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TRAINING HABITS AND MEDICAL CHARACTERISTICS OF YOUNG SWIMMERS IN THE WESTERN CAPE - AN OVERVIEW.

A PRESENTATION PREPARED BY DR. MOHAMMED NASIR JAFFER (MB CHB) IN FULFILMENT OF THE REQUIREMENTS FOR THE MASTER OF PHILOSOPHY DEGREE IN SPORTS MEDICINE FROM THE UNIVERSITY OF CAPE TOWN

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DECLARATION

I, ..., hereby declare that the work on which this dissertation is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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ABSTRACT:

Objective:

Very little data exists on swimmers in South Africa. A series of three studies were undertaken to assess the medical status of young swimmers in the Western Cape, their training habits and how these relate to performance. The aim of the first study was to determine the training habits of young competitive swimmers, whether there were gender differences in training, and whether the training habits changed over a three-year period (1995-1998). The second study assessed the prevalence of existing medical conditions in young competitive swimmers and whether there were gender differences amongst the swimmers for the various medical conditions. In the third study, mood changes in young competitive swimmers were monitored over a swimming season to determine whether a relationship exists between mood states and swimming performance.

Methods:

The first study was conducted in two phases: The first took place in October 1995 and the second was conducted in October 1998. A questionnaire evaluated various parameters related to swimming - the age at which the swimmer began to swim, how long the swimmer had been swimming competitively, the amount of time spent on various activities during training and the intensity of training. In the second study, swimmers were questioned at the beginning of the swimming season concerning prevailing medical conditions,

previous operations and details with regard to injuries sustained in the previous season. Female swimmers were also asked details concerning the menses.
A modified version of the Profile of Mood States (POMS) was used to evaluate the psychological profile of the swimmers in the third study.
Performance details of individual swimmers who participated in competitions throughout the season, were then correlated to the POMS data in swimmers who had completed three or more POMS assessments throughout the season.

Results:

In the first study, male and female swimmers collectively reported swimming at a later age in 1998 compared to 1995. Male swimmers in 1998 trained at a higher intensity and spent significantly more time stretching and warming-up compared to swimmers in 1995.

Twenty -three percent of swimmers in the second study reported an existing medical condition. Asthma was the most prevalent medical illness (16% of all swimmers). There was no statistical difference in the time spent on various training activities for those swimmers with asthma compared to those swimmers without asthma. Tonsillectomy was the most prevalent operation performed (61%). Thirty percent of the swimmers sustained injuries in the previous season. The lower limb was the region most commonly affected. The commonest type of injury reported was muscle injuries. Fifty percent of the female swimmers had reached menarche.

In the third study, the POMS scores for the different parameters varied significantly amongst the swimmers throughout the season. The parameter of vigour had the least variation of all the POMS measurements. When swimmers were analysed as a group, vigour was the POMS parameter with the highest score. When data for swimmers who competed in three or more events in the season and who completed a POMS questionnaire at the same time were analysed, the POMS parameters which had a significant relationship to swimming performance were varied, depending on the distance swum and the type of swimming stroke.

Conclusion:

In the first study, male swimmers spent more time warming-up and stretching in 1998 compared to 1995. Time spent in these activities may improve performance and reduce the risk of injuries. Both male and female swimmers are also starting to swim at an older age. This trend needs further investigation as it could indicate inactivity, increased commitments towards other activities, and also a possible decline in interest in this specific sport.

The second study found a higher prevalence for asthma in young swimmers (16%) compared with the general childhood population (11%-12%). This may be due to the lower risk for developing exercise-induced asthma whilst swimming compared to the land-based activities. Young local female swimmers did not show the delayed menarche which may be prevalent in young athletes as found in other studies on sportswomen.

In the third study, no consistent relationship could be established between swimming performance and mood states. POMS scores did not consistently track changes in swimming performance over a season in a group of swimmers. Further research is warranted to determine whether more regular monitoring of the POMS can track the efficacy of training and detect early signs of overtraining.

Further studies should be conducted on swimmers elsewhere in the country to determine whether the findings are limited to the swimmers of the Western Cape or whether similar trends exist in other regions.

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CHAPTER 1:

INTRODUCTION

INTRODUCTION:

Swimming as a sport in South Africa, has attracted very little research in the scientific journals. Consequently, very little data exists on the training habits of swimmers and how these relate to performance. Whilst swimming is a low profile sport in South Africa, compared with more popular sports such as football, rugby, cricket and athletics, South African swimmers have fared remarkably well in the international arena, producing world class performances when pitted against stiff international competitors. The most notable achievements were at the 1996 Olympic games in Atlanta, U.S.A. when swimmers won South Africa's first medals since readmission to the international sporting fraternity. Penny Heyns and Marianne Kriel won two gold medals and a bronze medal respectively in their swimming events. The only other South African competitors who won medals at this games, were the distance runners Josiah Thugwane (gold in the marathon) and Hezekiel Sepeng (silver in the 800 metres event).

Despite these achievements which thrust swimming into the spotlight, there has not been a surge in interest in this sport as reflected by the number of swimmers who registered with the national swimming body, Swimming South Africa. In the year 2000, 6327 swimmers registered compared to 6049 swimmers in 1996. (Gary Albertyn-The Annual Audited Financial Statements of Swimming South Africa).

Subsequently, Terence Parkin (silver medal) and Penny Heyns (bronze medal) were the outstanding South African swimmers in the 2000 Olympic games in

Sydney. Their performances are especially noteworthy, as the South African team only managed a total of five medals at these games (2 silver and 3 bronze), the other medals being secured by track and field athletes.

In the light of the above achievements, it is, therefore, important that the training habits of swimmers are documented to better understand the sport and also to make recommendations to enable the swimmer to improve performance based on scientific evaluation. In accordance with this, a study was undertaken to gain more information on the training habits of young swimmers in the Western Cape. The aim of the study was to determine the training habits of young competitive swimmers, whether there were gender differences in training, and whether the training habits changed over a three-year period (1995-1998).

The medical background and health consequences of training amongst local swimmers is not known. Many uncontrolled medical illnesses affect the optimum functioning of the body adversely and may impair performance. Adequate management of these conditions is extremely important for optimal performance by the athlete. This study, therefore, also attempts to determine the current medical status amongst young Western Cape swimmers. The study is designed to assess the prevalence of existing medical conditions in young competitive swimmers and whether there were gender differences amongst the swimmers for the various medical conditions.

For many years, sport scientists have attempted to quantify training in competitive sports. The challenge to researchers has been to identify markers which would allow sportspersons and their coaches to adjust training loads to maximise the benefits of training while reducing the potential for overtraining or undertraining. One of the parameters which has been proposed as a marker, is mood changes. These changes may be determined by utilising a tool known as the Profile Of Mood States (POMS). This is a system of scoring various mood parameters which is then related to changes in performance. Whether changes in mood states are related to swimming performance amongst South African swimmers is not known, as there have been no reported studies on this subject. This study was also undertaken on young swimmers in the Western Cape to assess the mood states in swimmers prior to a swimming season, and then to monitor the changes in mood states throughout the season. In addition, mood states were correlated to performance in competitions, to assess whether a relationship exists between mood states and swimming performance.

CHAPTER 2:

TRAINING HABITS OF YOUNG COMPETITIVE SWIMMERS IN THE WESTERN CAPE

TRAINING HABITS OF YOUNG COMPETITIVE SWIMMERS IN THE WESTERN CAPE

MN Jaffer (MB ChB)

MP Schwellnus (MB ChB MD FACSM)

M Mendonca (BSc(Med)(Hon)Exercise Science)

MI Lambert (PhD)

MRC/UCT Bioenergetics of Exercise Research Unit, Department of Physiology

University of Cape Town Medical School

Sports Science Institute of South Africa

<u>**Address for correspondence:**</u>

Dr. M.N.Jaffer

MRC/UCT Bioenergetics of Exercise Research Unit

Sports Science Institute of South Africa

P.O.Box 115

Newlands

7725

Tel: 021 - 686 7330

Fax: 021 - 686 7530

E - mail: mnjaffer@iafrica.com

Abstract

Objective. The aim of the study was to determine the training habits of young competitive swimmers, whether there were gender differences in training, and whether the training habits changed over a three-year period.

Design. The study was conducted in two phases: The first took place in October 1995 (Study 1) in which five swimming clubs participated- n = 45 (18 males and 27 females), and the second was conducted in October 1998 (Study 2) where four clubs participated - n = 28 (13 males and 15 females). A questionnaire evaluated the following: the age at which the swimmer began to swim, how long the swimmer had been swimming competitively, the amount of time spent on various activities during training (warm-up, stretching, endurance, speed and strength training, warm-down and motivational talks) and the intensity of training (a subjective score of six- very, very light to twenty –very, very hard) during endurance and speed training.

Results. Female swimmers recorded that they started swimming at a later age in 1998 (7.5 ± 3.0 years) compared to 1995 (5.0 ± 1.6 years)- (P=0.053). When analysed as a group, male and female swimmers collectively started swimming at a later age in 1998 (6.7 ± 3.1 years), compared to 1995 (5.3 ± 2.1 years) - (P< 0.05). Male swimmers in 1998 spent significantly more time (64.2 ± 62.5 $min.wk^{-1}$) stretching than both male swimmers in 1995 (20.6 ± 33.3 $min.wk^{-1}$)- P< 0.05, and also female swimmers in 1995 (14.2 ± 22.0 $min.wk^{-1}$) – P < 0.05. The males in 1998 also spent more time (77.7 ± 66.7 $min.wk^{-1}$) warming–up than the females in 1995 (28.5 ± 22.0 $min.wk^{-1}$) – P < 0.05.

The male swimmers trained at a higher intensity for endurance in 1998 (14.8 ± 1.9 units) compared to both male swimmers in 1995 (12.1 ± 2.2 units)-$P < 0.05$, and also female swimmers in 1995 (12.5 ± 2.4 units) – $P < 0.05$. The speed intensity for males in 1998 (17.0 ± 1.8 units) was greater than that of the males in 1995 (13.7 ± 2.2 units) – $P < 0.05$.

Conclusions. Male swimmers spent more time warming-up and stretching in 1998 compared to 1995. Female swimmers did not increase the time spent in these activities. Male swimmers trained at higher average intensities in 1998. Both male and female swimmers are also starting to swim at an older age. Further studies are needed in other regions to determine whether the findings are peculiar to the swimmers of the Western Cape or whether similar trends exist elsewhere.

Introduction

It is generally accepted that exercise has beneficial health effects for adults and children. However, data are also available on the negative consequences of excessive exercise, particularly in young participants.[7,8,12,13,16,19,20,21,22,23] In many schools in South Africa, organised sports programmes are available to the young sportsperson. Recently, there appears to be a trend, encouraging greater participation in sports as a whole and with the advent of the professional era, financial incentives and monetary gain has given rise to a new generation of sportsperson. This has encouraged the sportsperson to increase training volume which has influenced younger athletes to train harder and longer. For example, gymnasts may train three hours per day, young athletes may run up to 100 kilometres per week in training and swimmers train for many hours and can carry out half a million swimming strokes per arm per year.[7] It is important that training habits of participants are documented to better understand the sport, and the medical and health consequences of training.

In accordance with this, a study was undertaken to gain more information on the training habits of young swimmers in the Western Cape. The aim of the study was to determine the training habits of young competitive swimmers, whether there were gender differences in training, and whether the training habits changed over a three-year period (1995-1998).

Methods

Swimmers aged 12 – 14 years old were selected to participate in the study. The study was divided into two phases: i) October 1995 and ii) October 1998 and involved two different cohorts.

For the first phase of the study (Study 1), 26 swimming clubs in the Western Cape were approached at an official meeting of the regional executive of Western Province Swimming. At this meeting, representatives from 18 swimming clubs affiliated to Western Province Swimming, were present and eight clubs were absent. The clubs that were not represented included four clubs that were based out of town in the country areas. Only nine of the eighteen swimming clubs present at this meeting, volunteered to participate in the study.

As a result of geographical considerations, two further clubs indicated that it would be difficult to involve their swimmers in the study. Another two clubs, after initial enthusiasm by the coaches, withdrew their support for the study. In total, five clubs eventually participated in this phase of the study.

For the second phase of the study (Study 2), clubs were again approached for participation in the study (October 1998). Due to geographical and logistical considerations and the possibility of non-compliance, six clubs from various regions in the Western Cape were available and agreed to participate in the study. During the study period, one of the coaches of a large club became ill and his swimmers were subsequently eliminated from the study.

