die verteks (Marfell-Jones *et al*., 2006). Massa is geneem op 'n gekalibreerde skaal en genoteer tot die naaste 0.1 kg. Spelers is in onderklere en sonder skoene aan geweeg (Marfell-Jones *et al.*, 2006).

Soepelheid van die hampese spiergroep is geneem deur middel van 'n goniometer. In 'n supinasie-posisie is die aksis van die goniometer op die laterale aspek van die heupgewrig geplaas, met die groter troganter as verwysingspunt. Die statiese arm is op die midlyn van die pelvis geplaas terwyl die bewegingsarm op die laterale midlyn van die femur geplaas is, met die laterale epikondiel as verwysingspunt. Beide bene moet reguit gehou word terwyl een been met 'n slag so ver moontlik deur 'n toetsafnemer na die bors gedruk word (Hayward, 2002).

'n Vertikale en horisontale sprong is gebruik om eksplosiewe krag te bepaal. Tydens die metings van die vertikale sprong is 'n maatlyn (in cm) teenaan 'n muur aangebring. Die proefpersoon staan dan vervolgens met sy regterskouer teenaan die muur en strek sy arm uit sodat 'n reikhoogte aangeteken kan word volgens die punt waar die langste vinger raak. Vervolgens word daar gespring deur van albei bene gebruik te maak asook swaaibewegings van die arms. Die proefpersoon spring so hoog as moontlik en die afstand tussen die reikhoogte en springhoogte word bereken en aangeteken (Hayward, 2002). Met die evaluering van die horisontale sprong neem die proefpersoon stelling in op 'n reguit lyn met voete skouerbreedte uitmekaar. Die proefpersoon spring dan so ver moontlik vorentoe van albei voete af. Proefpersone word aangemoedig om hul arms te swaai en knieë te buig ter voorbereiding vir die sprong. Die afstand (in cm) word bepaal van die punt af waar gespring is tot by die hak (nadat die sprong uitgevoer is) (Hayward, 2002).

Die 7-Vlak maagkragtoets is gebruik ten einde die krag van die abdominalespier-groepe te bepaal. Sewe verskillende vlakke waarvan elke vlak progressief moeiliker word, is tydens hierdie analise gebruik (Ellis *et al.*, 2000).

Ten einde rugkrag te bepaal, is proefpersone op 'n platvorm geplaas met knieë ten volle geekstensieer en kop en bolyf reguit met 'n 90°-buiging by die heupe. 'n Band word dan aan 'n handvatsel vasgemaak wat gekoppel is aan dinamometer en bo-oor die bo-rug geposisioneer. Sonder om terug te leun word 'n opwaartse beweging dan uitgevoer deur van die rugspiere gebruik te maak. Twee probeerslae word toegelaat en die beste poging word in Nm (Newtonmeter) aangeteken (Hayward, 2002). Tydens die meting van beenkrag word proefpersone geposisioneer op 'n platvorm met rûe reguit en knieë 130°-140° gebuig. Die proefpersoon hou aan 'n handvatsel vas (wat gekoppel is aan 'n dinamometer) met 'n pronasie-greep bokant die dye deur die lengte van die ketting te verstel soos nodig vir elke individu. 'n Band word oor die heupe geposisioneer, en met die gebruik van die beenspiere pas die proefpersoon soveel krag as moontlik toe. Twee probeerslae met twee minute se rus tussen elkeen word toegelaat. Die maksimum waarde (in Nm) word genoteer (Hayward, 2002).

Greepkrag van die linker- en regterhand word deur middel van die dinamometer gemeet. Tydens die afneem van die toets is proefpersone gevra om regop te staan, met arms reguit langs die sye. 'n Drukaksie, van een maksimale kontraksie word vervolgens uitgevoer. Die beste probeerslag uit twee is in kg aangeteken (Morrow *et al*., 2005).

Opsitte en optrekke is gebruik om spieruithouvermoë van onderskeidelik die abdominale en arm- en skouergordelspiere te bereken. Opsitte is uitgevoer deur hande oor die bors te kruis. Die bene is 90° gebuig en voete is deur 'n helper vasgehou. Die maksimum aantal opsitte in twee minute uitgevoer, is aangeteken (Morrow *et al.*, 2005). Met die uitvoer van optrekke is 'n proefpersoon gevra om aan 'n horisontale stang te hang met arms en bene ten volle geekstensieer en voete wat nie aan die vloer raak nie. Met handpalms wat weg van die liggaam af wys en voete wat stil hang, trek die proefpersoon homself op totdat sy ken bo-oor die stang is en laat sak homself weer tot by die beginposisie. Hierdie beweging word gevolglik herhaal totdat die proefpersoon uitgeput is, en die totaal word dan aangeteken (Morrow *et al*., 2005).

Spoed is op onderskeidelik 10 m en 40 m getoets. Tydens hierdie meting is spoedmonitors op onderskeidelik 10 m en 40 m opgestel. Die proefpersoon neem 'n gereedposisie agter 'n gemerkte lyn in en op "gaan" nael die proefpersoon so vinnig as moontlik verby die opgestelde spoedliggies. Die afstandbeheerder registreer vervolgens die tyd op 10 m en 40 m en die tye (in sekondes) word genoteer (Ellis *et al*., 2000).

Ratsheid is volgens die Illinois ratsheidstoets bepaal. Die toets is op 'n rugbyveld opgestel, word uitgevoer met 'n rugbybal waarvan albei hande ten tye van die toets op die bal moes gewees het, en tyd word in sekondes aangeteken.

Anaërobiese uithouvermoë is ontleed deurdat die proefpersoon so vinnig as moontlik (binne een minuut) te hardloop in 'n 20 m afgemerkte area. Die maksimum kere wat volledig voltooi is, word aangeteken. Die bleep-toets is gebruik as 'n indirekte aanduider van aërobiese uithouvermoë.

Twee rugbyvaardigheidstoetse is ook geëvalueer. Uitgee vir akkuraatheid (links en regs) is gedoen deur 'n proefpersoon wat posisie agter 'n lyn (± 3 meter) van 'n teiken (ronde ring) af inneem (Pienaar *et al*., 1998). Die deursnee van die ring is 50 cm en is gemonteer op 'n staander wat 50 cm van die grond af is. Die teiken is 4 m weg, en die proefpersoon kry

vervolgens 10 kanse om na elke kant die bal deur die teiken te probeer aangee. Skop vir afstand is gebruik om die verste afstand wat 'n proefpersoon (in meter) kan skop te bepaal. Proefpersone het posisie ingeneem voor 'n reguit lyn (± 2 meter) vanaf 'n skoplyn. Die proefpersoon moet dan poog om die bal so ver as moontlik te skop. Die afstand van die afskoplyn af tot waar die bal eerste die grond tref, word aangeteken. Drie probeerslae is toegelaat, en slegs die beste afstand is aangeteken (Pienaar *et al*., 1998).

Statistiese verwerking

Die STATISTICA program (StatSoft, 2006) vir Windows is gebruik vir die statistiese analise van die data. Eerstens is daar van beskrywende statistiek gebruik gemaak en is die minimum en maksimum waardes, standaardafwykings en gemiddeldes gerapporteer. Vervolgens is daar van die herhaalde metings oor tyd analise en van tweerigting variansie-analise gebruik gemaak om statistiese en praktiese betekenisvolle verskille rakende die motoriese en fisieke vermoëns asook rugbyvaardighede van elke groep afsonderlik, asook tussen die groepe oor die drie jaar heen te bepaal. Daar is vervolgens ook vir ras en vir spelposisie in die analise gekorrigeer ten einde die moontlike rol van die veranderlikes in die resultate te bepaal. Die resultate van die een laat ontwikkelaar is as 'n gevallestudie in die artikel hanteer.

