TITLE: Health status of South African masters swimmers and senior netball players, their medication use and attitudes towards doping

WORLD ANTI-DOPING AGENCY (WADA) SOCIAL SCIENCE RESEARCH GRANT ANNUAL RESEARCH REPORT

UNIVERSITY OF PRETORIA

Division: Biokinetics and Sport Science
Department: Physiology
Faculty: Health Sciences
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RESEARCH TEAM

_____. 4 January 2024

Dr. K Nolte **Date**

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Introduction

An application for funding (Social Science Research Grant) was submitted to The World Anti-doping Agency (WADA) in January 2021 for the research project Tier 3 - *The chronic disease, injury, medication use, doping attitudes and the doping implications in South African Masters athletes.* The research project fell within the priority: Athlete pathway and experience. The research project was approved by WADA on 26 May 2021. The agreement between WADA and the University of Pretoria was finalised in November 2021.

Status of research

The project evolved to include 2 sports: South African masters swimmers and senior netball players. Thus, the title: Health status of South African masters swimmers and senior netball players, their medication use and attitudes towards doping. Two MSc students were selected for the project. Ms. Annemarie Dressler for the swimming component and Ms. Micaela de Abreu for the netball component. Both the Swimming and Netball components of the study have been completed. The results have been analysed and the results are provided in this report.

Expenses

Please see Table A for the expenditures that have been made for the study to date. Rows shaded blue are for expenses in 2022 and rows shaded in green are for expenses in 2023. Please find the attached cost centre print out for proof of payments (Appendix A). A total of R62 913.85 (approximately $4194) has been used for the project to date. The editing services still need to be paid. The payment will be made to the student (De Abreu) as she covered the costs so that the payment could be made timeously and the editing could be completed. Please note, no more funding is required for the project as the research is completed and there were less expenses than anticipated. There is still some money remaining that has already been paid out and the researchers plan to use the money for publication costs (Scientific peer-reviewed journals) and for student study costs as the one MSc student needs to re-register next year as her dissertation must still be examined.

Table A. Expenditures to date

Item	Payment made to	Amount (Rands)
Study fees (2022)	MS. A Dressler (6404210010086)	14 563.48
Study fees (2022)	De Abreu (9707280116089)	14 563.48
Study fees (2023)	De Abreu (9707280116089)	20 000.00

Item	Payment made to	Amount (Rands)
Editing services (2023)	Say it With Style	6300.00
Institutional Overhead Levy (2023)	University of Pretoria	7486.89
Total		**62 913.85**

Swimming research

Title: Health status of South African masters swimmers, their medication use and attitudes towards doping

Synopsis

Physical inactivity is recognised as one of the main causes of the onset of chronic diseases such as diabetes (DM), coronary artery disease (CAD) and cancer.[1] In recognition of this the South African government has started programs like the Let's Play physical education challenge to motivate children to exercise and the Long-term Participant Development Program (LTPD) to motivate athletes to transition from competitive participation to staying active for life.[2] Due to the increased importance attached to exercise and a healthy lifestyle, older adults explore and engage in recreational pursuits to once again compete as athletes in sports that they previously partook in.[3] This has led to increased participation in recreational and competitive sporting events world-wide.[4] This is also evident in South Africa where participation in swimming events has increased in popularity. Open water swims such as the aQuellé Midmar Mile attract large entry numbers. In 2019, the aQuellé Midmar Mile drew over 12 000 swimmers, many of them adult swimmers, making it the largest open water event in the world.[5]

As age increases, adults experience a higher prevalence of chronic diseases.[6-8] Masters athletes with diagnosed chronic disease and injuries train for and take part in swimming events. They use prescribed or over the counter (OTC) medication to treat their disease and/or injuries and to alleviate pain.[9, 10] Some of the medication used by masters swimmers may carry health risks in training and competition contexts and may also be prohibited before and during competitions.[11, 12] The main aim of this study was to investigate the health status and associated medication use of South African masters swimmers. Quantifying possible unintentional doping infringements through the use of medication and intentional doping with the sole purpose to enhance performance will provide insight into doping complexities faced by masters swimmers. This study also analysed the doping attitudes and doping knowledge of South African masters swimmers.

The study used a cross-sectional design. A web-based, online survey was used to collect quantitative data based on the aims and objectives of the study. Initial purposive sampling of the swimmers in the South African Masters Swimming (SAMS) database was broadened to snowball sampling to target a representative sample of competitive and recreational masters swimmers. Participation in the survey was anonymous and voluntary. To test the self-constructed questionnaires' validity and consistency and to limit survey bias, a pilot study was conducted on 10 randomly selected masters swimmers representative of the population. Their feedback on the survey process, length and question structure was used to improve the online survey structure and questions.

Data curing and analysis of the data was done independently by a statistician using Microsoft Excel and SPSS data analysis software version 28.1. Grouping of medications was done by a registered pharmacist using the EMGuidance application.

The survey resulted in 359 responses with a good balance between male (48.7%) and female (50.7%) swimmers and with swimmers taking part in a variety of events namely triathlon and Ironman, pool and open water events.

The mean age (years) of the participants was 51.3 with a standard deviation of 1.5 years. Given the option of selecting three motivations why they train and compete in swimming the dominant motivation of the swimmers to was to improve health and fitness (85%), followed by the motivations to relieve stress (47.4%) and for enjoyment and fun (45.5%). The prevalence of chronic disease in the masters swimmers was 39.1%. The results showed that 22.4% of participants had only one chronic disease and 16.5% reported multi-morbidity. There was a significant ($p<0.001$) weak positive relationship between chronic disease and age showing a Pearson correlation coefficient of $r=0.24$. There was also a significant ($p<0.001$), weak positive relationship ($r=0.26$) between number of chronic diseases and age.

The population prevalence for chronic medication use was 33.7% and 11.4% of the participants used medication that is on the World Anti-doping Agency (WADA) prohibited list.

Participants reported an injury prevalence of 26.1% in the five years preceding the survey with injuries in the shoulder region most frequently reported (18.1%) and tendinitis (9.7%) being the most prevalent reported shoulder injury. There was a significant ($p<0.005$) but weak negative correlation ($r=-0.15$) between age and injury prevalence.

Analysis of the prescribed and OTC medication showed that 16.4% of the study participants took medication to treat injury or illness shortly before or during competitions. The most used

medication was Nonsteroidal Anti-inflammatory Drugs (NSAIDs) (15%), analgesics (4.5%) and cortisone (2.5%).

In response to the direct life-long and current doping questions only one male swimmer indicated that he had used a banned substance. No participants indicated that they are currently using Prohibited Performance-enhancing Drugs (PEDs). The expressed attitude of the participants on the Performance Enhancement Attitude Scale (PEAS) 8-item instrument showed that masters swimmers do not have a positive or lenient attitude towards doping. Specific questions set to test the swimmers' attitude towards chronic medication use, indicated that they believed that chronic medication helped masters swimmers to perform as healthy individuals and that this medication use should not be construed as doping. Swimmers showed limited knowledge of doping and Therapeutic Use Exemption (TUE) application. This study may assist in steering doping education in the right direction.

To the researcher's knowledge, no studies have been conducted on masters swimmers in South Africa relating to health status and doping. This study will add to the limited research that has been done on this study population. To make training and competitions safer for masters swimmers, future research could focus on pre-screening to determine the risk factors that may contribute to cardiovascular events and injury.

Introduction

Physical inactivity is recognised by the World Health Organization (WHO) as one of the main causes of chronic diseases such as DM, Cardiovascular Disease (CVD) and cancer.[1] In recognition of this, the South African government has started programs like the Let's Play physical education challenge to motivate children to exercise and the Long-term Participant Development Program to motivate athletes to transition from competitive participation to staying active for life.[2] Due to the increased importance attached to exercise and a healthy lifestyle, older adults are looking to return to new and former recreational and competitive sports.[3] This has led to increased participation in recreational and competitive sporting events.[4] This is also evident in South Africa where participation in swimming events has increased in popularity.[5]

As age increases, adults experience a higher prevalence of chronic diseases.[6-8] Masters athletes with diagnosed chronic disease and injuries train for and take part in swimming events such as the World Masters Games (WMG). They use prescribed or OTC medication to treat their disease and/or injuries and to alleviate pain.[9, 10] Some of the medication used by masters swimmers may carry health risks in training and competition contexts and may also be prohibited before and during competitions.[11, 12] To this end an exploration of the concept of

doping, doping control and the use of prohibited substances was necessary in the South African masters swimmers context. The study received ethical approval from the Research Ethics Committee of the Faculty of Health Sciences at the University of Pretoria (REC number: 193/202).