Another coach from a different club misplaced her questionnaires and thus only four clubs participated in the second study.

Subjects

Each coach from the various clubs selected 12-14 year old swimmers from their elite squads who were asked to volunteer for the study. Many potential subjects indicated that they were unavailable due to other commitments. A meeting was then set up with the volunteers, coaches and parents of each club to explain the study in detail.

Measurement tool- questionnaire

A questionnaire was designed to evaluate the demographic data of swimmers, for example, the age at which the swimmer began to swim and for how long the swimmer had been swimming competitively. In addition, the swimmers were questioned on the amount of time in minutes per week spent on various activities during training. Specifically, they were questioned on the amount of time spent on a warm-up prior to a training session. The amount of time spent on specific stretching routines during training was also enquired upon. The swimmers were also requested to record the amount of time in a training session spent on endurance or distance training as well as time spent doing speedwork in a training session. Finally, they were asked to note the amount of time spent on a warm-down following a training session. The intensity of training (a subjective score of six – "very, very light" to twenty –"very, very hard") during endurance and speed training was evaluated.[4,5] The questionnaire also assessed the amount of time spent on resistance training and motivational talks. The questionnaire was tested in a pilot study and any ambiguous questions were adjusted. The questionnaire was administered at the beginning of the swimming season.

Statistical methods

An analysis of variance was used to determine differences with "gender" and "study" as the main effects. A Scheffe's post- hoc test was used to determine differences when the overall F value was significant. Statistical significance was accepted as $P < 0.05$. All data are presented as mean and standard deviation.

Results

There were 73 participants in both studies- n = 45 in study 1 (18 males and 27 females), and n = 28 participants in study 2 (13 males and 15 females). The current age, age at which the subjects started swimming and the years of competitive swimming are shown in Table 1. There was a tendency for the starting age of the female swimmers to increase by 2.5 years in study 2 ($P=0.053$). When the males and females were combined and analysed as a group, the starting age of the swimmers increased by 1.4 years in study 2 ($P< 0.05$). There were no differences in the current age or the years of competitive swimming between the males and females or between study 1 and study 2 (Table 1).

Table 2 shows the amount of time spent in each of the training activities. The males stretched longer in study 2 (64.2 ± 62.5 $min.wk^{-1}$) compared to study 1 (20.6 ± 33.3 $min.wk^{-1}$)- $P< 0.05$. The females in study 1 stretched less than the males in study 2 (14.2 ± 22.0 $min.wk^{-1}$ vs 64.2 ± 62.5 $min.wk^{-1}$) – $P < 0.05$. The females in study 1 warmed up for less time than the males in study 2 (28.5 ± 22.0 $min.wk^{-1}$ vs 77.7 ± 66.7 $min.wk^{-1}$) – $P < 0.05$. There were no significant differences in any of the other variables either between males and females, or between study 1 and study 2 (Table 2).

Table 3 illustrates the intensity of the training sessions. The males trained at a higher intensity for endurance in study 2 (14.8 ± 1.9 units) compared to study 1 (12.1 ± 2.2 units)-$P < 0.05$. The endurance intensity for females in study 1 (12.5

$\pm$ 2.4 units) was less than that of the males in study 2 (14.8 $\pm$ 1.9 units) – $P < 0.05$. The speed intensity for males in study 2 (17.0 $\pm$ 1.8 units) was greater than that of the males in study 1 (13.7 $\pm$ 2.2 units) – $P < 0.05$. The speed intensity for females did not change from study 1 to study 2 (Table 3).

Discussion

The main finding of this study is that male swimmers in study 2 (1998) spent significantly more time during the week stretching than both male and female swimmers in study 1 (1995) (Table 2). The males in 1998 also spent more time warming–up than the females in 1995. This suggests that training for male swimmers incorporated more time for stretching and warm-up in their routines in 1998 compared to 1995. Studies have shown that stretching and warm - up prior to physical activities may either enhance performance and reduce the risk of injury, [6,15,24,25,27] or have no any effect.[14,26,28]

In addition, the American College of Sports Medicine in its recommendations on the prevention of sport injuries of children and adolescents, has advised that children and adolescents should include fitness exercises in the training routine, rather than devoting all of each training session to the development of specific skills required for a certain sport. The fitness activities may be geared toward the strength, endurance, and flexibility requirements of the specific sport, but should not exclude other components of a well-rounded general fitness programme.[3] The above findings could perhaps be explained by a greater awareness of swimmers and coaches in 1998 to the benefits of increased time spent stretching and warm- up prior to actual training. This finding also supports the conclusions of Francis[9], who, on reviewing the status of the year 2000 health goals for physical activity and fitness, found that the overall physical activity in adults and strengthening and stretching activities in children have increased. However, the percentage of sedentary persons had not changed.

Surprisingly, the female swimmers did not show this increase in time spent stretching and warming-up in their routines in the later study. This may indicate that squads are prescribed specific training according to gender or it may reflect the large variation in training styles of the various club coaches. Another finding was that the average endurance intensity and speed training intensity for males in 1998 was also significantly more than that for males in 1995 (Table 3). The average endurance intensity for males in 1998 was also significantly more than that of the females in 1995. Again, the female swimmers had no significant increase in training intensity (endurance and speed) in 1998 compared to 1995. This suggests that male swimmers were training harder in 1998 and that, once again, gender-specific routines were prescribed by coaches.

Another finding of this study was that the female swimmers in 1998 started swimming when they were older, compared to the female swimmers in 1995 (Table 1). In addition, the combined starting ages for both males and females in 1998 was also significantly later than the combined starting ages in 1995. This may indicate that competitive physical activity is pursued at an older age. A study on physical inactivity in high school students found a major increase in physical inactivity between ages 15 and 16.[1] In a later study, they found that the most important factors limiting involvement in physical activity were time constraints due to school work, other interests, and family activities.[2] In that study, females cited consistently higher levels of perceived barriers to participation in physical activity than males.

Despite limitations of this study with regard to sample size, representation and deficiencies in the questionnaire, it is an important study in that no previous study has detailed the actual time spent in various facets of training in young aged – group swimmers in the Western Cape. In fact, there are no other studies in any region which describes trends in swimming training over time.

In summary, this study found that male swimmers spent more time warming-up and stretching in 1998 compared to three years previously. This finding is heartening, as several studies have shown, that time spent in these activities will improve performance and reduce the risk of injuries. [6,15,24,25,27] It is, however, disturbing that female swimmers have not shown this increase in time spent in these activities, and it is predicted that their performance in competitions would reflect this negatively. In addition, it is predicted that they will sustain more injuries than their male counterparts. The male swimmers also trained at higher average intensities in 1998. This could eventually result in increased performance in competitions, or if sustained, could result in overtraining.[10,11,17,18] Finally, the study found that swimmers are starting to swim at an older age. This trend is worrying as it could indicate inactivity, increased commitments towards other activities, and also a possible decline in interest in this specific sport.

Further studies are needed to determine whether the findings are limited to the swimmers of the Western Cape or whether similar trends exist in other regions.

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TABLE 1: The current age in years (age), the age at which the subjects started swimming (start age) and the number of years of competitive swimming (yrs swim) of male and female subjects. The number in brackets denotes the sample size. Values are expressed as X ± SD.

	STUDY 1	STUDY 2	COMBINED
AGE:			
Males	13.9 ± 1.3 (18)	13.2 ± 1.3 (13)	13.6 ± 1.4 (31)
Females	13.3 ± 1.0 (27)	13.7 ± 1.4 (15)	13.5 ± 1.3 (42)
Total	13.5 ± 1.2 (45)	13.5 ± 1.4 (28)	13.5 ± 1.3 (73)
START AGE:			
Males	5.6 ± 2.6 (18)	6.0 ± 3.1 (13)	5.8 ± 2.8 (31)
***Females**	5.0 ± 1.6 (26)	7.5 ± 3.0 (13)	5.8 ± 2.5 (39)
**** Total**	5.3 ± 2.1 (44)	6.7 ± 3.1 (26)	5.8 ± 2.6 (70)
YRS SWIM:			
Males	4.8 ± 2.2 (18)	3.1 ± 1.7 (13)	4.1 ± 2.2 (31)
Females	3.8 ± 1.9 (24)	3.9 ± 2.4 (13)	3.8 ± 2.1 (37)
Total	4.2 ± 2.1 (42)	3.5 ± 2.1 (26)	3.9 ± 2.1 (68)

* females starting age study 1 vs study 2: P = 0.053

** combined starting age of subjects study 1 vs study 2: P < 0.05

<u>TABLE 2:</u> Time (mins per week) spent for different activities during training sessions. The numbers in brackets are the sample size. Values are X ± SD.

STUDY 1		STUDY 2	COMBINED
STRETCH:			
***Males**	20.6 ± 33.3 (18)	64.2 ± 62.5 (13)	38.9 ± 51.7 (31)
**** Females**	14.2 ± 22 (27)	45.8 ± 44.0 (13)	24.5 ± 33.8 (40)
Total	16.8 ± 26.9 (45)	55.0 ± 53.8 (26)	30.8 ± 42.8 (71)
WARMUP:			
Males	40.0 ± 15.4 (18)	77.7 ± 66.7 (13)	55.8 ± 47.7 (31)
*****Females**	28.5 ± 22.0 (27)	53.9 ± 44.0 (13)	36.8 ± 32.6 (40)
Total	33.1 ± 20.3 (45)	65.8 ± 56.7 (26)	45.1 ± 40.7 (71)
ENDURANCE:			
Males	190.6 ± 105.7 (18)	218.1 ± 94.6 (13)	202.1 ± 100.5 (31)
Females	163.7 ± 76.1 (27)	217.7 ± 251.1 (13)	181.2 ± 154.6 (40)
Total	174.4 ± 89.0 (45)	217.9 ± 185.9 (26)	190.3 ± 133.3 (71)
SPEED:			
Males	108.1 ± 108.6 (18)	132.3 ± 68.7 (13)	118.2 ± 93.4 (31)
Females	98.3 ± 68.6 (27)	61.9 ± 84.0 (13)	86.5 ± 74.9 (40)
Total	102.2 ± 85.8 (45)	97.1 ± 83.3 (26)	100.4 ± 84.3 (71)
WARMDOWN:			
Males	26.7 ± 20.6 (18)	30.8 ± 17.4 (13)	28.4 ± 19.2 (31)
Females	24.6 ± 15.4 (27)	24.6 ± 17.8 (13)	24.6 ± 16.0 (40)
Total	25.4 ± 17.5 (45)	27.7 ± 17.6 (26)	26.3 ± 17.4 (71)
STRENGTH:			
Males	18.9 ± 30.8 (18)	17.7 ± 49.7 (13)	18.4 ± 39.1 (31)
Females	13.7 ± 28.1 (27)	31.2 ± 84.5 (13)	19.4 ± 53.2 (40)
Total	15.8 ± 29.6 (45)	24.4 ± 68.3 (26)	18.9 ± 47.2 (71)
MOTIVATION:			
Males	10.3 ± 9.8 (18)	23.5 ± 43.3 (13)	15.8 ± 29.1 (31)
Females	12.0 ± 16.6 (27)	27.3 ± 64.8 (13)	17.0 ± 39.1 (40)
Total	11.3 ± 14.2 (45)	25.4 ± 54.0 (26)	16.5 ± 34.8 (71)
OTHER:			
Males	94.2 ± 157.4 (18)	96.1 ± 148.3 (13)	95.0 ± 151.1 (31)
Females	53.7 ± 89.4 (27)	47.3 ± 101.0 (13)	51.6 ± 92.0 (40)
Total	69.9 ± 121.2 (45)	71.7 ± 126.8 (26)	70.6 ± 122.4 (71)
GRAND TOTAL:			
Males	509.2 ± 349.6 (18)	660.4 ± 267.9 (13)	572.6 ± 322.1 (31)
Females	408.9 ± 185.1 (27)	509.7 ± 344.0 (13)	441.6 ± 248.1 (40)
Total	449.0 ± 264.5 (45)	585.0 ± 311.7 (26)	498.9 ± 288.1 (71)

* Stretching for males in Study 1 vs stretching for males in study 2: $P < 0.05$

** Stretching for females in study 1 vs stretching for males in study 2: $P < 0.05$

*** Warmup for females in study 1 vs warmup for males in study 2: $P < 0.05$

TABLE 3: Intensity of training sessions as rated on a scale from 6 (very very light) to 20 (very very hard). The number in brackets denotes the sample size. Values are expressed as X ± SD.