RESULTATE

Tabel 1 bied 'n beskrywing van die spelers se ras en spelposisies, soos geklassifiseer op 15.6-jarige ouderdom (2003) as vroeë (n=4), gemiddelde- (n=13) en laat ontwikkelaars (n=1).

TABEL 1. **BESKRYWENDE INLIGTING VAN SPELERPOSISIES EN RAS SOOS IN DRIE RYPINGSGROEPE VERDEEL**

	Vroeë ontwikkelaars	**Gemiddelde-ontwikkelaars**	**Laat ontwikkelaars**
	N	**N**	**n**
Aantal spelers in verskillende groepe	4	13	1
Wit	2	6	1
Bruin	1	1	-
Swart	1	6	-
Vastevoorspelers	2	2	-
Losvoorspelers	-	4	-
Agterspelers	2	7	1

Die vroeë ontwikkelaarsgroep het twee vastevoorspelers en twee agterspelers ingesluit, terwyl die gemiddelde ontwikkelaars vier vastevoorspelers, twee losvoorspelers en sewe agterlynspelers in die groep opgelewer het. Die enigste laat ontwikkelaar in die groep was 'n agterlynspeler. As die groep ten opsigte van ras ontleed word, blyk dit dat daar in die groep vroeë ontwikkelaars twee wit spelers, een bruin en een swart speler is, die gemiddelde ontwikkelaarsgroep uit ses wit, een bruin en ses swart spelers bestaan het, terwyl die laat ontwikkelaar 'n wit speler was. Die vastevoorspelergroep het uit twee wit en twee swart

spelers bestaan, die losvoorspelergroep uit drie wit spelers en een swart speler, terwyl die agterlynspelergroep uit vier wit, vier swart en twee bruin spelers bestaan het

TABEL 2. **BESKRYWENDE STATISTIEK VAN CHRONOLOGIESE EN BIOLOGIESE OUDERDOM VAN DIE SPELERS VAN 2003 TOT 2005**

		2003 (A)				2004 (B)				2005 (C)			
VERANDERLIKES	**G**	**X**	**SA**	**MIN**	**MK**	**X**	**SA**	**MIN**	**MK**	**X**	**SA**	**MIN**	**MK**
CO	1	15.8	0.60	15.1	16.4	16.8	0.60	16.1	17.4	17.8	0.6	17.1	18.4
	2	16.3	0.27	15.8	16.7	17.3	0.27	16.8	17.7	18.3	0.27	17.7	18.7
	3	15.10		15.10	15.1	16.10		16.10	16.10	17.1		17.10	17.1
BO	1	17.4	0.75	16.5	18.0	17.5	0.71	16.5	18	18.2	0.24	18.0	18.5
	2	16.8	0.32	16	17	17.2	0.33	16.5	17.6	18.2	0.20	18.0	18.5
	3	14		14	14	16.5		16.5	16.5	17.5		17.5	17.5
Verskil BO_CO:VO	1	1.6	0.25	1.4	1.10	0.9	0.41	0.0	1.4	0.6	0.81	-0.4	1.5
Verskil BO-CO:GO	2	0.5	0.32	-0.2	1.0	-0.1	0.33	-0.7	0.5	-0.1	0.20	-0.7	0.5
Verskil BO-CO:LO	3	-1.10		-1.10	-1.10	-0.5		-0.5	-0.5	-0.5		-0.5	-0.5

G = groep, 1 = vroeë ontwikkelaar; 2 = laat ontwikkelaars; CO = chronologiese ouderdom; BO = biologiese ouderdom.

Vroeë ontwikkelaars (Groep 1) se biologiese ouderdom het ’n toename van 0.1 maande van 2003 tot 2004 (jaar 1– jaar 2), en 0.9 maande van 2004 tot 2005 (jaar 2– jaar 3) getoon (Tabel 2). Gemiddelde ontwikkelaars (Groep 2) het 0.6 maande (2003-2004) en 12 maande (2004-2005) onderskeidelik gegroei met betrekking tot biologiese ouderdom, en hierdie toenames oor die driejaartydperk was betekenisvol. Die Laat ontwikkelaar het 2.5 jaar ouer geword met betrekking tot skeletouderdom van 2003 tot 2004, met ’n verandering van een jaar van 2004 tot 2005. Oor die algemeen blyk dit gevolglik dat die laat ontwikkelaar in hierdie drie jaar die meeste gegroei het met betrekking tot skeletouderdom (42 maande), gevolg deur die GO- (18 maande) en VO-spelers (10 maande). Alhoewel hierdie LO steeds ’n laer skeletouderdom as die GO en VO in 2005 toon, blyk die verskil kleiner te geword het namate die speler gegroei het. Tabel 2 toon ook dat die VO in 2005 (laaste jaar van meting) ’n hoër skeletouderdom as chronologiese ouderdom toon, terwyl die GO se skeletouderdom een maand en die LO vyf maande onder die chronologiese ouderdom is.

Tabel 3 toon die beskrywende inligting van die fisieke en motoriese vermoëns en Tabel 4 van die rugbyvaardighede van die spelers in die verskillende ontwikkelingsgroepe oor ’n driejaartydperk aan, asook of daar verskille tussen die groepe was in elke jaar maar ook binne elke groep oor die tydperk van drie jaar. Biologiese ouderdom het in 2003 betekenisvol

verskil ($p<0.05$), alhoewel die verskille nie in die tabel aangedui word nie. Geen betekenisvolle verskille is tussen die GO- en VO-groepe in elk van die drie jaar van meting gevind met betrekking tot fisieke en motoriese vermoëns en rugbyvaardighede nie. Daar het egter wel prakties betekenisvolle veranderinge oor die driejaartydperk binne die verskillende rypingsgroepe voorgekom. Aangesien die studie slegs een laat ontwikkelaar (LO) opgelewer het, kan laat ontwikkelaars nie as 'n groep in die studie ontleed word nie, maar is dit belangrik geag om ook die waardes wat hierdie speler behaal het, in die verskillende motoriese en fisieke vermoëns te rapporteer en die speler soos in 'n gevallestudie te bestudeer ten einde 'n duideliker beeld van groeitendense wat by laat ontwikkelaars mag voorkom, te kan uitlig.

Slegs drie vermoëns het prakties betekenisvolle binngegroepverbeteringe van 2003 tot 2005 getoon, naamlik hampese-soepelheid (L) en twee eksplosiewekrag-waardes. Hampese-soepelheid (L) het slegs by die GO-groep vanaf 2003 tot 2005 betekenisvol verbeter. Eksplosiewe beenkrag, soos gemeet in vertikale en horisontale spronge, was die enigste ander vermoëns wat by die VO sowel as die GO betekenisvol van 2003 tot 2005 verbeter het, alhoewel die verskille tussen die VO en die GO nie in enige van die drie metingsjare betekenisvol was nie. Ander kragvermoëns wat oor die tydperk van drie jaar toenames getoon het, was been- en rugkrag, alhoewel hierdie toenames nie betekenisvol was nie en gevolglik as tendense beoordeel moet word. Skop vir afstand het ook oor die tydperk in al die groepe verbeter, alhoewel ook nie betekenisvol nie. Die verbetering wat in beenkrag waargeneem kan word, kon dalk bygedra het tot die verbetering in eksplosiewe beenkrag en skopafstand wat by die groepe gevind is. Die bleep-vlakke (wat 'n indirekte bepaling van aërobiese vermoëns is) het ook toegeneem in albei groepe oor die tydperk van drie jaar, alhoewel ook nie betekenisvol nie.