For the purposes of this study masters athletes are defined as "Individuals who systematically train for and compete in, organised forms of competitive sport specifically designed for older adults."[13] In the South African context masters swimmers are classed as swimmers 18 years and older and constitutes a sub-set of masters athletes as defined above.[14]

Doping can be defined as the collective term used to describe the use of prohibited substances or methods to enhance performance.[15] The use of PEDs before and during sporting competitions is prohibited for all athletes including swimmers. The World Anti-Doping Agency (WADA) implemented policies on anti-doping to make sporting competitions fair and equal and to protect the health of athletes.[16] Masters swimmers in South Africa are also subjected to the WADA criteria when they partake in events.[17, 18]

Masters swimmers might commit infringements in a variety of ways. Research shows that masters athletes competing in the various sporting codes at the WMG commit doping offences through the use of prescribed medicine to treat chronic disease.[10] Studies also showed that masters athletes get injured in their preparation for or during competitions and that they take OTC drugs such as pain killers and NSAIDs to treat these injuries.[19, 20] Although NSAIDs are not on the WADA prohibited list, their potential health risks for athletes has been well documented.[21, 22] Purposive doping with the sole motivation to increase performance has been reported mostly in studies on elite athletes.[23-25] A recent study on ultra-marathon runners demonstrated that competitive masters athletes may elect to use PEDs. The same study showed that competitiveness and a positive attitude towards doping was positively correlated to doping behaviour.[26]

Adults enter swimming events for a variety of reasons including increased health and fitness, to delay old age, to socialise and to be competitive and to win.[27-30] In order to understand why masters swimmers would use PEDs the motivation and attitude of masters swimmers towards intentional and unintentional doping was measured.

Necessity and value of the study

The results of this study provided insight into the health status and medication use of masters swimmers. Comparison of the medication used by the swimmers with the WADA prohibited list showed the prevalence of doping infringements. Testing the attitudes of the swimmers

towards doping shed light on the intentional and unintentional doping complexities faced by masters athletes. To the researcher's knowledge, no similar studies have been conducted on South African masters swimmers.

Aim of the study

The aim of this study was to determine the health status, associated medication use, possible doping infringements, doping attitudes and doping knowledge of South African masters swimmers.

Results

Demographic data analysis

Age distribution

The 359 masters swimmers that completed the survey selected five-year age categories as defined in the previous section on age range of swimmers included in the survey. The age range was 18 - 89 years. The mean age of 51.3 years, 95% CI (49.8, 52.7) for the participants was determined using mid-point coding. Figure 1 below shows the age distribution of the participants.

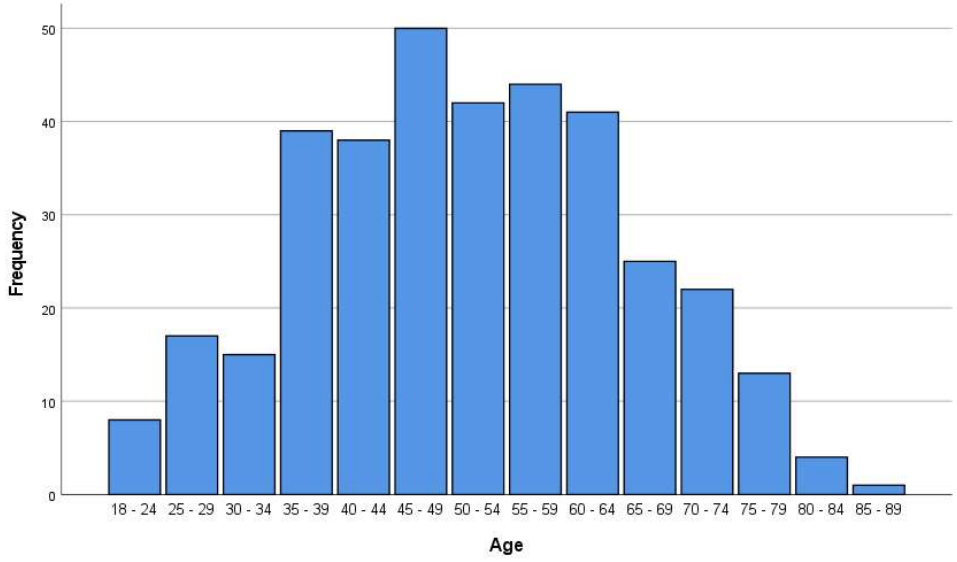

Figure 1: Age distribution of participants

Gender

The gender distribution showed that 50.7% (n=182) of the participants were female and 48.7% (n=175) were male. Two participants did not disclose their gender. A study population pyramid showing an overview of the age and gender distribution of the participants is shown in Figure 2.

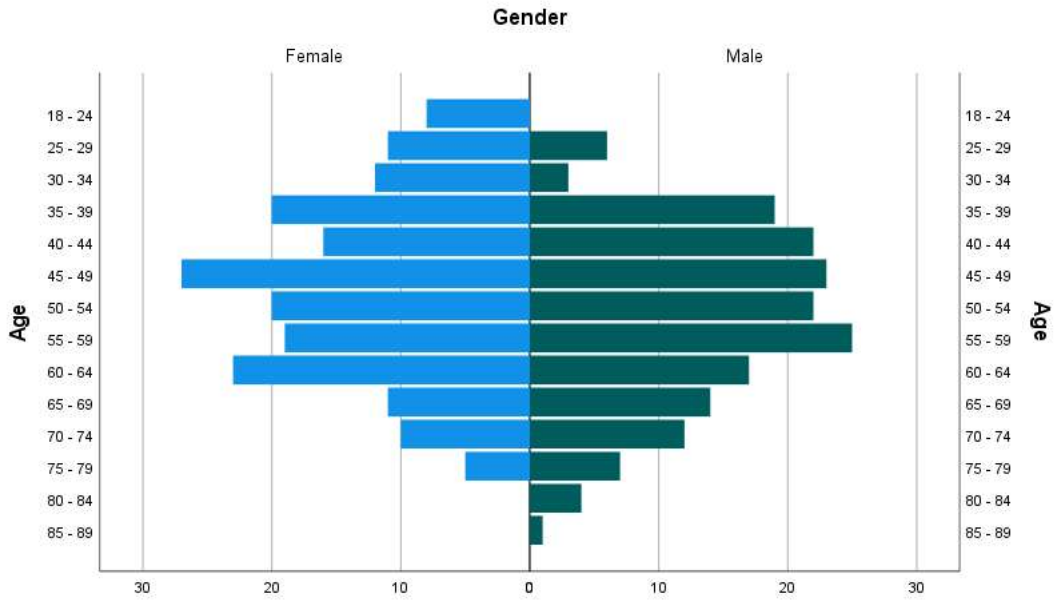

Figure 2: Population pyramid displaying age and gender distribution

Medical aid

The percentage of participants that subscribed to a medical aid was 96.1%, 95% CI (94.1, 98.1). This question was included for possible comparison of participants health status with that reported in medical aid statistics. Medical aid data on chronic diseases were available to the researchers and adaptation of age groupings of the statistics made comparisons possible.

Frequency of training

The responses to the question 'How many times in a week do you swim?' are listed below in Table 1. One participant did not respond to this question.

Table 1: Number of training sessions per week

Number of training sessions per week	n	Percentage (%)
Less than once per week	29	8.1%
Once per week	16	4.5%
Twice per week	84	23.4%
Three times or more per week	229	63.8%

The results showed that 63.8% of the swimmers train three or more times per week.

Distance of training per session

The responses to the question 'What distance do you swim per training session?' are listed below in Table 2. One swimmer did not respond to this question.

Table 2: Training distance per session in meters (m)

Training distance per session (m)	n	Percentage (%)
Less than 500 m per session	9	2.5%
500 - 2000 m per session	174	48.5%
2000 - 3000 m per session	151	42.1%
More than 3000 m per session	24	6.7%

Swim training volume-load per week

Two participants did not respond to this question. To compare the results of this study to previous research, it was necessary to calculate the training volume-load for the participants. Swimming volume-load for the participants and the results are summarised in Table 3 below.

Table 3: Volume-load per week

Volume-load category	n	Percentage (%)
Low (0 - 4.9 km/w)	106	29.5
Medium (4.9 - 11.9 km/w)	227	63.2
High (11.9 + km/w)	24	6.7

The calculated training-volume showed that most swimmers followed a medium regime of training, swimming between five and 12 km per week.

Figure 3 shows the % of swimmers against the training-volume.