STUDY 1		STUDY 2	COMBINED
ENDURANCE INTENSITY:			
***Males**	12.1 ± 2.2 (18)	14.8 ± 1.9 (13)	13.2 ± 2.4 (31)
** **Females**	12.5 ± 2.4 (27)	14.4 ± 2.2 (11)	13.0 ± 2.5 (38)
Total	12.3 ± 2.3 (45)	14.6 ± 2.0 (24)	13.1 ± 2.5 (69)
SPEED INTENSITY:			
*****Males**	13.7 ± 2.2 (18)	17.0 ± 1.8 (13)	15.1 ± 2.6 (31)
Females	14.7 ± 2.9 (27)	15.8 ± 2.2 (9)	14.9 ± 2.8 (36)
Total	14.3 ± 2.6 (45)	16.5 ± 2.0 (22)	15.0 ± 2.7 (67)

* Endurance intensity for males in study 1 vs endurance intensity for males in study 2: $P < 0.05$

** Endurance intensity for females in study 1 vs endurance intensity for males in study 2: $P < 0.05$

*** Speed intensity for males in study 1 vs speed intensity for males in study 2: $P < 0.05$

CHAPTER 3:

MEDICAL CHARACTERISTICS OF YOUNG COMPETITIVE SWIMMERS IN THE WESTERN CAPE

MEDICAL CHARACTERISTICS OF YOUNG COMPETITIVE SWIMMERS IN THE WESTERN CAPE

MN Jaffer (MB ChB)

MI Lambert (PhD)

MRC/UCT Bioenergetics of Exercise Research Unit, Department of Physiology

University of Cape Town Medical School

Sports Science Institute of South Africa

<u>**Address for correspondence:**</u>

Dr. M.N.Jaffer

MRC/UCT Bioenergetics of Exercise Research Unit

Sports Science Institute of South Africa

P.O.Box 115

Newlands

7725

Tel: 021 - 686 7330

Fax: 021 - 686 7530

Abstract

Objective. The aim of the study was to describe the medical history of young competitive swimmers and to assess whether there were any gender differences.

Design. Swimmers from nine swimming clubs in the Western Cape were assessed at the beginning of the swimming season. A questionnaire evaluated the following: prevailing medical conditions, any previous operations, the prevalence of injuries sustained in the previous season, the nature of the injury, the part of the body affected by the injury and how the injury affected training. Female swimmers were also asked details concerning the menses: age of the first period, the number of days between the period and the duration of the period in days.

Results. Seventy-three swimmers (13.5 ± 1.3 years) and with 3.9 ± 2.1 years swimming experience, participated in the study - 31 males and 42 females. Twenty -three percent of swimmers reported an existing medical condition. Asthma was the most prevalent medical illness (16% of all swimmers), followed by hayfever (4%), epilepsy (1%), sinusitis (1%) and epistaxis (1%). There was no statistical difference in the time spent on various training activities for those swimmers with asthma (n = 12) compared to those swimmers without asthma (n = 61). A total of 28 surgical operations were performed on the subjects -14 males and 14 females. Tonsillectomy was the most prevalent operation performed (61%) - 9 males and 8 females.

Twenty-two swimmers (30%) sustained injuries in the previous season and a total of twenty six injuries were reported in the previous season (14 females and

12 males). The lower limb was the region most commonly affected - 10 injuries (7 females and 3 males).This was followed by the upper limb (7 injuries) and the back (3 injuries). The commonest type of injury reported was muscle injuries - n = 10 (6 males and 4 females), followed by joint pain, ligament injuries, bone injuries and soft tissues injuries. Of the 26 injuries reported by the swimmers, 9 injuries (35%) required visits to a doctor. Four swimmers suffered a second injury in the previous season and one swimmer sustained a third injury in that season. Forty-six % of injuries caused the swimmers to taking a break from training, varying from one day to three months.

Fifty percent of the female swimmers had reached menarche.

Conclusions.

Sixteen percent of swimmers in this study reported asthma. This is higher than the prevalence rate for asthma in the general South African childhood population (11%-12%). This may be due to the lower risk for developing exercise-induced asthma (E.I.A.) in swimmers compared to the development of E.I.A. in land-based activities, as well as the medical benefits offered by swimming. Young local female swimmers did not show the delayed menarche which may be prevalent in young athletes compared to non-athletes as found in other studies on sportswomen. Further studies are needed in other regions to determine whether the findings are peculiar to the swimmers of the Western Cape or whether similar trends exist elsewhere.

Introduction

The main aim of this study was to assess the medical background of young competitive swimmers. Many uncontrolled medical illnesses affect the optimum functioning of the body adversely and may impair performance. Adequate management of these conditions is extremely important for optimal performance by the athlete.[24]

As no data on medical problems for young swimmers in the Western Cape are currently available, a study was undertaken to gain more information on medical conditions prevalent in young swimmers in the Western Cape. The aim of the study was to assess the prevalence of existing medical conditions in young competitive swimmers and whether there were gender differences amongst the swimmers for the various medical conditions. In addition, previous surgical operations were also documented.

Participants who compete in competitive swimming have a very low incidence of accident and injury compared with many other sports involving children and young athletes.[9] As a sport, swimming is unique, in that firstly, it is an inefficient method of body propulsion in comparison with running. Secondly, swimming is an inertial sport that is highly dependant on technique and muscle power contributes much less to ability in swimming than in many other sports. Thirdly, swimming is one of the few sports, which subjects the body to upper body strength training, lower body strength training as well as cardiovascular fitness.[11] Despite the overall intensity of this activity, swimmers have less risk of injuries than in most other sports.[11] This study also set out to determine the prevalence of injuries sustained by young swimmers in the previous season. The nature of the injury, the part of the body affected by the injury and how the injury affected training were also ascertained.

It has been hypothesized that young athletes, undertaking intensive training, have delayed menarche due to the effects of training at an early age, although it is known that other genetic and environmental factors contribute to this observed later menarche.[2] In this study, female swimmers were also asked details concerning the menses: age of the first period, the number of days between the period and the duration of the period in days.

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Methods

Swimming clubs in the Western Cape were approached at an official meeting of the regional executive of Western Province Swimming. At this meeting, representatives from eighteen swimming clubs affiliated to Western Province Swimming, were present and eight clubs were absent. The clubs that were not represented included four clubs that were based out of town in the country areas.

As a result of geographical considerations, two clubs indicated that it would be difficult to involve their swimmers in the study. Another three clubs, after initial enthusiasm by the coaches, withdrew their support for the study. Due to geographical and logistical considerations and the possibility of non-compliance, another four clubs were omitted from the study.

Therefore, nine clubs from various regions in the Western Cape were eventually available for selection and these clubs agreed to participate in the study.

Measurement tool- questionnaire

A questionnaire was designed to evaluate the background medical data of swimmers, for example, the current medical illnesses, any previous surgical operations and the age at which the operations were performed. The swimmers were also questioned on the prevalence of injuries sustained in the previous year, the number of injuries experienced by each swimmer, the parts of the body affected as a result of the injuries and the specific type of injury sustained by the swimmer. The severity of the injury was assessed, by firstly, whether the swimmer sought medical attention and, secondly, whether the swimmer had been absent from training as a result of the injury sustained. Female swimmers were also asked details concerning the menses: the age of the first period, the number of days between the period and the duration of the period in days.

The questionnaire was tested in a pilot study and any ambiguous questions were adjusted.

Statistical methods

The parametric data were analysed using a t-test. The prevalence data were analysed using a Chi^2 test. Statistical significance was accepted as $P< 0.05$. All data are presented as means and standard deviations.

Results

There were 73 participants in the study consisting of 31 males and 42 female swimmers. The average age of the swimmers was 13.5 ± 1.3 years and the average period of competitive swimming was 3.9 ± 2.1 years.

Twenty-three percent of swimmers reported a medical condition which existed when the questionnaire was completed (Table 1). The most prevalent medical illness was asthma - 16% of all swimmers (n = 12). The other reported medical illnesses were hayfever (4%), epilepsy (1%), sinusitis (1%) and epistaxis (1%) (Table 1). There were no differences between males and females for any of these medical conditions (Table 1).

Table 2 shows the time in minutes per week, spent for different activities during training sessions for subjects who reported asthma (n = 12) and those without asthma (n = 61). The activities documented are stretching, warmup, endurance training, speed training, warmdown, strength training, motivational sessions and other physical activities. There were no statistical differences for the time spent in these activities between those swimmers with asthma and those without asthma. (Table 2).

Table 3 depicts surgical operations which the swimmers had undergone in the past. A total of 28 operations were performed on the subjects, 14 on the male swimmers and 14 on the female swimmers. Tonsillectomy (61%) was the most prevalent operation, performed on 17 subjects (9 males and 8 females).
This was followed by grommets (2 swimmers), ear operations (2 subjects) and

eye operations (2 swimmers). Each of these operations were divided equally between male and female swimmers. One female swimmer reported an appendicectomy, one reported a hernia repair and one reported a tongue operation. No male swimmer reported any of these procedures. One male swimmer reported a fracture and another reported an orchidopexy. Two subjects (both males) had more than one operation and one male swimmer had three operations in the past (Table 3).

Table 4 shows the injuries sustained by the swimmers in the previous season. Twenty-two swimmers sustained injuries during this time. These swimmers reported a total of twenty six injuries (14 females and 12 males). Four subjects reported more than one injury in this period. The lower limb was the commonest region affected - 10 injuries (7 females and 3 males).This was followed by the upper limb - 7 injuries (4 females and 3 males) and the back - 3 injuries (2 females and 1 male swimmer). Other regions injured were the shoulder - 2 subjects, neck - 2 subjects and chest - 1 subject. One male swimmer also reported an unknown injury (Table 4).

The specific types of injuries sustained by the swimmers in the previous season, are listed in table 5. Ten swimmers (14%) reported muscle injuries (6 males and 4 females). Joint pain (8%) was the next most prevalent injury (6 swimmers, all females). This was followed by ligament injuries (5%) -4 subjects (3 males and 1 female swimmer), bone injuries(4%) - 3 swimmers (1 male and 2 females), skin and / or soft tissues(3%) - 2 subjects (1 male and 1 female) and one unknown injury (1 male swimmer) (Table 5).

Of the 26 injuries reported by the swimmers, only nine injuries (35%) required visits to a doctor for medical management. Six swimmers consulted a doctor for first-time injuries. Four swimmers suffered a second injury and two of these were assessed by a doctor. One swimmer sustained a third injury, which required a doctor's assessment.

Table 6 shows the number of injuries sustained by the swimmers resulting in days off from training. Of the 26 injuries experienced by the swimmers, 12 injuries (46%) caused the swimmers to take a break from training, whilst 14 injuries (54%) were not serious enough to cause the swimmer to stop training (Table 6).

Table 7 denotes characteristics of the menstrual patterns of female swimmers who had attained menarche. Twenty-one (50%) of the 42 female swimmers had reached the menarche. The average age at menarche was 12.0 ± 0.9 years (n = 21). The average age of the female swimmers in the study who had reached the menarche was 14.1 ± 1.2 years (n = 21) compared to 13.2 ± 1.1 years for the girls who had not reached the menarche (n = 21).The average duration of the menses was 5.3 ± 1.2 days (n = 21). The average time period before the next menstrual cycle was 26.8 ± 4.4 days (n = 18).

Discussion

The main aim of this study was to assess the medical background of young competitive swimmers.