Verbetering by die laat ontwikkelaar was soortgelyk aan dié van die VO- en GO-groepe in hierdie tydperk in die meeste vermoëns. Die laat ontwikkelaar se rug- en beenkragwaardes asook sy aërobiese kapasiteit het egter veral verbetering getoon en was ook heelwat hoër as dié van VO- en GO-spelers in 2005. Hierdie verskille kon egter nie vir betekenisvolheid ontleed word nie, omdat daar slegs een laat ontwikkelaar in die groep was. Daar het ook tendense na vore gekom waarby sekere kragtoetse 'n afnemende tendens oor die tydperk van drie jaar by die spelers getoon het soos maagspierkrag en opsitte. Dit kan wees dat die spelers nie maksimale pogings aangewend het toe hierdie toetse uitgevoer is nie, veral as minimum en maksimum waardes in hierdie toetse in 2005 met dié tydens 2003 vergelyk word. In terme van die rugbyvaardighede blyk dit of daar nie werklik enige tendense voorgekom het binne groepe of tussen groepe nie. Die LO toon egter weereens beter resultate in veral skop vir afstand en uitgee vir akkuraatheid.

TABEL 3. **BESKRYWENDE STATISTIEK ASOOK STATISTIESE BETEKENISVOLLE VERSKILLE VAN FISIEKE VERMOË VIR VROEË, GEMIDDELDE- EN LAAT ONTWIKKELAARS VAN 2003 TOT 2005**

		2003 (A)				2004 (B				2005 (C)				
VERANDER GLIKES		**X**	**SD**	**MIN**	**MK**	**X**	**SD**	**MIN**	**MK**	**X**	**SD**	**MIN**	**MK**	**Prakties betekenisvol-heid**
	1	74.5	4.04	71.0	80.0	81.5	2.38	79.0	84.0	78.8	14.4	58.0	91.0	
Str leg hamst	2	76.7	13.17	43.0	95.0	81.0	16.3	50.0	102	80.7	11.68	59.0	101.0	A-C*
(L) (°)	3	80.0		80.0	80.0	89.0		89.0	89.0	99.0		99.0	99.0	
	1	74.8	8.38	67.0	86.0	75.0	8.12	65.0	83.0	76.8	13.0	65.0	92.0	
Str leg hamst	2	76.4	14.99	41.0	96.0	80.0	18.0	37	97	82.5	13.43	53.0	105.0	
(R) (°)	3	85.0		85.0	85.0	95.0		95.0	95.0	89.0		89.0	89.0	
	1	46.0	4.55	40.0	50.0	44.5	3.70	39.0	47.0	53.3	4.8	48.0	59.0	B-C*
Vertikale	2	46.7	7.73	34.0	60.0	50	5.1	40	58	52.5	7.17	42.0	65.0	A-C*
sprong (m)	3	40.0		40.0	40.0	59.0		59.0	59.0	43.0		43.0	43.0	
	1	208.0	10.13	195.0	217.0	243.8	6.24	240.0	253.0	243	10.7	232	257.0	A-B*, A-C*
Horisontale	2	221.3	23.48	166.0	258.0	243	24.0	200	280	248	19.97	214	281.0	A-B*, A-C*
sprong (m)	3	207.0		207.0	207.0	240.0		240.0	240.0	249		249	249.0	
	1	4.5	2.08	2.0	7.0	4.8	2.06	2.0	7.0	4.0	2.2	2.0	7.0	
7 vlak	2	4.9	1.80	2.0	7.0	4	2.0	2	7	4.8	1.91	2.0	7.0	
maagkrag (vlak)	3	7.0		7.0	7.0	6.0		6.0	6.0	6.0		6.0	6.0	
	1	127.9	28.94	100.0	168.5	127.4	40.48	67.0	153.5	140.9	41.4	98.5	191.5	
Rugkrag (Nm)	2	133.8	42.42	59.0	190.5	120	54.7	50	235	123.2	54.79	51.0	193.0	
	3	131.0		131.0	131.0	211.5		211.5	211.5	203.5		203.5	203.5	
	1	213.8	62.69	142.5	291.5	195.8	41.0	160.0	237.0	230.0	68.2	153.5	319.5	
Beenkrag (Nm)	2	234.3	71.16	135.0	319.0	223	69.1	122	319	250.1	72.97	126.3	321.5	
	3	231.5		231.5	231.5	235.5		235.5	235.5	318.5		318.5	318.5	
	1	52.9	7.47	43.0	60.0	44.3	13.24	30.0	56.5	49.0	7.6	43.1	59.6	
Handgreep (L)	2	49.7	8.61	38.0	66.0	47.3	10.8	35	58	49.1	9.68	37.4	61.8	A-B*, B-C*
(Nm)	3	53.0		53.0	53.0	60.0		60.0	60.0	65.2		65.2	65.2	
	1	55.3	10.72	41.0	67.0	47.5	11.87	36.0	61.5	53.6	9.2	44.9	62.1	
Handgreep (R)	2	52.8	10.63	35.0	73.0	47	11.2	29	64	51.3	9.53	37.0	69.4	A-B*
(Nm)	3	60.0		60.0	60.0	59.0		59.0	59.0	61.1		61.1	61.1	
	1	58.0	14.72	43.0	78.0	47.8	4.57	43.0	53.0	51.0	12.7	38.0	68.0	
Opsitte (aantal)	2	62.5	15.57	44.0	105.0	59	13.0	42	86	58.8	16.26	38.0	91.0	
	3	62.0		62.0	62.0	71.0		71.0	71.0	60.0		60.0	60.0	
	1	8.0	3.37	6.0	13.0	8.3	4.79	4.0	15.0	7.0	3.6	4.0	11.0	
Optrekke	2	8.9	4.42	3.0	18.0	13	5.1	2	20	9.5	4.94	1.0	17.0	A-B*, B-C*
(aantal)	3	10.0		10.0	10.0	10.0		10.0	10.0	11.0		11.0	11.0	
	1	1.9	0.13	1.8	2.1	1.8	0.09	1.8	2.0	1.9	0.0	1.8	1.9	
10m spoed (m)	2	1.9	0.08	1.7	2.0	2	0.1	2	2	1.8	0.07	1.8	2.0	
	3	1.9		1.9	1.9	1.9		1.9	1.9	1.9		1.9	1.9	
	1	5.8	0.24	5.5	6.0	5.6	0.23	5.5	5.9	5.5	0.1	5.3	5.7	
40m spoed (m)	2	5.7	0.25	5.3	6.1	6	0.2	5	6	5.6	0.26	5.2	6.2	
	3	5.7		5.7	5.7	5.6		5.6	5.6	5.6		5.6	5.6	
	1	18.7	0.39	18.2	19.1	18.9	0.69	18.3	19.5	18.4	0.7	17.5	19.3	
Ratsheid (sek)	2	18.3	0.72	17.4	19.5	18	0.8	17	20	18.4	0.77	16.9	19.8	
	3	17.9		17.9	17.9	18.3		18.3	18.3	17.5		17.5	17.5	
	1	12.3	0.50	12.0	13.0	12.3	0.50	12.0	13.0	12.9	0.9	12.0	14.0	
Uithouvermoë	2	12.7	0.69	11.5	14.0	12	0.9	11	14	12.3	0.67	11.0	13.5	
(20 m)	3	11.0		11.0	11.0	12.0		12.0	12.0	13.0		13.0	13.0	

		2003 (A)				2004 (B				2005 (C)				
VERANDER GLIKES	**G**	**X**	**SD**	**MIN**	**MK**	**X**	**SD**	**MIN**	**MK**	**X**	**SD**	**MIN**	**MK**	**Prakties betekenisvol-heid**
	1	8.8	2.19	6.1	11.0	9.4	2.22	7.1	12.0	9.8	2.5	6.2	12.0	
Bleep (vlak)	2	9.2	2.65	6.0	13.1	10	1.8	7	12	9.6	1.92	7.1	12.6	
	3	8.1		8.1	8.1	12.1		12.1	12.1	13.1		13.1	13.1	