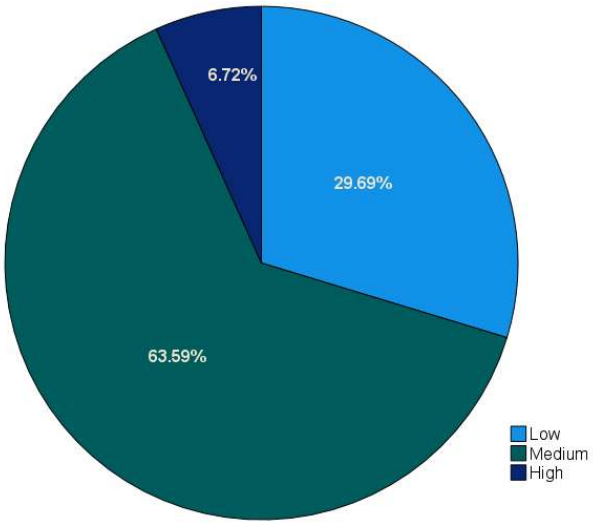

Figure 3: Pie chart showing number of swimmers against training-volume per week

Years of swimming

Swimming experience or life-time exposure was defined by Feijen et al. as the number of years swimmers participated competitively.[31] To be inclusive for recreational swimmers this definition was adapted for this study by not referring to competitiveness. The responses to the question 'How many years have you been swimming?' are listed in Table 4.

Table 4: Number of years swimming

Number of years swimming	n	Percentage (%)
0 - 1 years	28	7.8%
1 - 2 years	36	10.0%
3 - 5 years	39	10.9%
5 - 10 years	36	10.0%
More than 10 years	220	61.3%

Competitions attended

In this section the participants were asked three questions.

Question 1: 'Have you competed in an organised sporting event that included swimming in the last five years? This includes social, non-competitive, and fun events for example the Polar Bear swim.'

The relatively long reporting interval of five years was chosen due to the COVID-19 pandemic restrictions that limited events in the two years preceding the study. For this question 89.1%, 95% CI (86.0, 92.2) of participants indicated that they competed in an event in the last five years.

Question 2: 'Please specify the event(s). You can choose more than one option.'

Participants were given four categories of events to choose from namely triathlon, Ironman, open water swimming, pool and an option to specify other events. The results for triathlon and Ironman competition were combined as they include the same sporting codes at different distances, with Ironman being a specific type of triathlon. Participants then had to indicate the level at which they competed namely local, regional, national and/or international. They could indicate more than one level of competition.

Question 3: 'Please specify the event or events that you train for. Separate your events with a comma (,).' One hundred and two participants indicated that they competed in other events. Analysis of the open-ended question where swimmers could indicate what events they took part in resulted in most swimmers indicating that they train for the SAMS nationals championships, triathlon/Ironman and the Midmar Mile open water swim.

Several other events were specified namely cold-water swimming (18), fun events (6), lifesaving (3), religious events (2), and combination events (10). Combination events included biathle, biathlon and duathlon. Twelve participants replied that they trained for health and fitness only. Table 5 shows the analysis of the number of swimmers that competed in triathlon, pool, open water swimming and other events against the competition level selected.

Table 5: Analysis of events

Event	Percentage (%)	Event level			
		Local (%)	Regional (%)	National (%)	International (%)
Triathlon / Ironman	27.5	37.4	10.1	27.3	25.3
Pool swimming	56.7	11.3	9.3	67.2	12.3
Open water swimming	66.9	31.5	24.1	39.0	5.4
Other events	28.3	-	-	-	-

Analysis of the events showed that 27.5% of swimmers take part in triathlon and Ironman events, 56.7% in pool events and 66.9% in open water events.

Motivation to train and compete in swimming

Every swimmer could choose three motivations for why they swim. No ranking was performed for the motivations selected. The motivations selected by the participants are shown as a percentage of total participants in Table 6. Although two participants selected other motivations, they did not specify what these motivations were.

Table 6: Motivation to swim

Motivation	Percentage (%)
To improve my health and fitness	85
To relieve stress and feel better	47
To enjoy myself and have fun	45
To challenge myself and master new skills	34
For social interaction and being with friends	23
To compete and win	16
To delay the effects of aging	16
To be part of a team	8
To travel and gain new experiences	7
Other motivations	2

The results showed that most participants trained and competed to improve health and fitness. This was followed by the motivations to relieve stress and to have fun.

Chronic disease prevalence

The prevalence of chronic disease reported by the 358 participants that completed the question on chronic disease prevalence was calculated as 39.1%, 95% CI (34.0, 44.2). The prevalence of chronic disease for the 350 participants 25 years and older was calculated as 38.7%, 95% CI (33.6, 43.9). The prevalence of chronic disease for the 192 participants 50 years and older was calculated as 50.0%, 95% CI (42.9, 57.1).

Analysis of prevalence of chronic disease split by gender

The gender split for the 356 participants (two participants did not want to disclose their gender, one participant did not want to disclose chronic disease information) shows that 34.9%, (n=61) of the male participants were diagnosed with a chronic disease compared to 43.1%, (n=78) of the females.

Relationship between age and chronic disease

An analysis of the relationship between age and the prevalence of chronic disease in an age group is shown in Table 7 below. One participant did not want to disclose disease status and was excluded from the percentage calculations.

Table 7: Relationship between age and chronic disease

Age group	n with chronic disease	n per age group	Age group prevalence (%)	Population prevalence (%)
18 - 24	4	7	57.1	1.1
25 - 29	4	17	23.5	1.1
30 - 34	6	15	40.0	1.7
34 - 39	7	39	17.9	2.0
40 - 44	10	38	26.3	2.8
45 - 49	13	50	26.0	3.6
50 - 54	14	42	33.3	3.9
55 - 59	21	44	47.7	5.9
60 - 64	19	41	46.3	5.3
65 - 69	20	25	80.0	5.6
70 - 74	13	22	59.1	3.6
75 - 79	6	13	46.2	1.7
80 - 84	2	4	50.0	0.6
85 - 89	1	1	100.0	0.3
Total	140	358		39.1

There is a high prevalence of chronic disease in the younger age groups 18 - 24 years (57.1%) and 30 - 34 years (40.0%). From the age group of 34 - 39 years the prevalence of chronic disease gradually increases up to the age group of 65 - 69 years, after which the older age groups shows a decline in chronic disease prevalence.

Analysis of type of chronic disease

In this section of the questionnaire participants were given a selection of nine chronic diseases to select from. They could pick more than one disease as well as specify any other diseases not on the list under an open-ended option. The diseases they could select were

hypertension (HTN), hyperlipidaemia (HLD), diabetes mellitis 1 and 2 (DM), asthma (AST), thyroid disease, CAD, heart disease, epilepsy and bipolar mood disorder (BMD). One participant did not want to disclose disease status and was excluded from the percentage calculations. One participant indicated a chronic disease in question 1 but did not specify type of disease and medication and was excluded from the data analysis in question 2. The data were evaluated by the medication specified and the participant was added to the mental and behavioural diseases (MBD) type.

An analysis of the selected and open-ended listed chronic diseases for different age groupings is given in Table 8.

Table 8: Type of Chronic disease prevalence for different age groupings

Chronic disease	n 18+	18+ (n=357) (%)	n 25+	25+ (n=350) (%)	n 50+	50+ (n=192) (%)
Arthritis*	8	2.2	8	2.3	6	3.1
AST	24	6.7	21	6.0	12	6.3
BMD	7	2.0	6	1.7	4	2.1
Cancer	5	1.4	5	1.4	4	2.1
Heart disease*	12	3.4	12	3.4	9	4.7
Chronic pain*	7	2.0	7	2.0	4	2.1
DM	9	2.5	9	2.6	7	3.6
Epilepsy	0	-	-	-	-	-
HTN	48	13.4	47	13.4	42	21.9
HLD	43	12.0	43	12.3	37	19.3
MBD*	16	4.5	16	4.6	7	3.6
Osteoporosis	5	1.4	5	1.4	5	2.6
Thyroid disease	25	7.0	25	7.1	19	9.9
Other	17	4.8	16	4.6	9	4.7

*Heart disease excludes HTN, MBD includes BMD, schizophrenia, depression and anxiety conditions and arthritis includes osteoarthritis or rheumatoid arthritis (OA/RA), ankylosing spondylitis, and gout. Chronic pain conditions include chronic back and neck pain, fibromyalgia, non-specific polyarthralgia and unspecified neuropathy.

Other chronic diseases listed by participants included Addison`s disease, unspecified auto-immune disorder, Barrett's islands disease, prostate hypertrophy, haemophilia, Cushing's syndrome, endometriosis, glaucoma, graves' disease, hypogonadism, kidney disease (KD), optic neuritis, narcolepsy and ulcerative colitis.