The main finding of our study was that 16% of swimmers had asthma. This prevalence rate for asthma in our young swimmers appears to be higher than the prevalence of asthma for children in the general South African population (11% to 12%).[3,8] A study on Cape Town schoolchildren in 1994 (mean age 12 years), reported a prevalence rate of 12%.[3] A later study in 1995, on younger children (7-8 years old), in a less affluent area in Cape Town, reported a prevalence rate of 11%.[8]

The worldwide prevalence of asthma and other allergic conditions was assessed in a recent multi-centre trial.[29] A total of 463 801 children, aged 13-14 years old in 155 centres from 56 countries were studied. The prevalence rates for asthma were varied for the different countries and ranged from 2% to 37%.[29]

Data on the prevalence of asthma amongst young swimmers generally are not known. However, a study on US athletes participating in the 1996 Summer Olympics in Atlanta, Georgia, found that 17% had asthma.[30] In these Olympic Games, 4% to 15% of all the athletes showed evidence of asthma or used anti-asthmatic medication.[10] A study in 1997 on all senior elite Norwegian athletes concluded that the prevalence of asthma was greater among athletes (10%) compared with that in the general population (7%).[19] Weiler and Ryan of the United States Olympic Committee (USOC) found that 44 (22%) of the 196 US athletes who participated in the 1998 Winter Olympics in Nagano, Japan, had asthma.[31]

It is postulated that the higher prevalence rates for asthma in swimmers could be as a result of the fact that swimming is a sporting activity which young asthmatics often tolerate well.[17] The low risk of developing exercise - induced asthma (E.I.A.) in swimming activities compared with land-based activities has been attributed to the fact that swimming induces less severe bronchoconstriction than other sports.[1] The mechanisms for this protective effect of swimming are not clear, but it may be due to the high humidity of inspired air at water level, which reduces respiratory heat loss (and possibly osmolarity of mucus of the airways). Beneficial roles of horizontal posture and of water immersion have also been postulated as possible contributing factors to the lower risk of developing exercise - induced asthma.[1] Swimming, however, poses two potentially deleterious effects to the patient with asthma. One is the exaggerated parasympathetic tone due to the 'diving reflex', that has been shown to trigger bronchoconstriction and the other is airway irritation because of chlorine and its derivatives. Overall, swimming as a training modality has definite benefits for the patient with asthma, which include an increase in aerobic fitness and a decrease in asthma morbidity and thus it is an ideal form of physical activity for the asthmatic sportsperson.[1,16]

It is, therefore, likely that the higher prevalence of asthma amongst swimmers compared to other activities may be due to a combination of the lower risk of developing exercise- induced asthma, as well as the inherent benefits to the overall well-being of the sportsperson offered by swimming.

Establishing a reliable estimate of the prevalence of allergic rhinitis is difficult; prevalence estimates range from as low as 4% to more than 40%.[25] Four percent of swimmers in our study had allergic rhinitis. The world-wide prevalence for rhinitis was also assessed as part of the ISAAC study.[28] The prevalence varied from country to country and was assessed as 1% to 40% in 13-14-year-old children.[28]

Katelaris, et al. (2000) conducted a study on a population of elite Australian athletes from Olympic sports to ascertain the prevalence of allergic rhinoconjunctivitis.[12] Two hundred and fourteen athletes (61% male; mean age, 21 ± 16 years) representing 12 Olympic sports participated in the study. Fifty-six percent of the athletes gave a symptom history consistent with allergic rhinoconjunctivitis, 41% had symptoms of allergic rhinoconjunctivitis and a positive test response to any one allergen, and 29% had seasonal allergic rhinoconjunctivitis (a positive history and at least one positive skin prick test response to a seasonal allergen). Athletes from aquatic sports were more likely to have symptoms than those from other sports.[12] Allergic rhinitis and bronchial asthma frequently coexist in the same patients.[6,7] A growing body of literature has documented that the treatment of patients with allergic rhinitis may result in improvement of asthma symptoms, airway caliber, and bronchial hyperresponsiveness to exercise.[6]

Swimmers may display a wide variety of nasal and sinus symptomatology.[24] One swimmer in this study reported epistaxis and another sinusitis. The nasal mucosa's primary response to a variety of stimuli is a vasomotor reaction resulting in increased nasal mucosa surface area, increased obstruction and increased nasal secretions. This may predispose the swimmer to epistaxis, rhinitis and sinusitis.[24] Those swimmers who do experience nasal and sinus symptoms are advised to wear nasal plugs.[24]

One swimmer in our study reported epilepsy. Although the risk of drowning for epileptic children who swim is increased four times over that of normal children, the absolute risk is low.[20] This is borne out by Pearn, et al. (1978) who analysed data from Australia and Hawaii (combined population studied 1.6 million), where over a period of five years, no cases of epileptic children drowning in the sea or swimming pool were reported.[21] It is, therefore, advised that with adequate seizure control medication and supervision, the child with epilepsy should be able to enjoy swimming.[20,21,24]

In our study, twenty-two swimmers (30% of the total) sustained injuries in the previous season and a total of twenty six injuries were reported (14 females and 12 males). It is not known whether these injuries were directly as a result of swimming, or whether these injuries were acute or chronic. The regions injured most frequently were lower limb (38%), upper limb (26%) and back (11%). A study by Richardson (1999), reported 886 injuries amongst swimmers and coaches in the United States for the 1997 calendar year.[22] The assumed

participation for this sport was 150 000. Only 12% of these injuries were "major" and all were as a result of swimming. In his study, the regions involved most frequently were the lower limb (37%), upper limb (21%) and the back (3%), which is similar to the frequencies for injuries reported in our study.
However, the injuries reported in his study are largely as a result of accidents rather than injuries sustained directly as a result of the sport.[22]

It has been hypothesized that young athletes, undertaking intensive training, have delayed menarche due to the effects of training at an early age, although it is known that other genetic and environmental factors contribute to this observed later menarche.[2,27]

Studies on South African girls have found varying ages for the menarche. In 1977, a study on black girls found the average age for the menarche to be 14.1 years in rural girls and 13.0 years in urban girls.[23] In a later study on urban black and white girls, Chaning-Pearce and Solomon (1987) found the average menarchal ages to be 13.1 ± 1.4 years for white girls and 13.9 ± 1.7 years for black girls.[5]
Cameron and Nagdee (1996) studied 146 South African Indian mother-daughter couples, and found the average menarcheal age of the daughters to be 12.52 ± 1.25 years compared to mean maternal menarcheal age of 13.20 ± 1.57 years.[4] Their conclusion was that the data showed a reduced secular trend for menarcheal ages as evident in the intergenerational data (0.24 years/decade).[4]

In our study, the average age at menarche was 12.0 ± 0.9 years (n = 21). It is tempting to speculate that this shows an earlier menarcheal age for girls compared to the study by Cameron and Nagdee in 1996 and concurs with the conclusion that a reduced secular trend for menarcheal ages may be prevalent in South African girls. This finding should, however, be interpreted with caution as our data were collected in a self-reported descriptive study. Furthermore, not all the female subjects had reached the menarche. Therefore, the true average age of the female swimmers at menarche could not be determined. Bearing these study-design limitations in mind, it is reasonable to assume that our findings on young local female swimmers do not show the delayed menarche which may be prevalent in young athletes compared to non-athletes as found in other studies on sportswomen.[2,13,14,15,26,27]

It is unclear whether the later menarche observed in competitive athletes is due to genetic factors or environmental factors related to intense prepubertal training.[27] Baxter-Jones, et al. (1994) confirms that young athletes, undertaking intensive training, have delayed menarche due to the effects of training at an early age, although it is known that other genetic and environmental factors contribute to this observed later menarche.[2] A study in 1994, showed that the familial resemblance in age at menarche for athletes and their mothers and sisters, was identical with that in the general population. The conclusion from this study was that the later menarche commonly observed in athletes is to a large extent familial.[15] A similar conclusion was obtained by Baxter-Jones, et al. (1994), whose study confirmed that maternal menarcheal age and type of sport had a significant influence on subject's age of menarche.[2]

In summary, our study found a higher prevalence for asthma in young swimmers (16%) compared with the general childhood population (11%-12%). The reasons for this finding is not known, but may be due to the lower risk for developing exercise-induced asthma in swimmers compared to the development of E.I.A. in land-based activities, as well as the medical benefits offered by swimming. Young local female swimmers did not show the delayed menarche which may be prevalent in young athletes compared to non-athletes as found in other studies on sportswomen.[2,13,14,15,26,27]

Further studies are needed to determine whether the findings are limited to the swimmers of the Western Cape or whether similar trends exist in other regions.

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TABLE 1: The prevalence (%) of medical conditions in subjects according to gender.

CONDITION	**MALES** (n =31)	**FEMALES** (n =42)	**TOTAL** (n =73)
Asthma	13%	19%	16%
Epilepsy	3%	0%	1%
Hayfever	6%	2%	4%
Sinusitis	0%	2%	1%
Epistaxis	3%	0%	1%

TABLE 2: Time (min per week) spent for different activities during training sessions for subjects who reported asthma (n = 12) and those without asthma (n = 61). Values are X ± SD.

ACTIVITY (Min/week)	ASTHMA	NO ASTHMA
Stretch	17.9 ± 26.6	19.4 ± 27.3
Warmup	42.9 ± 33.8	42.2 ± 39.3
Endurance	162.9 ± 49.2	185.1 ± 96.2
Speed	90.8 ± 23.2	110.0 ± 92.5
Warmdown	23.8 ± 15.8	26.5 ± 17.9
Strength	11.7 ± 21.2	20.1 ± 51.8
Motivation	5.8 ± 10.0	21.2 ± 42.3
Other	49.2 ± 91.7	69.0 ± 123.7
GRAND TOTAL	405.0 ± 160.3	493.5 ± 293.8

TABLE 3: Operations performed on subjects. A total of 28 operations were performed.

OPERATION	MALES (n= 31)	FEMALES (n= 42)	TOTAL (n= 73)
Tonsillectomy	9	8	17
Grommets	1	1	2
Appendicectomy	0	1	1
Hernia	0	1	1
Fracture	1	0	1
Eye	1	1	2
Ear	1	1	2
Tongue	0	1	1
Orchidopexy	1	0	1
TOTAL OPERATIONS	14	14	28

Two subjects (both males) had more than one operation.

One subject (male) had three operations.

TABLE 4: The prevalence of injuries sustained by subjects in the previous season. Injuries are categorised according to the region of the body.

REGION	MALES (n= 31)	FEMALES (n= 42)	TOTAL (n= 73)
Lower limb	3	7	10
Upper limb	3	4	7
Back	1	2	3
Shoulder	1	1	2
Chest	1	0	1
Neck	2	0	2
Unknown	1	0	1
TOTAL	12	14	26

4 subjects reported more than one injury.

TABLE 5: The prevalence of injuries sustained by subjects in the previous season. Injuries are categorised according to specific type.

INJURY TYPE	**MALES** (n= 31)	**FEMALES** (n= 42)	**TOTAL** (n= 73)
Muscle	6	4	10
Ligament	3	1	4
Joint pain	0	6	6
Bone	1	2	3
Skin/Soft Tissue	1	1	2
Unknown	1	0	1
TOTAL INJURIES	12	14	26

Four subjects reported more than one injury .

TABLE 6: Number of injuries requiring days off from training.

Number of injuries (n=26)	Days off
14	0
2	1
4	2
1	3
2	7
1	10
1	42
1	90

TABLE 7: Menstruation patterns of female swimmers who have attained menarche. The number in brackets denotes the sample size. Values are expressed as X ± SD.

CHARACTERISTIC	VALUES
Age at first menses (years)	12.0 ± 0.9 (21)
Days between periods	26.8 ± 4.4 (18)
Duration of menses (days)	5.3 ± 1.2 (21)

CHAPTER 4:

SWIMMING PERFORMANCE AND MOOD STATE EVALUATION OF YOUNG COMPETITIVE SWIMMERS IN THE WESTERN CAPE

SWIMMING PERFORMANCE AND MOOD STATE EVALUATION OF YOUNG COMPETITIVE SWIMMERS IN THE WESTERN CAPE

Jaffer, M.N. MB ChB

Lambert, M.I. PhD

MRC/UCT BIOENERGETICS OF EXERCISE RESEARCH UNIT

SPORTS SCIENCE INSTITUTE OF SOUTH AFRICA

P.O. BOX 115

NEWLANDS

7725

TEL: 686- 7330

<u>Address for correspondence:</u>

M.N.Jaffer

MRC/UCT Bioenergetics of Exercise Research Unit

Sports Science Institute of South Africa

P.O.Box 115

Newlands

7725

Abstract

Objective. The aim of the study was to assess the relationship between mood states of young swimmers and swimming performance. Mood states were assessed prior to commencement of the swimming season and, thereafter, monitored throughout the season. Mood states were then correlated to swimming performance to determine whether a relationship existed between mood states and swimming speeds.

Design. A modified version of the Profile of Mood States (POMS) was used to evaluate the psychological profile of the swimmers. This questionnaire was issued in both English and Afrikaans and distributed to swimmers at the beginning of each month, for the six months of the swimming season. Performance details of individual swimmers who participated in competitions throughout the season, were obtained from the Honorary Records Officer of Western Province Swimming. Swimmers who had completed three or more POMS assessments coinciding with a specific swimming event throughout the season, were selected as a subgroup, and POMS variables that had a significant relationship to swimming speed were identified and recorded.