G= groep, 1 = vroeë ontwikkleaar; 2= gemiddelde -ontwikkelaars; 3= laat ontwikkelaar;
°= grade; L= Links; R= Regs; m= meter; Nm= Newton; x= gemiddeld

TABEL 4. **BESKRYWENDE STATISTIEK ASOOK STATISTIES BETEKENSIVOLLE VERSKILLE VAN MOTORIE VERMOËNS ASOOK RUGBYVAARDIGHEDE VAN VROEË, GEMIDDELDE- EN LAAT ONTWIKKELAARS VANAF 2003 TOT 2005**

		2003				2004				2005				
VERANDER- LIKES	**G**	**X**	**SD**	**MIN**	**MK**	**X**	**SD**	**MIN**	**MK**	**X**	**SD**	**MIN**	**MK**	**Prakties Betekenisvol-heid**
	1	2.0	0.82	1.0	3.0	2.0	0.0	2.0	2.0	2.3	1.9	1.0	5.0	
Uitgee akkur	2	2.1	1.19	0.0	4.0	3	1.0	1	4	2.2	1.59	0.0	5.0	
(L) (aantal)	3	6.0		6.0	6.0	2.0		2.0	2.0	1.0		1.0	1.0	
	1	2.0	1.15	1.0	3.0	2.8	1.50	1.0	4.0	2.5	1.3	1.0	4.0	
Uitgee akkur	2	2.4	1.19	0.0	4.0	3	1.0	1	5	2.5	1.51	0.0	5.0	
(R) (aantal)	3	3.0		3.0	3.0	1.0		1.0	1.0	3.0		3.0	3.0	
	1	39.4	4.76	32.6	43.3	41.5	5.89	36.2	47.7	42.1	5.6	38.6	50.5	
Skop v afstand	2	41.7	5.89	32.2	51.2	43	6.7	29	53	43.4	8.52	31.6	59.4	
(m)	3	47.7		47.7	47.7	47.3		47.3	47.3	51.8		51.8	51.8	

G= groep; 1 = vroeë ontwikkelaar; 2= gemiddelde ontwikkelaars; 3= laat ontwikkelaar;
L= Links; R= Regs; m = meter

'n Verdere analise is gedoen waarin daar vir ras (waar alle wit spelers (VO en GO) met bruin en swart spelers en wit en bruin spelers gesamentlik met swart spelers vergelyk is) asook vir spelposisie vir alle veranderlikes gekompenseer is (Tabel 5 en 6). Hieruit blyk dit dat hierdie aspekte (ras en spelposisie) wel 'n invloed op die gemiddelde waardes van sommige van die veranderlikes (veral met betrekking tot krag) uitgeoefen het. Die laat ontwikkelaar is vir die doel uit hierdie analise weggelaat.

Die gekorrigeerde waardes met betrekking tot ras (Tabel 5) dui daarop dat wit spelers in 2005 statisties betekenisvol beter gevaar het in die vertikale sprong. In 2003, 2004 en 2005 toon wit spelers ook deurgaans beter waardes as bruin en swart spelers vir beenkrag en handgreepkrag en in opsitte in 2003. Wit en bruin spelers saam toon in 2004 en 2005 verder ook statisties betekenisvol beter waardes vir rugkrag as swart spelers. Uit die resultate van beenkrag in 2004 blyk dit dat die bruin spelers grotendeels 'n negatiewe invloed op resultate gehad het, terwyl swart spelers weer 'n negatiewe invloed op die beenkrag se resultate in 2005 gehad het.

TABEL 5. **STATISTIES BETEKENISVOLLE VERSKILLE TUSSEN GEMIDDELDE WAARDES VAN FISIEKE EN MOTORIESE VERMOËNS TUSSEN WIT, BRUIN EN SWART SPELERS**

Komponent	**p-waarde**	**Wit X**	**Bruin X**	**Swart x**
Vertikale sprong (2005)	0.0250*	56.38	49.44	
Rugkrag (2004)	0.0005*	151.65		79.86
Rugkrag (2005)	0.0062*	154.15		84.07
Beenkrag (2003)	0.0425*	263.75	199	
Beenkrag (2004)	0.0004*	266.31	172.22	
Beenkrag (2005)	0.0009*	298.13	198.47	
Beenkrag (2004)	0.0243*	175.86		244.95
Beenkrag (2005)	0.0057*	283.65		187.82
Handgreep L (2003)	0.0076*	55.69	45.78	
Handgreep L (2004)	0.0001*	53.56	35.17	
Handgreep L (2005)	0.0001*	57.50	41.63	
Opsitte (2003)	0.0307*	70.13	53.78	

x = gemiddeld; * = betekenisvolle verskille, $p<0.05$

TABEL 6. **STATISTIES BETEKENISVOLLE VERSKILLE VAN FISIEKE EN MOTORIESE VERMOËNS TUSSEN LOSVOORSPELERS, AGTERLYNSPELERS, VASTEVOORSPELERS**

Komponent	**p-waarde**	**Losvoor-spelers X**	**Agterlyn-spelers X**	**Vastevoor-spelers x**
Beenkrag (2004)	0.0094*	262.63	202.31	
Beenkrag (2005)	0.0056*	301.38	228.13	
Spoeduithouvermoë (2004)	0.0488*	11.88	12.46	

x = gemiddeld; * = betekenisvolle binnegroepverskille, $p<0.05$

Wanneer daar vir spelerposisie gekorrigeer is (Tabel 6), toon losvoorspelers (2004, 2005) statisties betekenisvol hoër waardes in beenkrag as agterlyn- en vastevoorspelers, terwyl die agterlynspelers en vastevoorspelers gesamentlik statisties betekenisvol beter gevaar het in spoeduithouvermoë as losvoorspelers.

BESPREKING VAN RESULTATE

Hierdie navorsing het ten doel gehad om potensiële rugbyspelers tussen 15 en 18 jaar wat in verskillende rypingkategorieë geklassifiseer is, te ontleed met betrekking tot verskille en ontwikkeling in fisieke en motoriese vermoëns asook rugbyvaardighede oor ŉ driejaartydperk en verskille wat gevind is in verband te bring met rugbyprestasie. Die eintlike vergelyking wat gedoen wou word was om verskille tussen vroeë en laat ontwikkelaars te ontleed, maar die aard van die steekproef, wat ’n beskikbaarheidsteekproef was en uit ’n vooraf geselekteerde ontwikkelingsgroep bestaan het, het slegs een laat ontwikkelaar opgelewer. Dit