Number of chronic disease per participant

Participants could select an unlimited number of chronic diseases from the chronic disease list (CDL) of the ten most prevalent chronic diseases in South Africa. They could also specify any diseases not listed in an open-ended option. Table 9 summarizes the number of chronic diseases listed by swimmer as a percentage of the total number of participants (n=358).

Table 9: Number of chronic diseases per swimmer

Number of chronic diseases per swimmer	n	Percentage (%)
No chronic conditions	218	61.1
One or more chronic conditions	140	39.1
More than one chronic condition (multi-morbidity)	59	16.5
Only one chronic condition	80	22.4
Two chronic conditions	39	10.9
Three chronic conditions	13	3.6
Four chronic conditions	6	1.7
Five chronic conditions	1	0.3

The results showed that 22.4% of participants had only one chronic disease and that 16.5% reported multi-morbidity. The maximum number of reported co-existing chronic diseases was five in the same individual. Multi-morbidity prevalence reported in males was 14.9% (n=26) and in females 18.1% (n=33).

The figure below is a summary of the reported number of chronic diseases per swimmer.

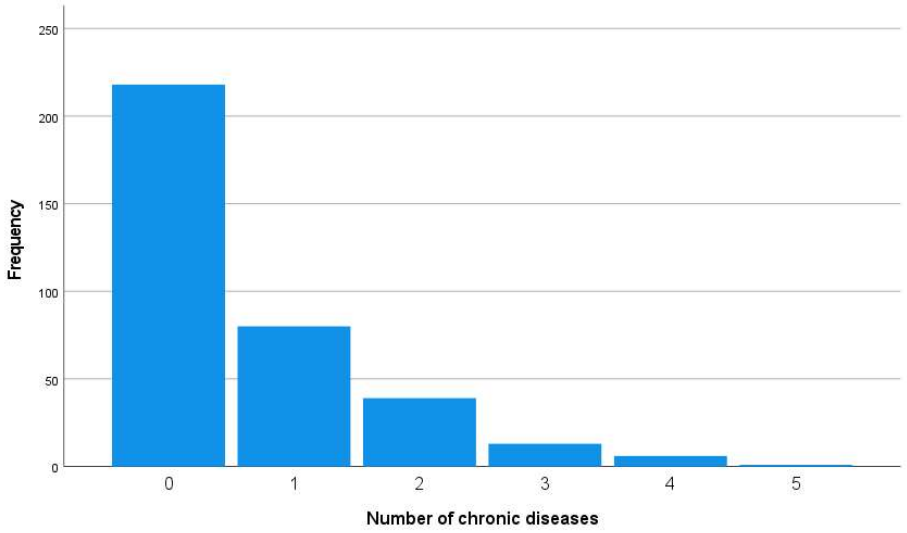

Figure 5: Number of chronic diseases per participant

Prescribed chronic medication for chronic disease

Analysis of the prescribed chronic disease medication showed that 84.6% of the masters swimmers with a chronic condition took medication to treat their condition. In total 121 swimmers indicated that they used chronic medication. This makes the total population prevalence of chronic medication use 33.7%, 95% CI (28.8, 38.6). Table 10 shows the number of swimmers taking medication per type of chronic condition.

Table 10: Most prescribed medication

Type of medication	n	Percentage (%)
HTN	48	13.4
Hypolipidemic	39	10.9
NSAIDs	27	7.5
Cardiac	15	4.2
Bronchodilators	15	4.2
Mental health	11	3.1

Type of medication	n	Percentage (%)
DM	11	3.1
Glucocorticoid	2	0.6
Analgesic	2	0.6
Arthritis	2	0.6
For other chronic diseases	44	12.3

The results showed that the most prescribed chronic medications are HTN and hypolipidemic medications. This is followed by NSAIDs, cardiac medication and bronchodilators.

Possible doping infringements through the use of chronic medication

Of the 121 swimmers that used medication to treat their chronic disease 34.7%, (n=42) were committing a possible doping offence. This makes the total population percentage of possible doping offences through the use of prescribed medication to treat chronic disease 11.4%. Table 11 gives a breakdown of the type of infringement.

Table 11: Type of doping infringement through use of chronic medication

Type of PED	n	Percentage (%)
Stimulants	4	1.1
Beta-2-antagonists	5	1.4
Diuretics and masking agents	27	7.5
Glucocorticoids	1	0.3
Metabolic and hormone modulators	4	1.1
Total infringements	41	11.4

Diuretics and masking agents that are mostly used for the treatment of hypertension were the most prescribed medication found on the prohibited list. This was followed by beta-2-antagonists used mostly to treat AST. Although one participant used a beta-blocker, swimming is not one of the specified sports on the prohibited list and was excluded from the infringement calculations.

Prevalence of injury

In this section of the questionnaire participants were asked if they suffered any injury due to swimming that required treatment e.g., use of medication or required them to seek medical advice from a health professional in the last five years. The prevalence of injury split between the genders is summarised in Table 12.

Table 12: Prevalence of injury split by gender

	n Males	n Females	Male (%)	Female (%)	Population (%)
Injury	45	48	12.6	13.5	26.1

The prevalence of injuries in the five years preceding the survey was 26.1% with males reporting slightly less injuries (12.6%) than females (13.5%).

Injury by body region

An analysis of the selected injured regions ranked by location or joint is given in Table 13. Seven swimmers indicated that they suffered an injury due to swimming in a body region that was not listed as an option. They did not specify which body region the injury occurred in.

Table 13: Prevalence of injury by body region

Injury location	n	Prevalence (%)	95% CI
Shoulder	65	18.1	(14.1 – 22.1)
Back and/or neck	13	3.6	(1.7 – 5.6)
Knee	6	1.7	(0.3- 3.0)
Ear	3	0.8	(0.0 – 1.8)
Other	7	1.9	(0.5 – 3.4)

The most injured region was the shoulder followed by the back and/or neck and knee regions. Injuries to other regions were not specified by the participants and could not be analysed.

Relationship between age and injury

Table 14 gives a summary of the prevalence of the swimmer's injuries per age group.

Table 14: Age group and injury prevalence analysis

Age group	Number of Injuries	n in age group	Injury % per age group
18 - 24	4	8	50
25 - 29	6	17	35
30 - 34	2	15	13
34 - 39	13	39	33
40 - 44	13	38	34
45 - 49	16	50	32
50 - 54	12	42	29
55 - 59	10	44	23
60 - 64	8	41	20
65 - 69	4	25	16
70 - 74	3	22	14
75 - 79	3	13	23
80 - 84	0	4	0
85 - 89	0	1	0

The prevalence of injuries in the 18 - 24 age group was the highest. The results show that prevalence of injuries mostly decrease with increased age.

Shoulder injuries

In this section swimmers were asked if they suffered any of the following injuries to their shoulders? The options given were swimmer's shoulder and /or impingement, inflammation of tendons in shoulder or arm (tendinitis), rotator-cuff tear, OA and shoulder pain. Swimmers were allowed to choose more than one option or could specify an injury not listed. The other

shoulder injuries swimmers specified were acromioclavicular (AC) ligament injury (1), calcification of tendon (1), dislocation (2), trapezius tear (1) and a labrum tear (1). The results of the analysis for shoulder injuries are shown in Table 15.

Table 15: Type of shoulder injuries reported

Type of injury	n	Percentage (%)
Inflammation of tendons in shoulder or arm (tendinitis)	35	9.7
Swimmer's shoulder and /or impingement	34	9.5
Rotator-cuff tear	23	5.8
Shoulder pain	19	5.3
Osteo-arthritis	3	0.8
Other:	6	1.4

Analysis by type of shoulder injury showed that tendinitis and impingement are the most reported shoulder injuries.

Prescribed and OTC medication used shortly before and during competitions

This section included two questions on medication used to treat injuries or illness shortly before or during competitions. The first being 'Were you prescribed any injections, medications and/or did you buy any OTC medication, to treat an injury or any illness, suffered SHORTLY BEFORE OR DURING COMPETITIONS? This may include cortisone injections or tablets, NSAIDS, any pain tablets, cold and flu medication, cough syrups or any other medications that you may have used.' Analysis of the prescribed and OTC medication showed that 16.4% of the participants took medication to treat injury or illness shortly before or during competitions. Table 16 shows the percentages of the most prescribed and OTC medication types used by the swimmers to treat injury or illness shortly before or during competitions.

Table 16: Prescribed and OTC medication used shortly before or during competition

Type of medication	n	Prevalence (%)
NSAIDs	48	13.4
Analgesic	10	2.8
Cortisone	9	2.5
Muscle relaxant	6	1.7

Type of medication	n	Prevalence (%)
NSAID and analgesic	6	1.7
Bronchodilator	2	0.6
Antibiotic	2	0.6

The medications used to treat injuries or illness shortly before or during competitions were NSAIDs, analgesics and cortisone.