Results. Eighty-seven swimmers participated in the study - 38 males and 49 females (mean age = 13.5 ± 1.3 years). The parameters of the POMS (tension, depression, anger, vigour, fatigue and confusion), varied significantly amongst the swimmers as shown by the coefficient of variation (cv) - (a) At the beginning of the season (n = 87) - CV = 42 to 160%, (b) more than two POMS readings in the season (n = 43) - CV = 28 ± 23% to 73 ± 69% and (c) three or more POMS

readings in the season ($n = 20$) - CV = 32 ± 23% to 90 ± 71%.

The parameter of vigour had the least variation of all the POMS measurements - (a) CV = 42%, (b) 28 ± 23% and (c) 32 ± 23%.

When swimmers were analysed as a group, vigour was the POMS parameter with the highest score -(a) 2.4 ± 1, (b) 2.2 ± 0.8 and (c) 2.1 ± 0.8).

When data for swimmers who competed in three or more events in the season and who completed a POMS questionnaire at the same time were analysed, the POMS parameters which had a significant relationship to swimming performance were varied, depending on the distance swum and the type of swimming stroke. For example, for the 50 metres freestyle swimmers ($n = 8$), it was the parameter of confusion ($r = 0.79$; $p < 0.05$) which related to swimming performance. The 100 metres freestyle swimmers ($n = 8$) had depression as the most significant parameter ($r = -0.72$; $p < 0.05$) and the 100 metres backstroke swimmers ($n = 3$) had both fatigue scores ($r = -1.00$; $p < 0.05$) and depression scores ($r = 1.00$; $p < 0.05$) related to swimming performance.

Conclusions. POMS scores do not consistently track changes in swimming performance over a season in a group of swimmers who did not show signs of overtraining. However, there are sufficient data to suggest that the POMS may be a useful tool to monitor swimming performance during a season. Further research is needed to determine how the POMS may be used in conjunction with the monitoring of physiological variables to determine the efficacy of training in swimmers.

Introduction

Sport scientists have for many years attempted to quantify training in competitive sports. The measurement of training volume and intensity and the monitoring of the sportsperson engaged in physical activity, has attracted the attention of numerous researchers on this particular subject.[1,6,11,12,14,18] The challenge to researchers has been to identify markers which would allow sportspersons and their coaches to adjust training loads to maximise the benefits of training while reducing the potential for overtraining or undertraining.[12,19]

Data in a study on swimmers by Hooper and her colleagues (1999), suggest that an accurate prediction of performance changes may be possible if the changes in a range of physiological and psychological variables are measured.[13] Hooper, et al. in a study on athletes in 1995, found that conscientious self-analysis by the athlete is the most efficient method of monitoring training.[12]

One of the measurement parameters which has shown to have a strong link with training and performance, is the Profile of Mood States (POMS), which was developed by McNair,et al. in 1971.[16] Other researchers have developed shortened versions of this tool.[7,15,25,27]The application of the POMS as a tool in the monitoring of performance, has been well studied and a link has been shown between mood states and physical activity.[2,3,4,5,8,11,13,17,19,20,21,22,23,24,26,28,29,30]

The use of the POMS in swimming specifically, has been evaluated by many researchers.[2,3,11,13,19,20,24,26] These studies have found that mood states such as tension, anger, depression, vigour, confusion and fatigue were useful in the assessment of training loads and subsequent adjustment of training. Most of these studies also showed increased mood disturbance with increasing training loads.

Whether changes in mood states are related to swimming performance amongst South African swimmers is not known, as there have been no reported studies on this subject. A study was thus undertaken on young swimmers in the Western Cape. The aim of the study was to assess the mood states in swimmers prior to a swimming season, and then to monitor the changes in mood states throughout the season. In addition, mood states were correlated to performance in competitions, to assess whether a relationship exists between mood states and swimming performance.

Methods

Swimming clubs in the Western Cape were approached at an official meeting of the regional executive of Western Province Swimming. Coaches selected 12-14 year old male and female swimmers from their elite squads who were asked to volunteer for the study. Many potential subjects indicated that they were unavailable due to other commitments. A meeting was then set up with the volunteers, coaches and parents of each club to explain the study in detail. Nine clubs eventually participated in this study (n = 87). The study was conducted over a period of six months (October - March).

Measurement tools:

a) Modified Profile Of Mood States

A modified version of the Profile of Mood States (POMS) questionnaire was utilised to evaluate the psychological profile of the swimmers. The limitation of the POMS questionnaire, is that it is not standardised for South African populations. In the absence of a local version, our questionnaire was based on the shortened version of the POMS as outlined by Shacham.[27]

The questionnaire assesses six psychological parameters (tension, anger, depression, vigour, fatigue and confusion) by using various words and phrases (See Appendix A and B). The swimmers were asked to document their mood states on a scale from 0 to 4 for each word or phrase as requested on the questionnaire at the time of issue. The scores were then grouped into each of the six psychological parameters and then averaged for a final score in that category.

The questionnaires were printed in both English and Afrikaans and explanations were given for uncommon and unfamiliar words/phrases (Appendix A and B). Questionnaires were issued to the swimmers at the beginning of each month and were collected and analysed at the end of the season.

b) Performance in Competitions

Swimmers participated in various galas and competitions throughout the season. These competitions were organised by Western Province Swimming and swimming times were accurately recorded by experienced personnel. These performance records were obtained from the Honorary Records Officer of Western Province Swimming and were then used to track performances of individual swimmers in races throughout the season.

c) POMS versus Performance

Subjects participated in different swimming events in any given month. For this reason, it was not always possible to synchronise the completion of a POMS questionnaire with a specific swimming event. Swimmers who completed three or more POMS assessments coinciding with a particular swimming event, were selected as a sub-group for further analysis.

Psychological parameters in the POMS questionnaire were related to swimming performance. The POMS variables that had a significant relationship to swimming speed were identified and analysed further by plotting each subject's swimming speed against the POMS variables.

Statistical methods

All data are presented as mean and standard deviations (X ± S.D.). The coefficient of variation [(S.D./mean) x 100], was also calculated for each mood state. The Spearman's rank order correlation coefficient was calculated between variables. Statistical significance was accepted as $P < 0.05$.

Results

There were 87 participants in the study (n = 38 males and n = 49 females). The average age of the whole group was 13.5 ± 1.3 years (13.6 ± 1.3 years for males and 13.5 ± 1.3 years for females).

The Profile Of Mood States (POMS) as measured at the beginning of the season in all these subjects, is shown in Table 1. The vigour score was the only parameter, which did not have a minimum value of 0. The vigour score also reflected the least amount of variation amongst the participating swimmers, as measured by the coefficient of variation (CV) of 42%. All the other parameters of the POMS varied significantly when the coefficient of variation was calculated (86% to 160%) - (Table 1) .

Table 2 shows the POMS scores measured in swimmers (n = 43), where more than two recordings were obtained in the season. The vigour and fatigue scores did not have a minimum value of 0. The vigour score also reflected the least amount of variation amongst the participating swimmers, as measured by the coefficient of variation of 28 ± 23% . The coefficient of variation for the other POMS parameters were high (52 ± 63% to 73 ± 69%) - (Table 2).

Table 3 depicts POMS scores measured in swimmers where three or more recordings were obtained during the season (n = 20). The vigour and fatigue scores did not have a minimum value of 0. The vigour score again showed the least amount of variation amongst the participating swimmers, as measured by the coefficient of variation of 32 ± 23%. The coefficient of variation of the other parameters were once again high (49 ± 47% to 90 ± 71%) - (Table 3).

In Table 4, the descriptive data of the performance times in competitions by swimmers recorded on three or more occasions during the season are noted. The performances documented are 50 metres freestyle (n = 19), 100 metres freestyle (n = 15), 100 metres breast-stroke (n = 14) and 100 metres backstroke (n = 10). The coefficient of variation in the swimming performance was less (CV= 2 ± 1% to 3 ± 3%) when compared to the coefficient of variation in the POMS scores over a similar time.

The lowest coefficient of variation was measured for the 100 metres freestyle (CV = 2 ± 1%). This was followed by 100 metres breaststroke (CV = 2 ± 2%), 100 metres backstroke (CV = 3 ± 2%) and finally 50 metres freestyle (CV = 3 ± 3%).

POMS parameters which had a significant relationship to swimming performance, are recorded in tables 5, 6, 7 and 8. The data were only analysed for swimmers who competed in three or more swimming events throughout the swimming season and completed a POMS questionnaire at the same time. The speed of the swimmer is recorded in metres per second (m/s). The parameters documented are 50 metres freestyle versus confusion - n = 8 - (Table 5) - r = 0.79; $p < 0.05$, 100 metres freestyle versus depression - n = 8 - (Table 6) - r = -0.72; $p < 0.05$, 100 metres backstroke versus fatigue - n = 3 - (Table 7) - r = -1.00; $p < 0.05$ and 100 metres backstroke versus depression - n = 3 - (Table 8) - r = 1.00; $p < 0.05$.

The time interval between events and POMS questionnaires is documented (First day of the swimming season = 1, second day = 2, etc.). No significant relationship was noted between the swimming speed and the other POMS scores.

The mean POMS scores for all the swimmers, is depicted graphically in figure 1. The depictions are subdivided into: Swimmers completing POMS questionnaires early in the season - the months of October and November (Figure 1a; n = 104), swimmers completing POMS questionnaires in the middle of the season - these include December and January (Figure 1b; n = 46) and swimmers who completed POMS questionnaires at the end of the season- the months February and March (Figure 1c; n = 23).

Analysis of the POMS scores for the swimmers early in the swimming season, shows the parameter of vigour recorded as the highest score (Figure 1a). Vigour is also the highest POMS parameter when the scores are analysed in the middle of the season (figure 1b) and also at the end of the season (figure 1c).

Figure 2 shows a subgroup of swimmers (n = 6), who each completed a POMS questionnaire at the beginning of the season (figure 2a), in the middle of the season (figure 2b) and at the end of the season (figure 2c).
Analysis of the POMS scores for the swimmers early in the swimming season, shows the parameter of vigour recorded as the highest score (Figure 2a). Vigour is also the highest POMS parameter when the scores are analysed in the middle of the season (figure 2b) and also at the end of the season (figure 2c).

In figure 3, the data for swimmers who participated in the 50 metres freestyle events on three or more occasions throughout the season (n =8), are documented. On inspection of these graphs, six swimmers (#'s 4, 78, 84,76, 82 and 103) showed a mid-season decline in performance (m/s), followed by an elevation towards the end of the season.

Three swimmers (#'s 4, 82 and 89) reported a mid-season peak for the confusion score. Only one swimmer (# 82) recorded a confusion score which tracked the improvement in performance. In this instance, an initial elevation in performance matched a decrease in confusion. This was followed by a mid-season decrease in performance when a higher confusion score was noted. Finally an increase in performance at the end of the season was matched by a lower confusion score.

Another swimmer (# 103) showed an inverse relationship between the performance and the confusion scores. The confusion score and the swimming speed were both high at the beginning of the season, followed by mid-season decrease for both values, and finally an increase of both parameters at the end of the season. There was no trend of a relationship between the speed of swimming and the confusion scores in the other six swimmers (#'s 4,78,84,98,76 and 89).

Figure 4 shows the data for swimmers who performed in the 100 metres freestyle events on three or more occasions (n = 8). The swimming speed in metres per second is plotted against the depression scores. Seven swimmers (#'s 1, 5, 76, 82, 84, 96 and 103) had a final performance time at the end of the season which was faster than the initial time at the beginning of the season. Five swimmers (#'s 1, 76, 82, 96 and 103) recorded higher initial depression scores at the beginning of the season when compared to the scores at the end of the season. Four swimmers (#'s 76, 82, 96, and 103) showed performance times, which tracked depression scores. In these cases, an elevated performance time was matched by an elevated depression score and when the swimming speed was slower, the depression score was also lower (Figure 4).

In figure 5, the performance times for 100 metres backstroke swimmers are documented (n = 3). There was no apparent relationship between swimming speed and fatigue scores or between swimming speed and depression scores.