het dit onmoontlik gemaak om ’n realistiese vergelyking van sodanige verskille te kon maak. Die laat ontwikkelaar was op 15.8-jarige ouderdom 1.10 jaar jonger as sy skeletale ouderdom, vergeleke met die vroeë ontwikkelaars wat 1.6 jaar ouer as hulle skeletale ouderdom was en wat tot ’n verskil van amper vier jaar tussen die groepe se skeletale ouderdom bygedra het. Alhoewel die LO in sommige van die komponente (regter hampese soepelheid, 7-vlak maagkrag, rugkrag, beenkrag, linker en regter beenkrag, opsitte, optrekke, ratsheid en aërobiese uithouvermoë, skop vir afstand, uitgee vir akkuraatheid) tydens enkele van die toetsgeleenthede beter gemiddelde waardes as die VO en GO behaal het, was die speler nie beter in die meeste komponente toe die maksimum waardes van die ander twee groepe daarmee vergelyk is nie. Die speler het wel die hoogste waardes op 17.8 jarige ouderdom behaal in aërobiese uithouvermoë (bleep), rugkrag en linkerhandgreepkrag verkry waaruit tendense van verskille tussen die een laat ontwikkelaar en die ander twee rypingsgroepe se ontwikkeling in aspekte soos dinamiese en eksplosiewe krag en aërobiese vermoëns afgelei kan word. Die speler se skeletale ouderdom was ook steeds laer as sy chronologiese ouderdom op 17.8-jarige ouderdom, vergeleke met vroeë en gemiddelde ontwikkelaars waar skeletale ouderdom groter was. Beide hierdie bevindinge dui daarop dat die later ontwikkelaar verdere ontwikkeling na skool kan ondergaan, wat tot voordeel vir sy rugbydeelname kan strek. Hierdie resultate word ook bevestig deur die longitudinale studie van Beunen *et al.* (2009) wat aandui dat laat ontwikkelaars beter spierfunksie soos gemeet deur handgreepkrag en eksplosiewe krag as ander rypingsgroepe vanaf 13 jaar tot in hulle laat dertigjare toon. Verdere navorsing word gevolglik aanbeveel om die ontwikkeling van laat ontwikkelaars in meer diepte, maar ook oor ’n langer tydperk, van groei en ontwikkeling te ondersoek, aangesien hierdie eienskappe veral belangrik is vir rugbyprestasie.

Vroeë en gemiddelde ontwikkelaars is gevolglik in hierdie studie met mekaar vergelyk terwyl die een laat ontwikkelaar slegs vir beskrywende doeleindes in die vergelyking betrek kon word. Oor die driejaartydperk is slegs prakties betekenisvolle verskille tussen chronologiese en biologiese ouderdom van vroeë en gemiddelde ontwikkelaars gevind wat op groot verskille in skeletale ouderdom tussen hierdie groepe dui veral op 16-jarige ouderdom (1.1 jaar in 2003, 0.8 maande in 2004 en 0.6 maande in 2005). Hierdie resultate toon dat die verskille tussen vroeë ontwikkelaars en gemiddelde ontwikkelaars met verdere toename in ouderdom krimp en dat die gemiddelde ontwikkelaar teen ’n effens vinniger tempo as vroeë ontwikkelaars groei. Hierdie bevinding kom ooreen met resultate wat rapporteer dat seuns wat vroeë ontwikkelaars is, op ’n vroeër ouderdom stadiger begin groei as seuns wat later deur hul rypheidstadium vorder (Malina *et al.*, 2004). Die resultate het nie werklik enige spesifieke tendense by enige van die twee groepe (VO en GO) in motoriese en fisieke vermoëns uitgewys wat aan rypingsverskille toegeskryf kan word nie. Baie min veranderlikes het ook betekenisvol oor die tydperk van drie jaar heen verbeter. Eksplosiewe krag (vertikale en horisontale sprong) het by gemiddelde en vroeë ontwikkelaars betekenisvol verbeter, asook linkerhampese-soepelheid by GO, alhoewel die toenames nie tot betekenisvolle verskille tussen GO en VO gelei het nie. Dit wil dus voorkom of die fisieke en motoriese vermoëns en rugbyvaardighede van GO en VO nie werklik in hierdie tydperk van groei verskil het wat verdere ontwikkeling betref nie. Hierdie bevinding is nie ongewoon as die klein verkille tussen die vroeë en gemiddelde ontwikkelaars se skeletale ouderdom veral tydens die tweede en derde jaar van die studie in ag geneem word nie. Wat ook in ag geneem moet word, is dat navorsingsbevindinge wat verskille tussen rypingsgroepe uitwys gewoonlik uitgevoer is waar vroeë en laat ontwikkelaars vergelyk is (Docherty, 1996; Malina *et al*., 2004), terwyl hierdie

studie slegs gemiddelde en vroeë ontwikkelaars se ontwikkeling vergelyk het. Die bevindinge van hierdie studie stem egter ooreen met navorsing van Adendorff *et al.* (2004) waar gevind is dat geselekteerde spelers wat op 10 jaar as vroeë ontwikkelaars beskou was, nie op die ouderdom van 18 jaar prakties betekenisvol beter was in enige van die fisieke en motoriese vermoëns as die later ontwikkelaars nie, en dat die enigste verskille tussen die groepe dié in liggaamsgrootte was. Navorsing (Beunen *et al.*, 2009) dui ook daarop dat die grootste verskil in liggaamsgrootte, krag en snelkrag op die ouderdom van 14 jaar tussen seuns van verskillende rypingsgroepe sal voorkom, wat hierdie studie se resultate dan ook bevestig.

Dit moet in ag geneem word dat fisieke en motoriese vermoëns en rugbyvaardighede nie die enigste aspekte is wat met rugbyprestasie te make het nie, maar dat 'n aspek soos liggaamsgrootte byvoorbeeld ook 'n rol daarin speel. Dit kan ook wees dat inoefening 'n rol kon gespeel het in verskille of geen verskil nie wat met hierdie studie ten opsigte van fisieke en motoriese vermoëns gevind is. 'n Leemte in hierdie studie was egter dat die navorsers nie inligting oor die oefenprogramme gehad het nie. Hierdie inligting sou 'n moontlike verklaring kon bied omtrent verskille (of geen verskille) wat tussen groepe voorgekom het. Sekere motoriese en fisieke vermoëns het 'n hoë genetiese onderbou, alhoewel inoefening wel ook tot verbetering daarin kan bydra. Tendense van laer waardes wat by sommige veranderlikes oor die driejaartydperk gevind is, kan gevolglik toegeskryf word aan verskillende afrigtingstyle en die effek daarvan op fiksheid asook die motivering van spelers om toetse, waar maksimum pogings vereis word, voluit uit te voer. Die klein groepgrootte van veral die VO kon verder daartoe bygedra het dat 'n enkele speler met swak waardes in die groep die gemiddelde waardes van die komponente van die VO-groep beïnvloed het.

Die resultate waar daar vir ras en spelerposisie gekompenseer is, het getoon dat beide hierdie faktore wel by sekere veranderlikes 'n uitwerking gehad het op die gemiddelde waardes vir fisieke en motoriese vermoëns wat in die verskillende groepe behaal is. Suid-Afrika se unieke bevolkingsamestelling en sportsisteem noodsaak dat 'n aspek soos ras in navorsing wat met motoriese en fisieke vermoëns te make het, in ag geneem moet word aangesien daar verbande met ras in die literatuur met betrekking tot hierdie komponente aangedui is (Van der Merwe, 1997, Malina *et al.*, 2004). Wanneer die gemiddelde waardes gekorrigeer is vir die effek van ras, het verskillende tendense in veral die kragwaardes van die verskillende rasgroepe (wit, bruin en swart) na vore gekom. Wit spelers het beter kragwaardes getoon, en wit en bruin spelers het deurgaans verbetering in die kragtoetse (veral beenkrag) oor die drie jaar heen getoon het, teenoor die swart spelers wat oor dieselfde tydperk min of meer dieselfde gebly het. Dit blyk dat die wit spelers beter gevaar het in kragkomponente wat gevolglik 'n invloed kon gehad het op die resultate van die groepe (VO of GO) waarin die spelers gekategoriseer was. Uit Tabel 1 kan gesien word dat daar twee uit vier wit spelers in die VO-groep en ses uit dertien wit spelers in die GO-groep was. Uit die komponente waar krag 'n rol speel (vertikale sprong, horisontale sprong, 7-vlak maagkrag, rugkrag, beenkrag en handgreepkrag), blyk die GO beter of dieselfde gemiddelde waardes as die VO te behaal. Die afleiding kan gemaak word dat die wit spelers se gemiddelde waardes in kragvermoëns hierdie groep se gemiddelde waardes waarskynlik positief beïnvloed het.