Possible doping infringements through use of prescribed or OTC medication shortly before or during competition

Of the 59 swimmers that used medication shortly before or during competition 34.7%, (n=10) were committing a possible doping offence. The percentage of possible doping infringements for the total population is 2.8%. Table 17 gives a breakdown of the type of infringement.

Table 17: Type of doping infringement through use of prescribed or OTC medication shortly before or during competition

Type of PED used	n	Percentage (%)
Beta-2-antagonists	1	0.3
Glucocorticoids	9	2.5
Total infringements	10	2.8

Attitudes towards doping

In this question swimmers were asked to express their attitude towards the intentional use of PEDs. They were asked to rate their answers as strongly disagree (1), disagree (2), slightly disagree (3), slightly agree (4), agree (5) to strongly agree (6). The mid-point or mean score for each of the PEAS items is 3.5 and for the total of 8-items is 28. Values reported below these scores signify a negative or non-lenient attitude towards doping. The mean scores and SD of the PEAS instrument are listed in Table 18.

Table 18: Results of the PEAS instrument

PEAS items	Mean score ± SD
1. Legalizing performance enhancements would be beneficial for sport.	1.416 ± 1.0
2. Doping is necessary to be competitive.	1.340 ± 1.0
3. The risks related to doping are exaggerated.	1.801 ± 1.4
4. Athletes should not feel guilty about breaking the rules and taking performance-enhancing drugs.	1.248 ± 0.9
5. Doping is an unavoidable part of the competitive sport.	1.885 ± 1.4
6. Doping is not cheating since everyone does it.	1.228 ± 0.8
7. Only the quality of performance should matter, not the way athletes achieve it.	1.465 ± 1.2
8. There is no difference between drugs and speedy swimsuits that are all used to enhance performance.	1.616 ± 1.2
PEAS total	11.99 ± 4.8

The participants scored well below the item and total mean scores, showing a non-lenient attitude towards doping.

Possible gender differences in the scores between males and females were investigated. Table 19 below summarises the PEAS scores separately for males and females.

Table 19: PEAS scores for genders

Gender	n	Mean score ± SD
Males	172	12.49 ± 5.1
Females	180	11.53 ± 4.5

The mean PEAS scores split per gender above shows that the male scores were slightly higher than that of females.

Swimmers' attitude towards fellow competitors doping

In this section participants were asked to rate their attitude towards fellow competitor use of medication and PEDs. The five questions were scored by using a 5-point Likert-type scale with a range of scores between one and five. They were asked to rate their answers as (1) strongly disagree; (2) disagree; (3) neither agree nor disagree; (4) agree; and (5) strongly agree. The mean score for the questions was 3. The mean scores and SD for the questions are listed in Table 20.

Table 20: Swimmers' attitude towards fellow competitors doping

Attitude questions	Mean score ± SD
Swimmers taking medication to treat chronic disease, illness or injury have an unfair advantage in competitions.	2.18 ± 1.0
I do not care if my competitors take medication even if it gives them an unfair advantage in competitions.	2.85 ± 1.4
I do not care if my competitors INTENTIONALLY use prohibited substances other than chronic medication or methods to give them an unfair advantage in competitions.	1.52 ± 1.8
Intentionally taking performance enhancing drugs with the sole purpose of improving performance has long-term health implications.	4.27 ± 1.1
The use of chronic medication helps masters swimmers to perform as healthy individuals.	3.45 ± 1.3
In your opinion does advancing age make swimmers more vulnerable to (intentional and unintentional) doping?	2.78 ± 1.2

Intentional doping to improve performance

This section included three questions on doping.

Question 1: Have you ever intentionally used banned substances or methods to enhance your swimming performance? It further specified that 'This excludes the use of prescribed chronic medication or the unintentional use of performance enhancing medication to treat injury or

illness. Remember that the questionnaire is anonymous and your identity is protected. Please be honest.' One male swimmer answer indicated the intentional use of a PED in this question.

Question 2: Do you currently use a banned substance(s) or method(s) to enhance your sporting performance? All participants answered 'no' to this question.

Question 3: Please specify the drug or method that you use to improve your performance. This was an open-ended question. No swimmers completed this question.

Knowledge about doping

In this section participants were asked several questions pertaining to doping knowledge and where they attained the knowledge.

The first question asked if participants were familiar with the WADA website, anti-doping rules, regulations and policies. In response to this question 37.9%, (n=136) of the masters swimmers answered 'yes'.

In the second question participants could then indicate where they found doping information in a selection table with an open-ended option where they could further specify sources. The selection and sources specified under the open question were categorised into Table 21.

Table 21: Sources of doping information

Sources	n	Percentage (%)
WADA and SAIDS websites	92	25.6
SSA	69	19.2
Social and news media	137	38.2
Family/friends	97	27.0
Medical professionals	2	0.6
Own research/Internet searches	8	2.2
Expert lectures and journal articles	6	1.7
My profession	4	1.1
Swim coach	4	1.1

Sources	n	Percentage (%)
Other sport	6	1.7

In the third question swimmers were asked if they have ever heard about the WADA prohibited list and to this question 57.4% (n=206) of the participants indicated 'yes'.

To the fourth question 'Have you ever asked your doctor if the medication he prescribed is legal to use when taking part in sporting events?', 24.5%, (n=88) of the participants indicated that they had asked.

The next two questions tested the participants knowledge about TUEs and the application process for exemption. Question 1: Have you ever applied for a Therapeutic Use Exemption (TUE) for YOURSELF in any sport? This question resulted in 1.9% (n=7) of the participants indicating that they have applied for TUEs. Question 2: Have you ever applied for a Therapeutic Use Exemption (TUE) for a family member in any sport? Only three swimmers (0.8%) answered yes to this question.

In the last question participants were asked if they were aware of the consequences of committing anti-doping rule violations. To this question 70.2%, (n=252) answered that they were aware of the consequences of doping.

Discussion

The survey resulted in 359 responses with 48.7% male and 50.7% female swimmers completing the gender question. Two swimmers did not declare their gender. The mean age of the participants was 51.27 ± 1.5 years. The study population showed a representative sample of masters swimmers, with swimmers taking part in a variety of events namely triathlon and Ironman (27.5%), pool events (56.7%) and open water events (66.9%). Most of the participants (61.3%) have been swimming for more than 10 years, but a surprisingly high number of swimmers (17.8%) indicated that they have only recently (< 2 years) taken up swimming as a sport.

The dominant motivation of the swimmers to train and compete in swimming was to improve health and fitness (85%), followed by the motivations to relieve stress (47.4%) and for enjoyment and to have fun (45.5%). In line with previous studies the swimmer's motivation to compete and win (16.2%) was a less dominant motivation.[29]

Comparisons with population data in the USA and Australia as well as South African medical aid data shows that South African masters swimmers have a lower prevalence of specific chronic diseases when compared to general population statistics found in the literature.[9, 32]

The comparisons show higher HTN, HLD and DM prevalence's for the South African masters swimmers compared to masters athletes and runners from other countries. A significant weak positive relationship r=0.24, ($p<0.001$) was found between chronic disease and age and between age and number of chronic diseases r=0.26, ($p<0.001$).

The prescribed chronic disease medication use prevalence of 33.7% in the study is higher than the 25.3% reported by masters athletes and that of the runners (14.8%), but the use of bronchodilators were similar.[9, 33] Further analysis of the chronic medication used showed that 11.4% of the participants used medication that is on the prohibited list. This is lower than the prevalence found in Campian et al.[10] (19.8%) and slightly higher than that by Chalmers et al. (10.1%).[28]

Injuries to the shoulder (18.1%) and the knee (1.7%) in the participants was much lower than previous prevalence reported on masters swimmers.[34-36] This might be due to the two-year COVID-19 lockdown restrictions on facilities and events that limited training and competitions in South Africa. Statistical analysis showed a negligible correlation between volume-load and injury. This finding is similar to findings by Atilla et al.[35] and Barry et al.[36] that concluded that correlation between the parameters was insignificant and unclear. There was a significant ($p<0.005$) but weak negative correlation (r=-0.15) between age and injury prevalence. Similar to the result in this study, Heazlewood et al. found no significant correlation between injury incidence and age in football players in preparation for the WMG.[37]

Analysis of the prescribed and OTC medication showed that 16.4% of the swimmers took medication to treat injury or illness shortly before or during competitions with 2.8% of swimmers committing possible doping infringements. This was mostly due to the use of cortisone shortly before or during competition. This doping prevalence for the masters swimmers is lower than the estimated 24-hour estimated doping prevalence reported in female runners (8.1%) and ultramarathon runners (8.4%) during competition or training.[38-39]

The expressed attitude of the swimmers on the PEAS 8-item version showed that masters swimmers do not have a positive or lenient attitude toward doping. Although male swimmers showed a slightly more lenient but still negative attitude towards doping when compared to female swimmers, the difference between the genders was not significant ($p=0.064$).