Discussion

The main finding of this study, is that no consistent relationship could be established between swimming performance and mood states. This, however, should be interpreted in the context of the study design and consequently, by the small sample size. Another factor influencing the outcome of the results, is that the POMS questionnaire is not standardised for the South African population and hence interpretation of the results should be treated with circumspection. Another limitation of this study is that the coaches for the various clubs differed and thus the coaching styles may have biased the results to some extent.

The POMS questionnaires were issued to the swimmers at the beginning of each month and were completed on a specific day during that month. As subjects could have mood states which fluctuate on a daily basis, ideally POMS should be assessed every day or at least, on a weekly basis. This would also alleviate the problem of correlating POMS to swimming performance, as in this study, the number of statistically significant performance events for a particular swimmer were assessed retrospectively after completion of the season. The swimming events, therefore, did not always coincide with the timing of the completion of the POMS questionnaire and hence the sample size was dramatically reduced. For example, eighty-seven subjects completed the POMS questionnaire initially at the beginning of the swimming season and from this group, there were only eight subjects who had POMS scores which overlapped with the assessments of swimming performance.

Despite these limitations, this study has provided some important findings. Eighty-seven subjects completed the POMS at the beginning of the season. The vigour score was the only parameter, which did not have a minimum value of 0 at at the beginning of the season. This implies that these swimmers all had a perception of having had some energy at the start of a swimming season . All the other parameters of the POMS varied significantly between swimmers (CV = 86 - 315%). This suggests that swimmers show profound differences in psychological states at the beginning of a swimming season.

When analysing the scores for the six psychological parameters of the POMS questionnaire, the vigour parameter, on average, was the highest score measured at the beginning of the season (2.4 ± 1) - Table 1. It is also disturbing, that on average, the fatigue parameter had the second highest score (1.0 ± 1.1). At this stage of the season, this could indicate poorly trained swimmers. When more than one POMS questionnaire was completed in the swimming season, the vigour parameter, again never reached a 0 score and was also the highest score documented by the swimmers- Tables 2 and 3. The implication of this finding is that despite varying training loads as the season progressed, a perception of absolute fatigue or a lack of energy was never shown by the swimmers throughout the season. This reflects positively on coaching methods and also points to good motivation amongst swimmers. However, once again, fatigue scores were second highest, on average, when swimmers completed POMS questionnaires swimmers on more than one occasion in the season. This may be due to poor pacing in certain swimmers.

When POMS was correlated to swimming performance, no clear pattern could be ascertained. Three events were identified in a sub-group of swimmers who completed three or more POMS assessments coinciding with a swimming event during the swimming season. These events were the 50 metres freestyle, 100 metres freestyle and 100 metres backstroke. In each case the POMS parameter which related significantly to swimming performance was different. When swimmers competing in the 50 metres freestyle were monitored, the confusion score was the most significant parameter. In contrast, the depression score was the most significant parameter related to performance in the 100 metres freestyle events. In the 100 metres backstroke events, both depression and fatigue scores were related to performance.

Other studies on swimmers have also found no clear link between one single parameter of the POMS and swimming performance.[11,13,21,24] Three studies conducted on swimmers over a similar period of time (six months) showed no single parameter of the POMS relating to swimming performance.[11,13,21] Hooper, et al. (1995) showed that fatigue was the most significant POMS parameter related to changes in swimming performance.[11] In a later study in 1999, confusion was the most significant POMS parameter related to changes in swimming performance.[13] O'Connor, et al. (1989) showed that depression was the most significant POMS parameter related to changes in swimming performance.[21] Raglan, et al. (1990) in a study on swimmers over four years, showed that specific mood parameters increased and decreased in accordance with alterations in training loads, with the exception of tension, which remained high, despite a reduction in training loads.[24] In essence, this indicates that no single POMS parameter consistently changes in relation to changes in swimming performance.

Although changes in POMS scores and mood disturbances were recorded by the swimmers throughout the season in this study, it is encouraging that most swimmers had faster swimming speeds at the end of the season when compared to performances at the beginning of the season (Figures 3,4 and 5). This suggests that the swimmers generally, were not overtraining, as had this been the case, this would have resulted in impaired swimming performance[10,19,20,21]. In the final analysis, this is the outcome that the coaches and swimmers strive for with their training programmes and this ultimately determines the success of a swimming season. It is, therefore, likely, based on the results from previous studies, that the POMS scores may have been different if the swimmers had developed overt signs of overtraining or overrreaching.[10,12,19,20,21]

Another finding was that, when analysed as a group, the swimmers' mean POMS scores throughout the swimming season, showed consistent elevation of the positive scores for vigour, well above the scores for the negative parameters of tension, confusion, depression and anger (Figure 1). This cross-sectional data is documented graphically over three periods i.e. early in the season (Figure 1a; n = 104), in the middle of the season (Figure 1b; n = 45) and at the end of the season (Figure 1c; n = 23). A striking resemblance is noted when analysing the three graphs. The similarity of the graphs in these three phases is even more dramatic if one considers the high drop-out rate of the subjects over the course of the season. For example, 104 questionnaires were completed early in the season and only 23 at the end of the season. This trend is mirrored by the longitudinal data obtained from individual swimmers as reflected by the graphs for six swimmers who each completed POMS questionnaires firstly, early in the season (Figure 2a), then in the middle of the season (Figure 2b) and, finally, at the end of the season (Figure 2c). Once again, the graphs closely resemble each other. The similarity of the graphs depicting the POMS parameters for the whole group throughout the season (figure 1) - (cross-sectional data) and the subgroup of six swimmers (figure 2) - (longitudinal data), suggests that swimmers' perception of training as reflected by the pychological parameters of the POMS, were uniform and that training intensity and duration possibly did not reach a point where the swimmers were overtrained. This suggests appropriate preparation in training and good motivation by the swimmers, as also shown by Morgan.[19]

In summary, the monitoring of training and performance is not a simple matter. The delineation between undertraining, appropriate training and overtraining is not very clear because of complex, interacting factors which eventually determine performance[10,12]. These factors are multifactorial and varied. In order to address the problem of training effectively, all the components should be addressed.[9] Physiological and biochemical markers of training alone have shown only inconsistent or weak trends.[11] One of the most easily accessible and sensitive components is mood change, which can be monitored easily and cheaply by the POMS test. However, physiological mechanisms may contribute to psychological responses during physical activity and hence, psychological monitoring may be most beneficial when complimented by physiological measurements.[10] Morgan has recommended that optimal training may be achieved with the regular monitoring of the psychological states in conjunction with the recording of physiological variables.[19]

In conclusion, the main finding in this study, is that POMS scores do not consistently track changes in swimming performance over a season in a group of swimmers who do not show the signs of overtraining. There is, however, sufficient data from other studies to suggest that monitoring POMS regularly together with other physiological variables has advantages when assessing the efficacy of training and detecting early signs of overtraining.[10,12,19,20,21]
The POMS should, therefore, be considered an inexpensive and useful adjunct for local coaches and their charges, when monitoring the efficacy of training.

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Appendix A:

POMS

NAME DATE

Below is a list of words that describe feelings people have. Please read each word carefully.
Circle to the right of each the number which best describes HOW YOU FEEL RIGHT NOW.

The numbers refer to the following phrases:

0 = not at all **1 = A little** **2 = Moderately** **3 = Very** **4 = Extremely**

PROUD	0 1 2 3 4	MUDDLED	0 1 2 3 4	COMPETENT	0 1 2 3 4
TENSE	0 1 2 3 4	UNEASY	0 1 2 3 4	HELPLESS	0 1 2 3 4
ANGRY	0 1 2 3 4	UNABLE TO CONCENTRATE	0 1 2 3 4	WEARY	0 1 2 3 4
WORN OUT	0 1 2 3 4	FATIGUED	0 1 2 3 4	BEWILDERED	0 1 2 3 4
LIVELY	0 1 2 3 4	ANNOYED	0 1 2 3 4	FURIOUS	0 1 2 3 4
CONFUSED	0 1 2 3 4	DISCOURAGED	0 1 2 3 4	FULL OF PEP	0 1 2 3 4
SECURE	0 1 2 3 4	NERVOUS	0 1 2 3 4	WORTHLESS	0 1 2 3 4
PEEVED	0 1 2 3 4	BLUE	0 1 2 3 4	FORGETFUL	0 1 2 3 4
SAD	0 1 2 3 4	CONFIDENT	0 1 2 3 4	SATISFIED	0 1 2 3 4
ACTIVE	0 1 2 3 4	EXHAUSTED	0 1 2 3 4	POWERFUL	0 1 2 3 4
ON EDGE	0 1 2 3 4	ANXIOUS	0 1 2 3 4	UNCERTAIN ABOUT THINGS	0 1 2 3 4
GROUCHY	0 1 2 3 4	ENERGETIC	0 1 2 3 4	TIRED	0 1 2 3 4
UNHAPPY	0 1 2 3 4				

Make sure that you have answered every item

<u>Explanations:</u>

TENSE - Feeling uptight
WORN OUT- Tired
SECURE - Safe, Untroubled
PEEVED - Irritated
ON EDGE - Excitable, irritable
GROUCHY - Sulky, complaining mood

MUDDLED - Confused
DISCOURAGED - Lack of hope, no confidence
BLUE - Low spirits, feeling down
ANXIOUS- Troubled, uneasy

COMPETENT - Able to do things well
WEARY - Tired
BEWILDERED - Confused
FURIOUS - Angry
FULL OF PEP - Lots of energy
WORTHLESS - Having no value, unimportant

Appendix B:

POMS

NAAM DATUM

Onderstaande is 'n lys van woorde wat beskryf hoe mense voel. Lees elke woord aandagtig.
Omkring die nommer aan die regterkant van elke woord wat die beste beskryf HOE JY NOU VOEL.

Die nommers verwys na die volgende:

0 = Glad nie **1 = Effens** **2 = Taamlik** **3 = Baie** **4 = Uiters**

TROTS	0 1 2 3 4	DEURMEKAAR	0 1 2 3 4	BEKWAAM	0 1 2 3 4
GESPANNE	0 1 2 3 4	ONGEMAKLIK	0 1 2 3 4	MAGTELOOS	0 1 2 3 4
KWAAD	0 1 2 3 4	NIE IN STAAT OM TE KONSENTREER	0 1 2 3 4	TAM	0 1 2 3 4
VERMOEID	0 1 2 3 4	AFGEMAT	0 1 2 3 4	VERBOUEREERD	0 1 2 3 4
LEWENDIG	0 1 2 3 4	VERERG	0 1 2 3 4	WOEDEND	0 1 2 3 4
VERWARD	0 1 2 3 4	ONTMOEDIG	0 1 2 3 4	VOL LEWE	0 1 2 3 4
GERUS	0 1 2 3 4	SENUWEEAGTIG	0 1 2 3 4	NIKSWERD	0 1 2 3 4
OMGEKRAP	0 1 2 3 4	BEDRUK	0 1 2 3 4	VERGEETAGTIG	0 1 2 3 4
TREURIG	0 1 2 3 4	VOL VERTROUE	0 1 2 3 4	TEVREDE	0 1 2 3 4
AKTIEF	0 1 2 3 4	UITGEPUT	0 1 2 3 4	KRAGTIG	0 1 2 3 4
PRIKKELBAAR	0 1 2 3 4	BEANGS	0 1 2 3 4	ONSEKER OOR DINGE	0 1 2 3 4
KNORRIG	0 1 2 3 4	ENERGIEK	0 1 2 3 4	MOEG	0 1 2 3 4
ONGELUKKIG	0 1 2 3 4				

Maak seker dat u elke item beantwoord

VERDUIDELIKING:

VERMOEID - Moeg word
VERWARD - Nie duidelik nie, deurmekaar
PRIKKELBAAR - Word gou kwaad, omgekrap
KNORRIG - Ontevrede met alles

AFGEMAT - Moeg, uitgeput
ONTMOEDIG - Sonder vertroue of hoop, moedeloos
BEDRUK - Hartseer, neergedruk, moedeloos

BEKWAAM - 'n taak knap doen, sonder enige moeite
TAM - Moeg, uitgeput

VERBOUEREERD - Onsteld, omgekrap

Table 1: Profile of Mood States measured at the beginning of the season. (n=87).

MOOD	MINIMUM	AVERAGE	MAXIMUM	COEFFICIENT OF VARIATION(%)
Tension	0	0.8 ± 0.8	3.2	100
Depression	0	0.4 ± 0.5	2.7	125
Anger	0	0.5 ± 0.8	3.4	160
Vigour	0.2	2.4 ± 1	4.0	42
Fatigue	0	1.0 ± 1.1	4.0	110
Confusion	0	0.7 ± 0.6	2.5	86

Table 2: POMS measured on two or more occasions in the swimming season (n = 43).