Aangesien rugby 'n spansport is, is daar ook gekorrigeer vir spelerposisie en die analise het ook geringe verskille uitgewys. Losvoorspelers blyk oor beter beenkrag terwyl agterspelers oor beter aërobiese waardes te beskik het. Die groep losvoorspelers het beter waardes in

beenkrag in 2004 en 2005 behaal, terwyl hierdie groep in 2004 weer in spoeduithouvermoë teenoor agterlynspelers en vastevoorspelers gesamentlik swakker gevaar het. Hierdie resultaat kom ooreen met prestasie-eise in sekere spelposisies waar goeie beenkrag ’n groter rol in voorspelerspel sal speel teenoor spoeduithouvermoë wat weer by agterspelers voordelig sal wees (Luger & Pook, 2004). Uit die wit:swart ratio (1:1 vir vastevoorspelers, 3:1 vir losvoorspelers en 1:1 vir agterlynspelers) in die onderskeie groepe kan die aanname gemaak word dat die losvoorspelergroep se voordeel in beenkrag grotendeels te make het met die aantal wit en bruin spelers wat in die groep gegroepeer is. Toekomstige studies van soortgelyke aard behoort gevolglik met groter groepe uitgevoer te word om die resultate van die studie te bevestig en ’n meer indiepte-ondersoek te doen van aspekte wat verband hou met ras en spelposisie.

SAMEVATTING

Alhoewel enkele van die fisieke en motoriese vermoëns wel betekenisvol oor die driejaartydperk van die studie heen verbeter het, kon die resultate van hierdie studie geen verskille in potensieel talentvolle vroeë en gemiddelde ontwikkelende rugbyspelers tussen 15- en 18-jarige ouderdom se fisieke en motoriese vermoëns asook rugbyvaardighede uitwys nie. Die gevolgtrekking kan egter gemaak word dat laat ontwikkelaars op ’n latere ouderdom moontlik vroeë ontwikkelaars kan verbysteek wat betref fisieke en motoriese vermoëns wat vir rugbyprestasie benodig word.

Die resultate van hierdie studie kan rigting gee aan verdere studies wat in hierdie verband uitgevoer word. Verskille wat gevind is wanneer ras en spelerposie in die resultate in ag geneem is, het getoon dat sodanige veranderlikes in verdere navorsing van hierdie aard nie buite rekening gelaat moet word nie. Daar word ook aanbeveel dat soortgelyke vergelykings tussen verskillende rypingsgroepe, van ’n jonger ouderdom af uitgevoer moet word, aangesien dit duidelik uit hierdie studie blyk dat daar slegs geringe verskille in biologiese en chronologiese ouderdom 17- tot 18-jarige ouderdom tussen veral vroeë en gemiddelde ontwikkelaars voorkom. Navorsing behoort gevolglik eerder soortgelyke vergelykings tussen vroeë en laat ontwikkelaars en van ’n jonger ouderdom af, soos 14 jaar, uit te voer.

SUMMARY

The effect of growth and maturation on physical and motor abilities, as well as rugby skills of early, average and late developers

Malina *et al.* (2004) indicate that growth and maturation will affect sport performance. They report that boys with an advantage in biological maturity will have an advantage over boys who develop at a slower rate, especially between ages nine and 16 years. According to literature, boys from the same chronological age can differ up to five or six years in biological age (Noakes & Du Plessis, 1996, Woodman, 1985). In agreement to this, research indicates that early developers will be taller, heavier and stronger than late developers. Despite this advantage at an early age it seems that the boys, who developed at a slower rate, would rather be those who would become successful at provincial and national level once having reached full maturity. The aim of this study was to evaluate the effect of growth and maturation on potentially talented rugby players over a three-year period (15.9-17.9 years)

within and between groups on physical and motor abilities as well as specific rugby skills. A total of 18 boys (identified as talented rugby players to play for the North West Province) were selected and tested from 2003 to 2005, with a mean age of 15.9 years in the first year (sd = 0.32). Different flexibility, explosive power, strength, muscle endurance, aerobic power and speed tests were evaluated over a period of three years, once per year. Skeletal age (determined by means of the Greulich Pyle x-ray method) was used to classify the boys as early (n=4), average (n=13), and late developers (n=1). Differences over the three-year period were analysed within and between groups using descriptive statistics, repeated measurements over time and a two-way analysis of variance. An analysis adjusting for race and playing position was also performed to evaluate the role of these characteristics in the results. Although no statistical differences between the different maturity groups were found (except for chronological and biological age), descriptive statistics indicated that the difference that existed between early and average developers at 15.9 years of age seems to shrink as boys in the different groups grow older. Only one late developer was part of the group, therefore no direct comparisons could be made with the other development groups. This player's data was therefore treated as a case study in some comparisons that were made. The results indicated statistical increases for ED and AD over the three years for explosive power (vertical and horizontal jump) while only the AD showed statistically significant increases for left hamstring flexibility. It further seemed that white players showed better results in strength components while playing position had an influence on leg strength and speed endurance, while the effect of late development seems to shrink as boys grow older. The conclusion can be drawn from this study that potentially talented rugby players (divided into early and average developers) between ages 15 and 18 years do no differ in terms of their physical and motor abilities or rugby skills. The assumption from this study was that later developers would probably "catch up" with early developers and might even reach better performance potential in terms of physical and motor abilities as they grow older.

BRONNELYS

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RACE AND SOUTH AFRICAN RUGBY: A REVIEW OF THE 1919 "ALL BLACK" TOUR

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ABSTRACT

In as much as British civil rugby leagues were suppressed during the First World War, rugby in military guise experienced a revival. The highlight was the Inter-services Tournament in 1919 in which Great Britain and the Dominions competed for the King George V Cup. New Zealand was the eventual winner of this trophy. In South Africa the South African Rugby Board wanted to boost local rugby after a lull caused by the war. Thus they invited the New Zealand Services team to tour South Africa for six weeks on their way home. The negative aspect of this tour was the prior request of the South African Rugby Board for them not to bring any coloured players. The South African High Commissioner in London, W.P. Schreiner, extended the invitation and was satisfied with the coloureds being included in the team, but it was his son, Bill Schreiner, who voted against it at the Rugby Board meeting. The players concerned were Ranji Wilson and Parekura Tureia. This scandal would rock the rugby world only years later. The positive aspect of the tour was the new ideas and enthusiasm the tour brought to South African rugby. South African forward play and tackling were subsequently improved. It also gave new impetus to the Springboks' desire to tour New Zealand. This tour only became a reality in 1921.

Key words: Rugby; New Zealand; South Africa; 1919 "All Black" tour; Ranji Wilson; Parekura Tureia; First World War.

INTRODUCTION

Nine days after the declaration of the First World War on 4 August 1914, the Rugby Football Union (RFU) urged all rugby players to join the Forces. All national, regional and club matches were suspended. Special matches, however, were arranged in aid of war funds. Barbarian Service sides, for example, played six matches for this purpose as well as for recruiting purposes. One of these matches between the Barbarians and the South African Forces was played on the Richmond Athletic Ground on Saturday, 20 November 1915 (Owen, 1955: 280). The proceeds were in aid of comforts for the colonial troops (Twickenham Rugby Museum).

As the RFU believed the game served a much more moral purpose than mere recreation (such as preparing young men to become future leaders of the British Empire), it wanted to do justice to the game within the defence forces. Initially the British army did not share the RFU's sentiments, as soccer had been their sport, but judging by reports rugby did come into its own in the First World War. In so far as institutionalised rugby was suppressed during the war, it survived in military format. Already with the arrival of the first volunteers in the

training camps the game was played and inter-platoon tournaments soon started. Matches were even played between battalions and nearby schools. At the beginning of 1915 at least 10 military teams in London were ready to play regular matches, as were a number of public schools. Although soccer was still more popular and rugby was regarded as a game for officers only, the large influx of troops from South Africa, New Zealand and Australia in 1916 changed the situation. The number of games played increased dramatically and even quasi-international matches took place (Collins, 2009: 49-50, 54-57).