Specific questions were set to test the swimmers' attitude towards fellow competitors use of PEDs. The findings showed that swimmers believed that swimmers taking medication to treat disease or injury to allow them to compete as healthy individuals did not have an unfair advantage in competitions and that taking medication should not be construed as doping. The

participants were not lenient towards intentional doping. This reiterates the results of the PEAS score.

In response to the direct doping questions, only one male swimmer indicated having used a banned substance. No swimmers indicated that they were currently using PEDs.

Recommendations

Chronic disease usually requires medical treatment and may limit activities of daily living and athletic performance. Fèdèration Internationale de Natation (FINA) must be aware of the increased incidence of chronic disease with increased age and the associated risk in competition for older athletes as they state in their general rules for masters competitions: “Masters competitors must be aware of the need of being well prepared and medically fit before entering into masters competitions.” Even though this statement clearly indicates some form of medical screening, no pre-participation health screening guidelines are provided for masters swimmers.[17] As 39.1% of swimmers in this study have been diagnosed with chronic disease and used chronic medication, they should get medical clearance before competing and they should be educated on the risks of taking chronic medication while exercising and competing.[11] This substantiates the need for further studies to set parameters for pre-screening of swimmers before taking up training and entering competitions.

Masters swimmers in this study displayed limited knowledge about the doping implications of medication use. They also did not enquire about the legality of prescribed medication use for athletes from their health care providers. The high prevalence of chronic disease and the associated medication use in this study, combined with the limited knowledge about doping, indicate that information campaigns about doping and medication use could be beneficial to the masters swimmers and for medical professionals that prescribe and issue medication to them.

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Netball research

Synopsis

Netball is a popular women's sport with 20 million participants across 80 countries.[1, 2] There are 70 National Netball Associations affiliated to World Netball across multiple continents, including Africa.[1] South Africa introduced its semi-professional Telkom Netball League in 2008.[2] Netball is played utilising a combination of agility movements, accelerations, high jumping to receive or intercept passes, landing, guarding, passing, shooting, and set plays.[1, 3] There is limited research on the health and injuries of South African senior netball players. To the researcher's knowledge, no studies have been conducted on medication use and doping attitudes in senior South African netball players. Senior netball players may be at greater risk of injuries and, therefore, more vulnerable to doping.

This study is a quantitative, cross-sectional, descriptive study. Data was collected using an online self-report questionnaire. The study received ethical approval from the Research Ethics Committee of the Faculty of Health Sciences at the University of Pretoria (REC number: 373/2022). The sample was taken from a population of senior netball players in South Africa. South African senior netball players are defined as athletes actively representing the SPAR Proteas and/or athletes actively playing in professional netball competitions. Non-random, purposive sampling of a defined group of netball players was conducted.

A total of 110 netball players gave written informed consent and completed the online self-report questionnaire using the Qualtrics online platform. Only 60 questionnaires were analysed. The prevalence of chronic disease and the prevalence of injury in the 5 years preceding the study, as well as information on medication prescribed and purchased over the counter (OTC) shortly before or during a competition was determined. The validated 8-item Performance Enhancement Attitudes Scale (PEAS) was used to gather information on the netball player's attitudes towards doping. Descriptive statistics were used to describe the data using proportions (categorical), means (normally distributed, continuous) and medians (non-normally distributed, continuous). Injury and doping prevalence and the accompanying 95% confidence interval were calculated.

The majority of the netball players fell within the 18 - 25 year age range (65%), had more than 10 years of netball playing experience (86.67%) and participated in training more than 3 times per week (90%). In terms of netball positions; Goal Shooter (35%) and Goal Defence (30%) were the most common netball positions played by the netball players.

The prevalence of chronic disease was 11.67% (95% CI: 4.82 – 22.57). In particular asthma, depression and attention-deficit/hyperactivity disorder (ADHD) were reported at a higher incidence (3.33%) compared to any other disease. The prevalence of injury in the past 5 years was calculated to be 70% (95% CI: 56.79 – 81.15) and the prevalence for reoccurrence of the same injury was calculated to be 45%. The findings are in support of what is typically reported in the literature. The upper and lower limbs were the most frequently injured body regions at 11.76% and 74.51% respectively. Furthermore, in the lower limbs, sprains and strains were the most frequently reported injury occurring in the ankle ligaments, anterior cruciate ligaments, medial collateral ligaments and the gastrocnemius muscle.

The prevalence of chronic prescription medication use was 8.33%. The most common prescription medication utilised was Symbicort turbohaler at 3.33%, with Pulmicort, Exsira, Epitec, Pritor, Amloc, Astor, Eltroxin and Concerta reported at a prevalence of 1.67%, respectively. The prevalence of receiving any prescription injections or medications or utilising any OTC medications for treating injury or illness suffered 1-6 weeks before or during competition was 66.67%. The high prevalence of OTC medications may put netball players at risk of inadvertent doping. Only 31.03% of surveyed netball players reported using nutritional supplements. The most common supplements utilised were vitamins, minerals, caffeine and branched-chain amino acids (BCAAs), eicosapentaenoic acid (EPA), gelatin and collagen, creatine, herbal and other supplements.

The prevalence of answering NO to doping was 88.33% (95% CI: 77.43– 95.18), and 84.31% strongly disagreed that doping is necessary to be competitive. The study also demonstrated that most netball players have a strongly negative attitude towards doping. There was a worrying proportion of netball players (25.93%) that reported that they were not familiar with the World Anti-Doping Agency (WADA) website, anti-doping rules, regulations, and policies, and a concerning proportion (24.07%) of netball players reported that they had not heard of the WADA prohibited list. This suggests that anti-doping education within this netball player cohort appears insufficient.

The limitations of the study include that self-report questionnaires on doping are vulnerable to some answers being intentionally altered, as the participants may not wish to disclose their own or their peers' use of prohibited substances, even when confidentiality and anonymity are ensured. The sample size was relatively small, and the dataset was considered not large enough to run analyses regarding predictors of doping or injury. We believe that the main strength of the study was that, to our knowledge, it is a novel study analysing attitudes towards doping and anti-doping education status in South African netball players.

We recommend that areas of future research include an analysis of training loads and the repetition of this study on larger samples of participants. Furthermore, a possible strategy for improving anti-doping education in netball could involve the development of a free SAIDs Drug-Free Sport mobile app similar to that of the Australian Sports Anti-Doping Authority (ASADA) Clean Sport mobile application.

Introduction

Netball's physical demands are characterised as dynamic, high-intensity and intermittent.[1, 2] Netball is a team-based sport that is played over 60 minutes in elite level ranks.[1, 2] The 60 minutes are played in 15-minute quarters with 4-minute rests afforded between quarters 1-2 and 3-4.[1, 2] Professional netball leagues afford 8-12 minute half-time rest between quarters 2-3.[1, 2] A team consists of 7 positions, namely: Goal Shooter, Goal Attack, Wing Attack, Centre, Wing Defence, Goal Defence, and Goal Keeper.[1, 2] Together, the physical, technical and tactical demands of the sport impose unique mental skills and physicality from netball players.[2]

Incorrect landing, slipping, tripping, direct trauma and other factors contribute towards the high incidence of injury in netball.[2, 3, 5.] In senior South African netball players, studies have reported an incidence of approximately 500 injuries per 1000h of game time.[1, 5] The probability of injury per elite netball player has been reported at 0.15.[3] Common anatomical sites of injury in elite South African netball players include injuries sustained to the face, neck, shoulder girdle, wrist, hands and fingers, ribs, lower back, hip and groin, anterior and posterior thigh, knees, ankle and toes.[3] The most prevalent injuries reported in netball players are muscle strain and ligament injuries.[5]

Medication and non-anabolic supplement use may assist athletes in maintaining optimal health and performance and assist in rapid recovery from injury and illness.[6-8] Research indicates that the incidence of prescription medication use by athletes is 20% higher than that of the general population. Upon searching the literature, no studies on medication use in netball players specifically could be found.