MOOD	MINIMUM	AVERAGE	MAXIMUM	COEFFICIENT OF VARIATION(%)
Tension	0	0.7 ± 0.6	2.1	63 ± 54
Depression	0	0.4 ± 0.5	2.0	52 ± 63
Anger	0	0.5 ± 0.6	2.3	73 ± 69
Vigour	0.3	2.2 ± 0.8	3.9	28 ± 23
Fatigue	0.1	1.2 ± 0.9	2.9	66 ± 53
Confusion	0	0.7 ± 0.6	1.9	64 ± 53

Table 3: POMS measured on 3 or more occasions during the swimming season (n = 20).

MOOD	MINIMUM	AVERAGE	MAXIMUM	COEFFICIENT OF VARIATION(%)
Tension	0	0.8 ± 0.5	1.9	63 ± 54
Depression	0	0.5 ± 0.6	2.0	59 ± 68
Anger	0	0.6 ± 0.7	2.3	90 ± 71
Vigour	0.6	2.1 ± 0.8	3.6	32 ± 23
Fatigue	0.1	1.3 ± 0.9	2.8	73 ± 56
Confusion	0	0.8 ± 0.7	1.9	49 ± 47

Table 4: Descriptive data of the swimming performance (times for 50 metres freestyle, 100 metres freestyle, 100 metres breaststroke and 100 metres backstroke) measured on 3 occasions during the season.

EVENT	MINIMUM (seconds)	AVERAGE (seconds)	MAXIMUM (seconds)	COEFFICIENT OF VARIATION(%)
Free_50 (n=19)	27.7	34.2 ± 3.3	40.0	3 ± 3
Free_100 (n=15)	62.9	73.7 ± 5.2	82.4	2 ± 1
Brst_100 (n=14)	77.9	92.1 ± 7.2	104.0	2 ± 2
Back_100 (n=10)	65.9	83.8 ± 11	97.5	3 ± 2

Table 5: Time interval for swimmers competing in the 50 metres freestyle event and confusion scores (n = 8).

PERFORMANCE				CONFUSION SCORES	
SWIMMER	DAY	TIME (s)	SPEED (m/s)	DAY	SCORE
4	21	36.83	1.36	112	0.7
4	63	37.67	1.33	125	0.2
4	132	35.46	1.41	163	0.7
4				174	0.0
76	65	32.10	1.56	23	1.3
76	103	32.00	1.56	78	0.8
76	122	31.10	1.61	126	0.3
78	31	32.26	1.55	30	0
78	59	32.82	1.52	79	0
78	122	32.73	1.53	93	0
82	59	37.60	1.33	1	0.3
82	80	39.15	1.28	45	0.2
82	122	38.34	1.30	78	0.3
82				93	0.2
84	24	33.00	1.52	22	0
84	38	32.00	1.56	108	0
84	59	40.42	1.24	125	0.2
84	65	31.00	1.61		
84	122	32.00	1.56		
89	31	33.03	1.51	26	0.3
89	59	33.46	1.49	54	2.7
89	65	33.07	1.51	132	0.5
89	100	33.93	1.47		
98	24	31.56	1.58	32	0.8
98	44	32.40	1.54	62	0.7
98	65	31.73	1.58	124	0.8
98	100	31.67	1.58		
98	108	32.20	1.55		
103	24	32.36	1.55	32	1.7
103	44	33.39	1.50	62	1.2
103	65	33.9	1.47	121	1.8
103	103	32.96	1.52		

Table 6: Time interval for swimmers competing in the 100 metres freestyle event and depression scores (n = 8).

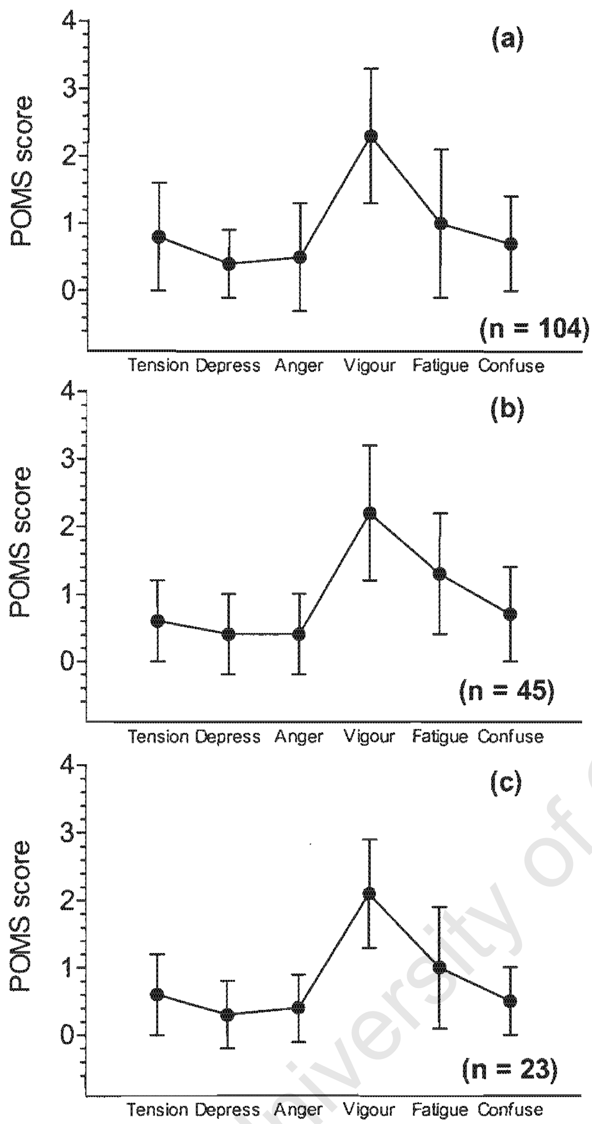
PERFORMANCE				DEPRESSION SCORES	
SWIMMER	DAYS	TIME (s)	SPEED (m/s)	DAYS	SCORE
1	48	76.88	1.30	51	0.3
1	77	78.86	1.27	157	0.2
1	101	76.22	1.31	170	0.2
1	132	76.58	1.31		
5	42	82.46	1.21	110	0
5	71	80.38	1.24	128	0
5	132	76.96	1.30	163	0
5				174	0
76	65	70.74	1.41	23	0.7
76	103	71.10	1.41	78	0
76	122	70.01	1.43	26	0.2
82	31	82.72	1.21	1	0.2
82	59	83.43	1.20	45	0
82	122	81.00	1.23	78	0
82				93	0
84	24	78.00	1.28	22	0
84	31	73.29	1.36	108	0
84	38	75.00	1.33	125	0.2
84	65	71.00	1.41		
84	122	74.00	1.35		
96	24	66.90	1.49	23	1.0
96	51	64.06	1.56	57	1.3
96	79	67.84	1.47	91	0.3
96	103	65.69	1.52	114	0.8
98	24	70.15	1.43	32	1.0
98	44	72.21	1.38	62	0.5
98	65	71.30	1.40	124	1.0
98	100	73.18	1.37		
103	24	71.91	1.39	32	1.2
103	30	72.91	1.37	62	0
103	44	74.57	1.34	121	0.3
103	65	73.63	1.36		
103	103	71.42	1.40		

Table 7: Time interval for swimmers competing in the 100 metres backstroke event and depression scores (n = 3).

PERFORMANCE				DEPRESSION SCORES	
SWIMMER	**DAYS**	**TIME** (s)	**SPEED** (m/s)	**DAYS**	**SCORE**
4	21	96.03	1.04	112	0
4	63	94.90	1.05	125	0
4	132	93.24	1.07	163	0
4				174	0
9	13	83.35	1.20	58	0.5
9	54	86.20	1.16	110	0.2
9	101	85.20	1.17	135	0.8
9				152	1.0
89	100	78.59	1.27	26	0.2
89	104	76.03	1.32	54	0
89	113	75.38	1.33	132	0

Table 8: Time interval for swimmers competing in the 100 metres backstroke event and fatigue scores (n = 3).

PERFORMANCE				FATIGUE SCORES	
SWIMMER	**DAYS**	**TIME** (s)	**SPEED** (m/s)	**DAYS**	**SCORE**
4	21	96.03	1.04	112	1.8
4	63	94.90	1.05	125	1.2
4	132	93.24	1.07	163	1.0
4				174	0.2
9	13	83.35	1.20	58	0.8
9	54	86.20	1.16	110	0.8
9	101	85.20	1.17	135	2.0
9				152	0.8
89	100	78.59	1.27	26	2.6
89	104	76.03	1.32	54	1.2
89	113	75.38	1.33	132	1.6



<u>Figure1:</u> Mean POMS scores measured for all swimmers. Values are X ± SD

a) Mean POMS scores measured early in the season: Oct-Nov: (n = 104).

b) Mean POMS scores measured in the middle of the season: Dec-Jan (n = 45).

c) Mean POMS scores measured at the end of the season: Feb-Mar (n = 23).

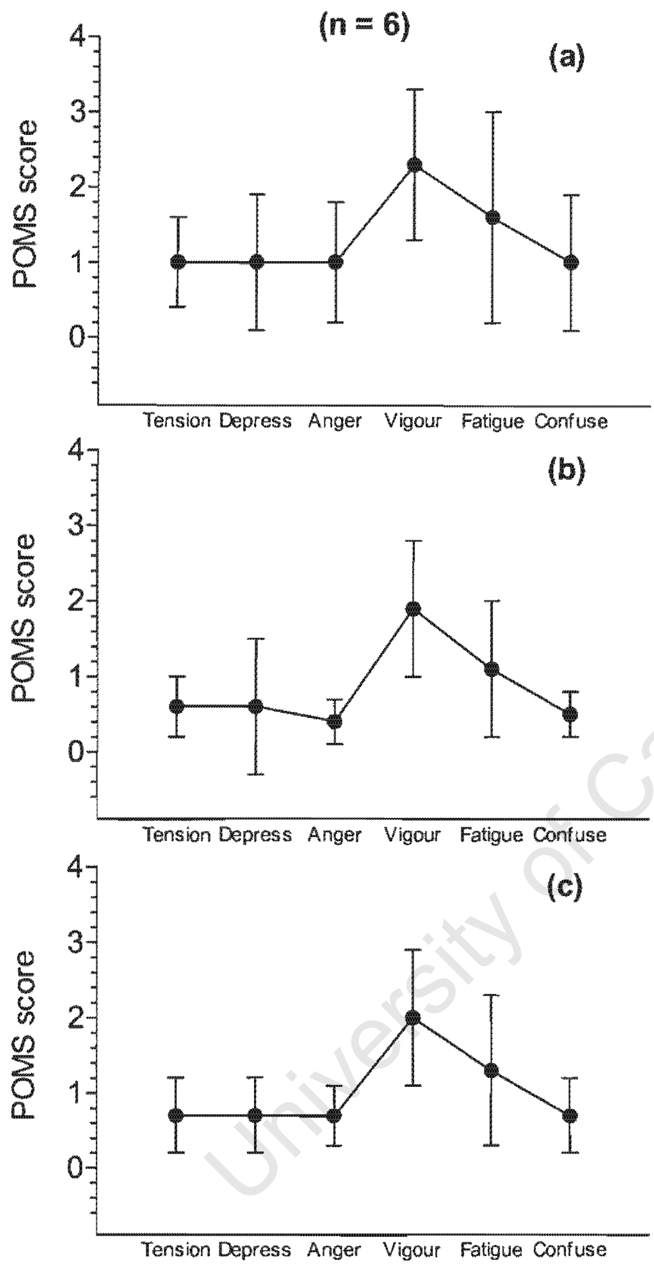


Figure 2: Mean POMS scores measured on the same subjects in each third of the season (n = 6). Values are X ± SD

a) Mean POMS scores measured early in the season: Oct-Nov.

b) Mean POMS scores measured in the middle of the season: Dec-Jan.

c) Mean POMS scores measured at the end of the season: Feb-Mar.