Between 1895 and 1914 the RFU experienced one crisis after the other and its position of authority was in jeopardy. After the war (by 1920) the sport was more united than ever before, with the RFU firmly at the helm. It took the first, and up to that stage the largest, rugby tournament in the world to accomplish this (Collins, 2007).

In March 1919 the Army Rugby Union organised an inter-services tournament with the King George V Cup at stake. Great Britain had two teams, namely Mother Country and Royal Air Force (with 10 South Africans in their ranks), while the other participating teams represented Canada (Canadian Expeditionary Force), Australia (Australian Imperial Forces), New Zealand (New Zealand Services) and South Africa (South African Forces). Between 1 March and 16 April 16 matches were played, with New Zealand the ultimate winner of the King's Cup at Twickenham when they beat Mother Country 11-3. The "All Blacks"[1] then also played and defeated a French Forces fifteen at Twickenham (Owen, 1955: 281; Dobson, 1996: 14).

NEGATIVE POLITICAL IMAGE

According to the Transvaal Rugby Union it was decided at its executive committee meeting on 7 April 1919 to invite a military team from Australia and New Zealand to undertake a short tour here on their way home (Ferreira *et al*., 1989: 28). The reason was to revive local rugby after the war. A defence force team that could stop off here on their way home would mean a substantial cost saving (Dobson, 1996: 15).

Yet it is evident in the minutes of the South African Rugby Board (SARB) that it had already been decided at its annual general meeting on 31 March 1919 to invite a New Zealand defence force rugby team to tour this country. This resulted in the following cablegram being sent to the High Commissioner in London on 1 April 1919:

> "From: Rugby Board
> To: High Commissioner, London
> Personal
> Would is be possible to arrange representative Australian or New Zealand Army Rugby Team break journey Cape Town Stop Tour Union for six weeks or less Stop Travelling and hotel expenses paid Stop Pardon liberty Stop Reply paid Stop and end." (Nieman & Laubscher, 2000: 24)

[1] It was of course not a fully representative team of their nation.

William Philip Schreiner, former president of the SA Rugby Board and Prime Minister of the Cape Colony was treated for heart problems in Germany in April 1914 and within days of his return to London war broke out. Later that year he took office as the Union's High Commissioner in London for the duration of the war (De Kock & Krüger, 1972: 655).

On 19 May 1919 Schreiner replied:

> "Your message second April Stop Arrangements now provisionally completed successful Stop New Zealand Services Team personnel twenty nine visit Union six weeks tour Stop You paying inland travelling and hotel expenses Stop Team leaving England about end May Stop Voyage contemplated three weeks Stop Please cable prompt confirmation Stop and end." (Nieman & Laubscher, 2000: 25)

The SARB's cablegram in reply read: "Arrangements confirmed Stop Cable when leaving and ship Stop and ends" (Nieman & Laubscher, 2000: 25).

On 2 June Schreiner replied as follows :

> "New Zealand Team leaving Cappelenia [sic] Stop Sailing seventh June Stop Should arrive Cape Town about twenty eight Stop Presume Union officials will accompany team as tour manager Stop Team asks if possible cable fixtures Stop and end." (Nieman & Laubscher, 2000: 26)

This was the same day on which the SARB met in Cape Town and only then realised that the visiting team might include Maoris…

> "The Board then discussed the question of the visit clashing with the Cape Universities tour in the Transvaal and also the question of procedure in view of the fact that the New Zealand team was believed to contain one of more Maoris. After a long discussion it was decided, by 8 votes to 6, on the motion of Mr. [R.] McIntyre seconded by Mr. [Bill] Schreiner that the following cablegram should be sent to the High Commissioner in London:-
> Confidential if visitors include Maoris tour would be wrecked and immense harm politically and otherwise would follow. Please explain position fully and try arrange exclusion.
> The question of finance was then considered, …" (South African Rugby Board, 1919:2)

The "full" report on this meeting appeared in the *Cape Times* (1919b: 8). What was interesting, however, is the fact that this virtually verbatim report on the meeting did not include the above extract. Whether this was done on the instruction of the SARB or the editor of the newspaper will probably never be known. The fact remains that the request was conveyed and successfully executed in England. It is not known how this was done.

Two New Zealand newspapers, the *Poverty Bay Herald* of 6 June 1919 (p.3) and the *Grey River Argus* of 7 June 1919 (p.2) reported that the New Zealand rugby team had left England and was on its way to South Africa … "All the inter-service team is included except Taurei [sic] and A. Wilson". Greg Ryan, a New Zealand historian who has conducted extensive research on this topic could find no other reference to [Sgt. A.] Wilson or [Corp. P.] Tureia

(Ryan, 2010). However, the *Poverty Bay Herald* (5 November 1919, p.2) did publish the following report on Tureia's return to Gisborne, New Zealand:

> "…while in France [he] was a member of the team which represented the NZ Division in a football match against the French Army in Paris. He subsequently was chosen to play in the All Black team which won the service competition in England and was later selected to tour South Africa with the team. Unfortunately, he missed the steamer which was taking the team to South Africa, and then returned to New Zealand via the Panama. Mr. Tureia is the first Gisborne footballer to gain international honours." (Palenski, 2010)

Nathaniel Arthur Wilson (18 May 1886 – 11 August 1953) (Wikipedia), nicknamed Ranji (derived from the Anglo-Indian cricketer, Ranjitsinhji) (Palenski, 2010), was born in Christchurch. He was not a Maori, as his mother was British and his father West Indian. Ranji played for the All Blacks in 1908, 1910, 1913 and 1914 and was also an All Black selector in 1924-1925. During the First World War he was one of the starts in the New Zealand defence force team (Wikipedia). The first name of Parekura Tureia (5 January 1897 – 23 November 1941) (NZETC) means "to fight a battle"(Casualty details). Apart from his contribution to the New Zealand defence force team, he also played for the New Zealand Maoris in 1921 and 1923 (Ryan, 2010).

Smith's (1999: 108) version that Wilson had to remain on board the ship when they arrived in Cape Town is therefore not quite correct. In newspaper reports it is evident that Wilson did meet his team-mates later when the ship called at Durban on its way home. At the time of the touring team's visit to Durban in late August 1919 two ships with New Zealand troops on board were in the harbour, namely the SS Cardona and the SS Hororata (*Natal Mercury*, 1919: 14). "Amongst the troops on the New Zealand transport is their great forward, Ranji Wilson, who had already met and fraternised with his old comrades" (*Natal Witness*, 1919a: 5). However, no questions were asked in the media about why Ranji was not part of the touring side. The following report makes it even more interesting:

> "The Pacific Islander, Wilson, just arrived from England, is perhaps the greatest player in the Service team and it would be a good thing if his inclusion could be arranged. He was a very popular player in the Home matches." (*Natal Witness*, 1919b: 5) (At this stage the touring team had already played 10 of its 15 matches.)

That Tureia missed the Cap Polonio is also not true. One just wonders how they had managed to persuade him to persist with this story. Nevertheless, this was the first international racial incident in rugby on South African soil, although it would only come to light much later.