Nutritional supplements typically lack regulation and the requirement to denounce demonstrated efficacy.[10] Nutritional supplements are typically considered natural and safe alternatives to performance enhancing drugs (PEDs).[32] It has been reported that dietary supplements, specifically those promoting weight loss and muscle building, possess a high risk, estimated at 5-20%, for containing unlabelled drugs and prohibited substances.[8]

Athletes competing at collegiate and elite level ranks consume more nutritional supplements compared to sedentary or physically active populations. Netball players have reported taking nutritional supplements to maintain health, as part of a dietary routine, to boost immunity, from peer recommendations, to improve energy and performance, to reduce fatigue, to improve strength, for sponsorship endorsements and for travel requirements.[9] Additionally, medication and nutritional supplement use are common amongst athlete populations, as well as amongst the older general populations.[11] Older athletes have been reported to utilise diuretics, statins and beta-adrenergic blocking agents for the treatment and management of chronic diseases, and may make them vulnerable to committing unintentional doping violations.[11]

The detection, usage and possession of prohibited PEDs and methods to improve performance or attempt to influence doping test results are collectively termed “doping” and are banned by national and international sport governing bodies and by the World Anti-doping Agency (WADA).[12-14,59] The number of athletes that test positive for doping remains consistent at 1-2% annually.[15-17]

No studies measuring attitudes towards doping, medication and supplement use in netball could be sourced. Information on health status, medication use and attitudes towards doping in South African senior netball players may guide future anti-doping programmes and interventions in this cohort, as well as other netball players or athletes.

Methods

Study design and ethical considerations

The study is a quantitative, cross-sectional, descriptive study. Data was collected by means of an online self-report questionnaire in compliance with the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) guidelines. The study received ethical approval from the Research Ethics Committee of the Faculty of Health Sciences at the University of Pretoria (REC number: 373/2022).

Participants (selection and description)

South African senior netball players are defined as athletes actively representing the SPAR Proteas and/or athletes actively playing in professional netball competitions. A non-random, purposive sampling of a defined group of netball players was conducted. A total of 110 netball players gave written informed consent and completed the online self-report questionnaire using the Qualtrics online platform. However, following the data cleaning process, 60 netball players’ responses were analysed.

Data collection

The prevalence of chronic disease and the prevalence of injury in the 5 years preceding the study were determined. Reporting of injury and injury prevalence followed the current International Olympic Committee (IOC) consensus statement on methods for recording, and reporting of epidemiological data on injury and illness in sport were examined. Information on medication prescribed and purchased over the counter (OTC) shortly before or during a competition was sampled. The validated 8-item Performance Enhancement Attitudes Scale (PEAS) was used to gather information on the netball players' attitudes to doping. A pilot study was conducted on 10 senior South African netball players to assess question validity and consistency and limit survey bias. Permission was granted by the South African Netball Federation (NSA) to conduct the study. NSA and the district head members distributed the survey via a link provided by the researchers to senior netball players.

Statistical analysis

Descriptive statistics were used to describe the data using proportions (categorical), means (normally distributed, continuous) and medians (non-normally distributed, continuous). Injury and doping prevalence and the accompanying 95% confidence interval were calculated.

Results

Participant demographics

Age distribution of the netball players included: 65% fell within the 18-25 years age range, 23% within the 25-30 years age range, and 11.67% within the 35-40 years age range. The percentage of netball players subscribed to a medical aid scheme was 75%.

Observing netball playing experience, 86.67% of the netball players had more than 10 years experience, 6.67% had 5-7 years experience and 1.67% had 2-4 years' experience. Only 3 netball players did not answer the question about netball playing experience. A total of 90% of the netball players participated in netball more than 3 times per week, 8.33% participated 2 times per week and 1.67% participated 1 time per week.

The average netball and other supporting training duration were not recorded due to a Qualtrics system survey error.

Concerning the netball playing position, 35% of the netball players played Goal Shooter, 30% played Goal Defence, 11.67% played Wing Attack, 11.67% played Goal Keeper, 6.67% played Centre, and 5% played Wing Defence.

Table 1. Competitions

		n (60)	Prevalence (%)
Competitions played	Telkom Netball League	15	25.00
	All competitions Spar Proteas competed in	3	5.00
	Spar national championships	9	15.00
	University Netball (University Sports South Africa, Varsity Cup, Internal Leagues, Unspecified)	29	48.33
	District	2	3.33
	Provincial Competitions (Inter Provincial Tournaments, Tshwane League, Gauteng Championships, KwaZulu-Natal super league, Ethekwini netball league)	12	20.00
	International Leagues	2	3.33
	National Competitions	6	10.00
	Twizza	3	5.00
	League Unspecified	2	3.33
	Other competitions (Quad series, Suncorp Supernetball, Vitality netball super league, Mayoral games, South African championships)	5	8.33
	None right now	4	6.67

Regarding the frequency of games played, 36.67% of the netball players played 2 games per week, 28.33% played more than 3 games per week, and 25% of the netball players played 1 game per week.

Incidence of illness

The prevalence of chronic disease was reported at 11.67%. In particular, 1.67% of players reported being clinically diagnosed with hypertension, high cholesterol, HIV/AIDS, thyroid disease and heart disease. Furthermore, 3.33% of players reported being diagnosed with

asthma, and 3.33% of players reported being diagnosed with other conditions, including depression and attention-deficit/hyperactivity disorder (ADHD).

Epidemiology of injuries in netball

The prevalence of injury in the past 5 years was calculated to be 70%. In addition, the prevalence for reoccurrence of the same injury was calculated to be 45%.

Body region (with specific body area) and clinical diagnosis

The injuries reported by the netball players are reported in Table 2. The prevalence of injury by body region was calculated with 9 missing responses. Lower limb injuries accounted for 74.5% of all the reported injuries, specifically 17.7% were ankle ligament sprains.

Table 2. Injury characteristics

Injuries by main body region	Body area and clinical diagnosis	n (51)	Prevalence (%)
Head and Neck	**All injuries**	**1**	1.96
	Whiplash	1	1.96
Upper limb	**All injuries**	**6**	**11.76**
	Shoulder impingement	1	1.96
	Rotator cuff injury	1	1.96
	Shoulder sprain	1	1.96
	Deltoid strain (Grade 3)	1	1.96
	Elbow and wrist fracture	1	1.96
	Wrist sprain	1	1.96
Trunk	**All injuries**	**3**	**5.88**
	Lower lumbar disc tear with spinal cord damage	1	1.96

Injuries by main body region	Body area and clinical diagnosis	n (51)	Prevalence (%)
	Lower back injury unspecified	1	1.96
	Abdominal muscle strain	1	1.96
Lower limb	**All injuries**	**38**	**74.51**
	Hip injury unspecified	2	3.92
	Hip replacement	1	1.96
	ACL strain	4	7.84
	MCL strain	2	3.92
	Meniscus damage unspecified	1	1.96
	Knee micro fracturing	1	1.96
	Knee injury unspecified	1	1.96
	Gastrocnemius strain	2	3.92
	Achilles tendonitis	1	1.96
	Achilles tendon injury unspecified	1	1.96
	ATFL strain	4	7.84
	CFL strain	3	5.88
	Syndesmosis strain	1	1.96
	Ankle fracture	1	1.96
	Ankle ligament sprain unspecified	9	17.65
	Ankle injury unspecified	3	5.88
	Toe fracture	1	1.96

Injuries by main body region	Body area and clinical diagnosis	n (51)	Prevalence (%)
Unspecified	**All injuries**	**5**	**9.80**
	Bone bruising	1	1.96
	Avulsion fracture	1	1.96
	Sprains	1	1.96
	Ligament injury	2	3.92

ACL – Anterior cruciate ligament MCL – Medial collateral ligament ATFL – Anterior Talo-Fibular ligament

CFL – Calcaneofibular ligament

Mechanism of injury

The prevalence of contact injuries was 53.19%, higher compared to that of non-contact injuries of 46.81%. Collisions with teammates and players of the opposing team accounted for 51.06% of the contact injuries. The incidence of mechanisms of injury was calculated with 13 missing responses.

Table 3. Mechanism of injury

Cause	Type of Contact	n (47)	Prevalence (%)
Contact (n=25)	Interception of the ball	1	2.13
	Collision with a teammate and/or player of the opposing team	24	51.06
Non-contact (n=22)	Running on the court	5	10.64
	Poor jumping and landing mechanics	9	19.15
	Poor change of direction technique	1	2.13
	Loss of balance	1	2.13
	Training on grass	2	4.26

	Repetitive exercises and poor conditioning	2	4.26
	Falling	2	4.26

Injury severity

Injury severity was evaluated using time-loss until players could resume normal training and/or competition. It was reported that 60% of players returned to training or play 3 weeks following injury, 17.5% of players returned the next day, 12.5% of players after 2 weeks and 10% of players returned to training or play 1 week after injury. The prevalence of time-loss was calculated with 20 missing responses.