50 m freestyle

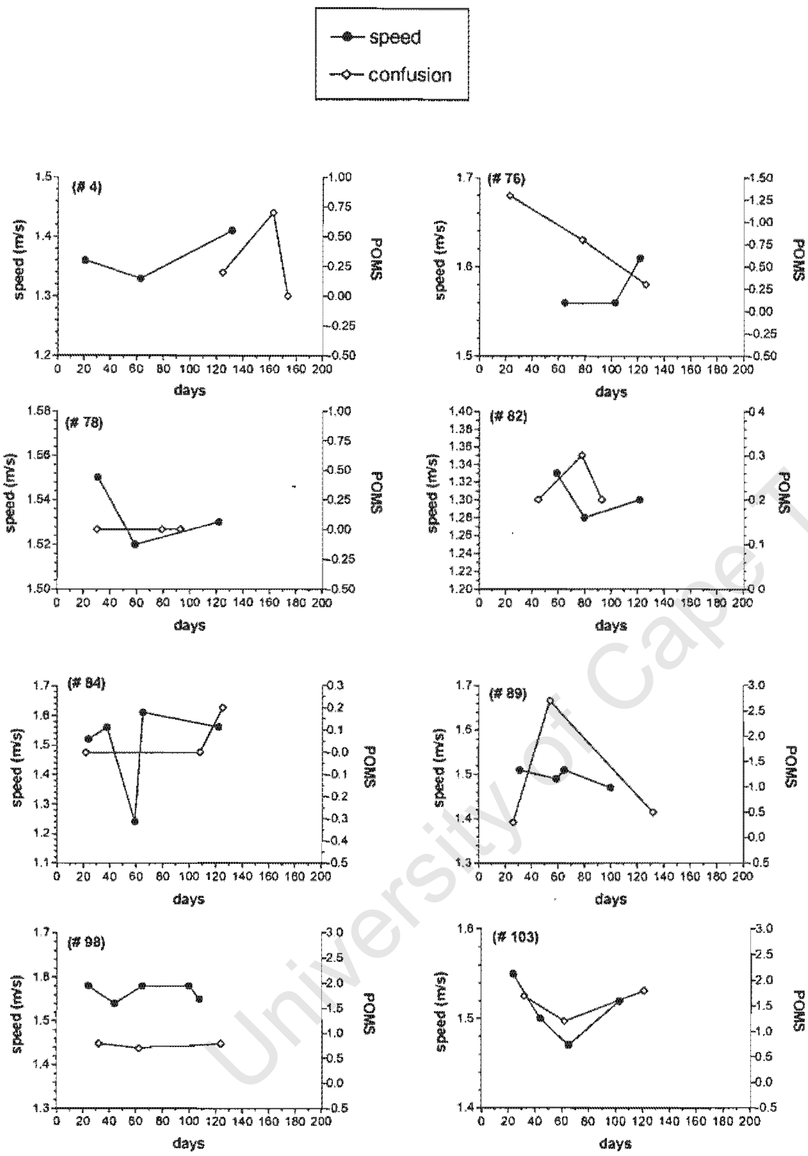


Figure 3: Confusion scores versus swimming performance in the 50 metres freestyle events, measured on three or more occasions in the swimming season (n = 8).

100 m freestyle

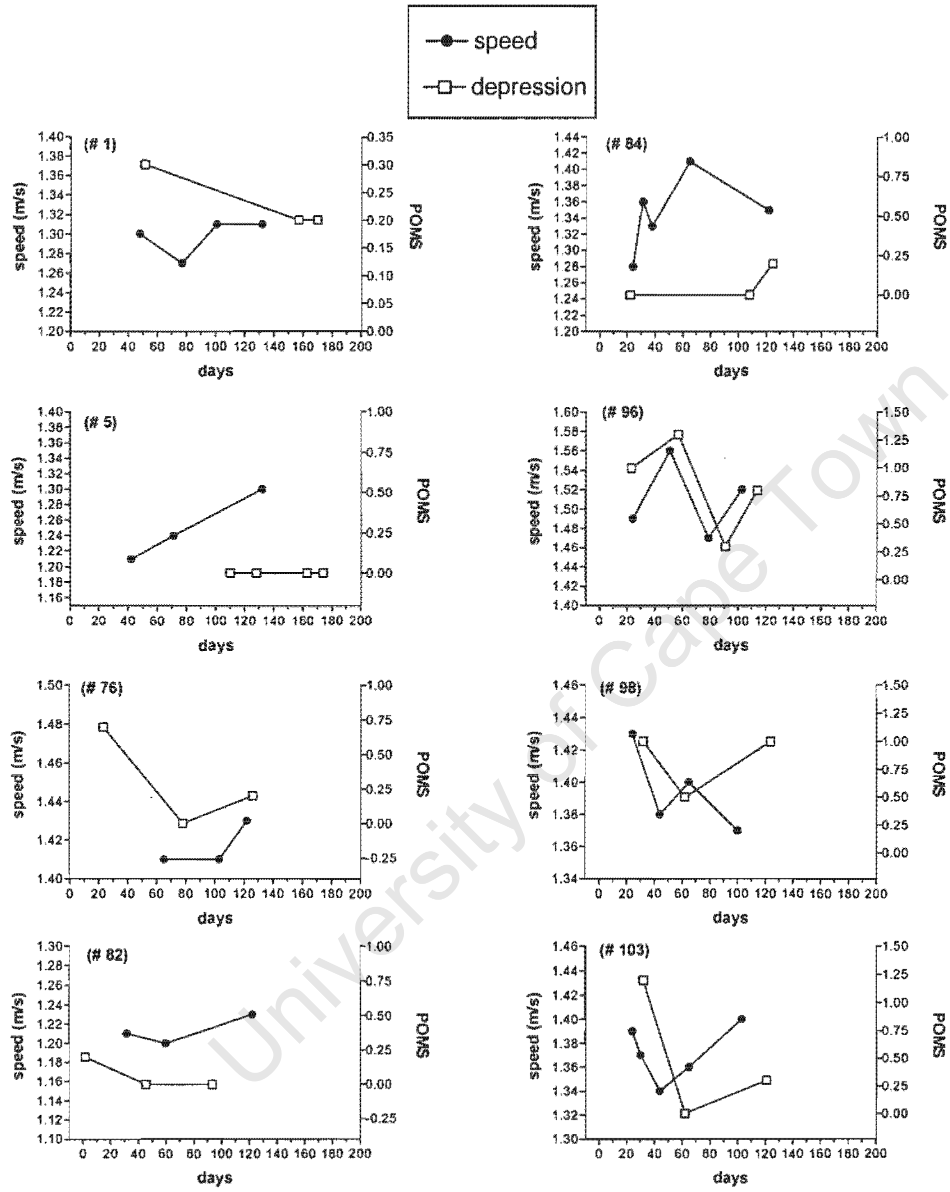


Figure 4: Depression scores versus swimming performance in the 100 metres freestyle events, measured on three or more occasions in the season (n = 8).

100 m backstroke

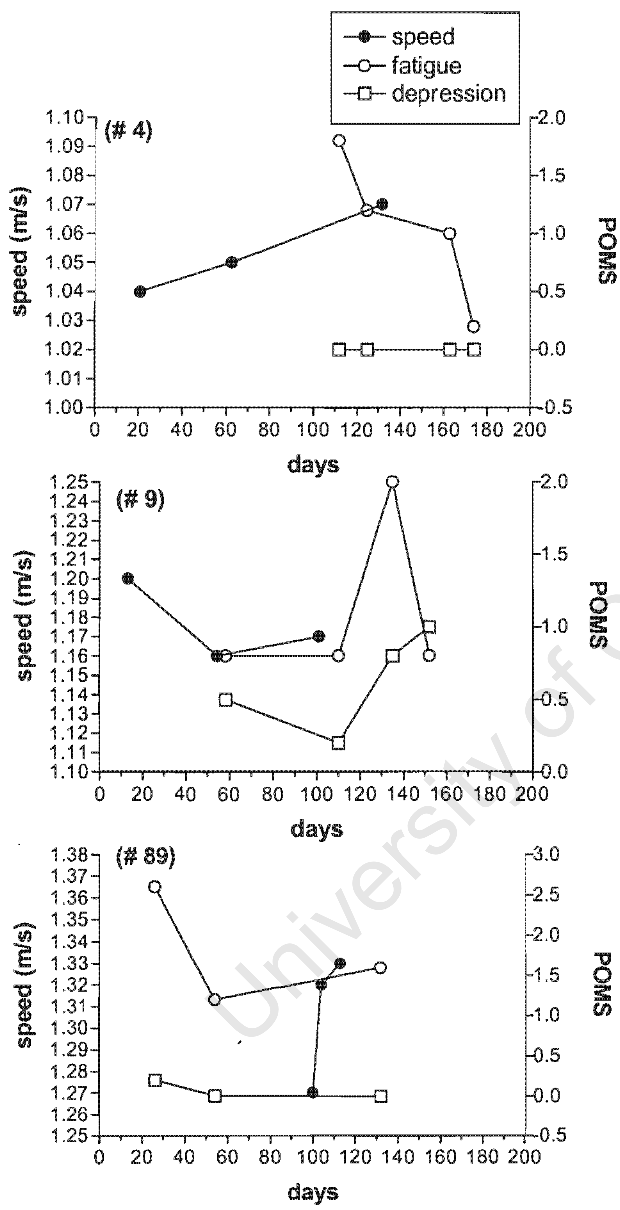


Figure 5: Fatigue and depression scores versus swimming performance in the 100 metres backstroke events, measured on three or more occasions in the season (n = 3).

CHAPTER 5:

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION:

Swimming as a sport has attracted very little research in South Africa. An attempt has been made to collect baseline data on swimmers, which, hopefully, will improve the understanding of researchers and coaches of training habits of local swimmers. The study has also highlighted the need for further research to be conducted on swimmers, in order to assist the swimmers and coaches to adjust training loads and routines to maximise performances based on scientific principles.

This study has limitations with regard to sample size, representation and other deficiencies e.g. the lack of a local standardised POMS questionnaire for South African populations, different coaches for the various clubs, different swimming techniques. However, even in the presence of these limiting factors, there is no reason to believe that the main conclusion in this study is compromised. It is, therefore, still an important study in that no previous study has detailed aspects of swimming in South Africa. Specifically, there are no data on the actual time spent in various facets of training in young aged –group swimmers in the Western Cape. In fact, there are no other studies in any region, which describes trends in swimming training over time.

This study found that male swimmers spent more time warming-up and stretching in 1998 compared to three years previously. This finding is heartening, as several studies have shown, that time spent in these activities will improve performance and reduce the risk of injuries. The male swimmers also trained at higher average intensities in 1998 compared to 1995. In addition, the study found that there is a trend for swimmers to start swimming at an older age. This trend needs further investigation as it could indicate inactivity, increased commitments towards other activities, and also a possible decline in interest in this specific sport.

The medical background of swimmers was also assessed. The two important findings of this study related to the asthmatic swimmer and the onset of the menarche in the female swimmer. The study found a higher prevalence for asthma in young swimmers (16%) compared with the general childhood population (11%-12%). The reasons for this finding are not known, but may be due to the lower risk for developing exercise-induced asthma while swimming compared to land-based activities.

Young local female swimmers did not show the delayed menarche as found in other studies on sportswomen. The reasons for this finding is unclear and it may be due to the fact that the later menarche observed in competitive athletes in other studies could be as a result of genetic or environmental factors rather than intense prepubertal training.

The final aspect of this study was to assess the relationship between swimming performance and mood states. No consistent relationship could be established between swimming performance and mood states. However, this section of the study was limited by the study design and consequently, by the small sample size. The mood changes were assessed by utilising a subjective tool known as the Profile Of Mood States (POMS). Further research is warranted to determine whether more regular monitoring of the POMS than was used in this study can track the efficacy of training and detect early signs of overtraining. A useful adjunct to this study would have been issuing of a questionnaire to coaches enquiring about training methods .

In conclusion, this study has for the first time in South Africa scientifically documented various aspects of swimming and swimming performance. Hopefully these data may be useful in assisting swimmers and coaches in South Africa to adjust training loads to benefit swimming performance. More effective monitoring of swimming performance is also recommended by utilising the POMS. In the short period of readmission to the international arena, swimmers have proven that they are more than capable of holding their own against more established opposition as is reflected by the medals obtained in the two previous Olympic games. It is predicted, that with the inclusion of sports scientists on the coaching panel, this sport will grow in strength.

Finally, it is recommended that further studies be conducted on swimmers elsewhere in the country to determine whether the findings are limited to the swimmers of the Western Cape or whether similar trends exist in other regions.