POSITIVE TRAINING SCHOOL FOR SOUTH AFRICAN RUGBY

An aspect that received a lot of media attention prior to the tour was the New Zealand scrum formation. In South Africa the forwards used a 3-2-3 formation as they arrived at the scrum ("…the first men up are to be the first men down") (*Cape Times*, 1919h: 9; *Cape Times*, 1919i: 7). Thus there were no specialist forward positions as there are today. The New Zealanders, on the other hand, used a diamond-shaped 2-3-2 scrum formation. Everything revolved around the player in the centre of the second row (lock). He had to bind the scrum

and keep it together. He bound the two hookers in front of him, while the two players on either side of him, as well as the two players behind him, also bound to him. There was no pushing forward, but the inward energy had to stabilise the scrum just long enough for the ball to come out. The lock kept his legs wide apart so the ball could roll cleanly through to the halfback at the base of the scrum (*Cape Times*, 1919i: 7). They had found that their unique scrum formation allowed the forwards to break apart much more quickly once the ball had been hooked, which happened much faster than in the case of the South Africans. When these seven forwards bound well, they looked just as strong as our eight forwards (*Cape Times*, 1919h: 9).

In the backline they played two halves, followed by two five-eights, then three three-quarters and finally the fullback (a triple backline). With the scrum breaking up more quickly, this formation could also change direction faster and the two five-eighths could support the centres in defence or attack. Like today, the South Africans used two halves, four three-quarters and a fullback (*Cape Times*, 1919h: 9).

Another aspect of their game was the use of a rover. This other halfback played with the wing-forward (flank) and the latter nearly always put the ball in the scrum. This wing-forward played, depending on the situation, on the left or the right of the scrum. In the 1930s the use of a rover was made illegal and the All Black scrum also became eight players (*Cape Times*, 1919e: 11; Nieman, 2010).

The very same Bill Schreiner, who would become a national rugby selector from 1912 till 1952, said the following about this team's visit:

> "There can be no two opinions as to the benefit derived by South Africa from the visit of this team. It gave a much needed impetus and fillip to the game, and everywhere large crowds attended the games, and the greatest enthusiasm prevailed" (Dobson, 1996: 16).

This was confirmed by the *Cape Times*: "The value of their visit will be reflected in our football ere long, and this will be to the advantage of the game, for theirs is more enterprising than ours" (1919k: 11) and "That their forwards are magnificent in attack and in defence is undeniable – they have taught us almost more than we can hope to learn …" (1919k: 8).

The visitors' effective tackling also made a huge impression on those concerned with local rugby. A.W. Lawton, chairman of the WP Rugby Football Union, referred to just that when he reproached the local players for having become lax in this regard (*Cape Times*, 1919j: 8).

After the tour the New Zealanders expressed their opinion on the state of rugby in South Africa. According to them the New Zealand style of play was superior as it gave them an extra player in the backline, without losing possession of the ball in the scrums. They regarded the South African forwards as excellent players in many respects, but said they were not able to open up the game. They left that to their backs (*Cape Times*, 1919l: 11). H.J. Sanderson (former president of the Transvaal Rugby Union) confirmed this by saying that no one passed the ball to a forward in those days. Not for one moment were they expected to

catch the ball or pass it – this was exclusively the work of the backs (Sanderson, 1964: 198). And in 1919 this was the main difference between the two countries.

In his farewell speech, the president of the SARB, J. Heynemann, paid them the following compliment:

> "The New Zealanders would never realise the great service which they had rendered to Rugby football in South Africa by their visit, and by their conduct on and off the field. Their play had come as a revelation, particularly in respect to their handling and tackling. In administering the hiding as they had done, they had done the game a world of good. It had taught the players a good, sound, honest lesson." (*Cape Times*, 1919l: 11)

According to the *Cape Times* (1919k: 8) the tour had been a huge success. It had brought new ideas to South Africa, eliminated wrong impressions, and given new impetus to a possible tour to New Zealand. In fact, at the farewell function the touring team expressed the wish that a South African team would visit their country in the not too distant future (*Cape Times*, 1919l: 11).

SUMMARY

Although New Zealand soldiers played against a South African team in Johannesburg during the Anglo-Boer War and won (Dobson, 1996: 11), the contact on the rugby field during the First World War constituted the first "international" matches between these later arch-enemies. Admittedly, after the Anglo-Boer War (on 14 October 1904) South Africa did try to forge rugby links with New Zealand, but to no avail. The idea was for the All Blacks to stop off here for a few games on their way to Britain for their 1905 tour, but they sailed around Cape Horn instead of the Cape of Good Hope and on their return via New York. In 1907 New Zealand in turn invited the Springboks for a tour, but the invitation was declined. They extended another invitation in late 1911 for a tour in 1912, but the SARB was of the opinion that it would take too long to raise the necessary funds. In 1913 an invitation for a tour in 1914 was declined for the same reason (Dobson, 1996: 12-13).

Rugby contact between these two countries during and shortly after the war rekindled South Africa's need to pit its strength against New Zealand: "… they caused serious pondering among the locals over how difficult it must be to take on a fully representative side from the two little islands way down under" (Greyvenstein, 1978: 64). However, this would only become a reality in 1921.

Another interesting aspect of these post-war visits by Australasian defence force teams (on their way home a number of Australian teams also played against local teams) was the proposal by two prominent Australian rugby officials that a triangular competition of two tests each between Australia, New Zealand and South Africa should be considered (*Cape Times*, 1919g: 9). This dream was only realised in 1996 when the present Tri Nations competition was launched.

It is proved that sport during the war had a positive effect on the morale of civil as well as military lives. In fact, the dominions such as Australia, New Zealand and South Africa made an exciting contribution to this (Collins, 2009: 68-69). It is just a pity that a negative political stigma is attached to these events of 1919. The racial ban, and not the positive aspects I attempted to highlight here, is all that is associated with it.

The timing of W.P. Schreiner's death is probably a coincidence, but one does wonder to what extent the South African Rugby Board's ban on Maoris played a role. Like his sister, Olive, Schreiner was very liberal and a great believer in "equal rights to all civilised men South of the Zambezi" (*Cape Times*, 1919c: 6). He would definitely not have had a problem with Maoris in the team. Yet his own son, William Francis (better known as Bill) (South African Rugby Board, 1964: 180), supported the motion against the inclusion of coloured players in the team. This must surely have been a huge shock and disappointment to him. We know that, owing to ill health, he went to Llandrindad Wells in Wales for two weeks shortly afterwards to recuperate, but died on Saturday, 28 June (National Library). One can only speculate about whether these events had played a role. Schreiner had been ill since the summer of 1917 and was laid low by flu in 1918. In May 1919 he once again required medical assistance. Incidentally, he died on the same day the Treaty of Versailles was signed (Walker, 1937: 379-380).

In an interview with the manager of the New Zealand defence force team, he made no mention of the two players that had been omitted (*Cape Argus*, 1919d: 8). In a reply to the question as to whether it was their strongest team available, their captain, staff sergeant Charles Brown said: "Undoubtedly, this is the best team that we could get. We have got everyone that we wanted" (*Cape Times*, 1919h: 9). The irony is that the South African team had already played against Wilson in their Inter-Services Rugby tournament match on March 29 (*Cape Times*, 1919a: 7).

Until now most secondary sources have focused only on Ranji Wilson and ignored Parekura Tureia. Although there were a number of players who had played for the New Zealand military side in Europe on occasion but had not been included in the touring team, Tureia was the only one singled out. This gives the impression that he had been a candidate for the touring side but had ultimately not been selected. Incidentally, Tureia did play for the New Zealand Maoris later, in 1921 and 1923 (Ryan, 2010).

The last aspect that deserves attention is the Transvaal Rugby Football Union's claim that they were responsible for this tour initiative (*Cape Times*, 1919f: 7; *Cape Times*, 1919j: 8; Ferreira *et al*., 1989: 28). This creates a problem as, unless Ferreira *et al*. (1989: 28) were wrong about the date, it could not have been their initiative. According to these authors the SARB, at the recommendation of the Transvaal Rugby Football Union, was to invite the defence force team. However, this meeting in Johannesburg was only held a week after the governing body had taken a similar decision.

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