Medication use

The prevalence of chronic prescription medication use was 8.33%. The most common prescription medication utilised was Symbicort turbohaler at 3.33%. Pulmicort, Exsira, Epitec, Pritor, Amloc, Astor, Eltroxin and Concerta were reported at a prevalence of 1.67%, respectively.

The prevalence of answering YES to receiving any prescription injections, medications or utilising any OTC medications for treating injury or illness suffered 1-6 weeks before or during competition was 66.67%. The most prevalent medication utilised was oral anti-inflammatories at 15%, followed by oral analgesics at 11.67%, platelet-rich plasma (PRP) injections at 5%, cortisone injections, cold and flu and cough syrup medication at 3.33% and anti-retroviral (ARV) drugs – Ribavirin at 1.67%.

Supplement use

The prevalence of answering NO was 68.97% and YES was 31.03% to supplement use. The prevalence of supplement use was calculated with 2 missing responses. The most common supplements utilised were vitamins at 55.56%, minerals at 50%, caffeine and branched chain amino acids (BCAAs) at 33.33%, eicosapentaenoic acid (EPA), gelatin and collagen at 22.22%, creatine and herbal supplements at 11.11%, and other supplements at 22.22%. Further evaluation of the OTHER supplements revealed that anabolic steroids, fat burners and methylsulfonylmethane (MSM) were reported at 5.56% respectively.

The brands of supplements utilised by the netball players include Apex, Dischem brand, USN, Chela-fer, Nutricon, Evox, Slow-mag, Healthspan Elite, XSV Lab, Biogen, Efferflu C, Solal,

Scorpion, Titan, DS-24 and NPL. The prevalence of supplement use was calculated with two missing responses.

Reasons for utilising supplements are presented in Table 4 The most common reason was for recovery at 33.33%.

Table 4. Reasons for utilising supplements

Reason	n (18)	Prevalence (%)
Reduce fatigue	1	5.56
Boost immune function	4	2.,22
Recovery	6	33.33
Address Mineral and Micronutrient Deficiencies	3	16.67
Joint and tendon support	2	11.11
Assist with training	3	16.67
Assist in the prevention of familial diseases	1	5.56
To maintain health	2	11.11
Relieve muscle stiffness	1	5.56
Boost energy	1	5.56

Prevalence of doping

The prevalence of answering NO to doping was 88.33%. However, within the dataset seven responses were observed to be incomplete.

Attitudes towards doping

Attitudes towards doping are presented in Table 5. The attitudes towards doping response percentage were calculated with a mean of nine missing responses.

The netball players disagreed that legalising performance enhancements would be beneficial for sport at an prevalence of 92.16%, 94.11% disagreed that doping is necessary to be competitive, 72.54% disagreed that the risks related to doping are exaggerated, 96.08%

disagreed that athletes should not feel guilty about breaking the rules and taking performance enhancing drugs, 88.24% disagreed that doping is an unavoidable part of competitive sport, 90.19% disagreed that doping is not cheating since everyone does it, 90.2% disagreed that only the quality of performance should matter, not the way in which athletes achieve it, 88.24% disagreed that there is no difference between drugs and biomechanically advantageous sport equipment that is used to optimise sports performance, 96.07% disagreed that netball players taking medication to treat chronic disease, illness or injury have an unfair advantage in competitions, 90.2% disagreed that they do not care if their competitors take medication even if it gives them an unfair advantage in competitions, 92.15% disagreed that they do not care if their competitors intentionally use prohibited substances other than chronic medication or methods to give them an unfair advantage in competitions, 68.62% agreed that intentionally taking PEDs with the sole purpose of optimising performance has long term health implications, and 60.79% disagreed that the use of chronic medication assists netball players to perform as healthy individuals.

Table 5. Attitudes towards doping

Question and response options	Response: Percentage (%)
Q1: Legalising performance enhancements would be beneficial for sport.	
Strongly Disagree	72.55
Disagree	17.65
Slightly Disagree	1.96
Slightly Agree	11.76
Agree	0.00
Strongly Agree	5.88
Q2: Doping is necessary to be competitive.	
Strongly Disagree	84.31
Disagree	7.84
Slightly Disagree	1.96

Slightly Agree	0.00
Agree	1.96
Strongly Agree	1.96
Q3: The risks related to doping are exaggerated.	
Strongly Disagree	56.86
Disagree	11.76
Slightly Disagree	3.92
Slightly Agree	11.76
Agree	5.88
Strongly Agree	7.84
Q4: Athletes should not feel guilty about breaking the rules and taking performance-enhancing drugs.	
Strongly Disagree	88.24
Disagree	3.92
Slightly Disagree	3.92
Slightly Agree	0.00
Agree	0.00
Strongly Agree	1.96
Q5: Doping is an unavoidable part of competitive sport.	
Strongly Disagree	64.71
Disagree	19.61
Slightly Disagree	3.92
Slightly Agree	3.92

Agree	1.96
Strongly Agree	3.92
Q6: Doping is not cheating since everyone does it.	
Strongly Disagree	84.31
Disagree	5.88
Slightly Disagree	0.00
Slightly Agree	1.96
Agree	1.96
Strongly Agree	1.96
Q7: Only the quality of performance should matter, not the way athletes achieve it.	
Strongly Disagree	76.47
Disagree	13.73
Slightly Disagree	0.00
Slightly Agree	1.96
Agree	1.96
Strongly Agree	3.92
Q8: There is no difference between drugs and biomechanically advantageous sport equipment that are used to optimise sports performance.	
Strongly Disagree	66.67
Disagree	17.65
Slightly Disagree	3.92
Slightly Agree	3.92
Agree	0.00

Strongly Agree	5.88
Q9: Netball players taking medication to treat chronic disease, illness or injury have an unfair advantage in competitions.	
Strongly Disagree	58.82
Disagree	25.49
Slightly Disagree	11.76
Slightly Agree	1.96
Agree	3.92
Strongly Agree	1.96
Q10: I do not care if my competitors take medication even if it gives them an unfair advantage in competitions.	
Strongly Disagree	43.14
Disagree	29.41
Slightly Disagree	17.65
Slightly Agree	5.88
Agree	1.96
Strongly Agree	1.96
Q11: I do not care if my competitors intentionally use prohibited substances other than chronic medication or methods to give them an unfair advantage in competitions.	
Strongly Disagree	74.51
Disagree	11.76
Slightly Disagree	5.88
Slightly Agree	1.96
Agree	1.96

Strongly Agree	5.88
Q12: Intentionally taking performance enhancing drugs with the sole purpose of optimising performance has long term health implications.	
Strongly Disagree	21.57
Disagree	7.84
Slightly Disagree	3.92
Slightly Agree	9.80
Agree	29.41
Strongly Agree	29.41
Q13: The use of chronic medication assists netball players to perform as healthy individuals.	
Strongly Disagree	29.41
Disagree	17.65
Slightly Disagree	13.73
Slightly Agree	17.65
Agree	7.84
Strongly Agree	9.80

The netball players indicated that they believed that the pressure to perform or pressure from coaches and parents, to gain a competitive edge or improve performance, underperformance, lack of knowledge of the medication, improve recovery, cope with depression, gain more skills, fear of losing a spot to younger players, to make the team, chronic disease management, and negligence of the coaching or support staff, make netball players more vulnerable to intentional or unintentional doping. Additionally, some of the netball players reported that they do not know why someone would dope, that there is no valid reason and that netball players have no right to compete if they cannot cope with the pressures, and that the netball players have not been tested since before the outbreak of COVID-19, so they believe that there are

no repercussions. Contrastingly, one netball player reported believing that netball is a clean sport.

Attitudes and perceptions

Reasons for competing in netball are presented in Table 6. Most participants (68.33%) played netball to enjoy themselves at a prevalence of 68.33%.

Table 6. Reasons for competing in netball

Reason	n (60)	Prevalence (%)
To enjoy myself and have fun	41	68.33
For social interaction and being with friends	13	21.67
To relieve stress and feel better	12	20.00
To form part of a team	17	28.33
To travel and gain new experiences	22	36.67
To delay the effects of aging	1	1.67
To compete to win	22	36.67
Other	2	3.33
Suicide prevention	1	1.67
To be the best that I can	1	1.67

Anti-doping education status

The prevalence of answering YES to being familiar with the WADA website, anti-doping rules, regulations and policies was at 74.07%. Furthermore, the prevalence of answering NO to being familiar with the WADA website, anti-doping rules, regulations and policies was at 25.93%. Additionally, 75.93% of the netball players indicated that they had heard of the WADA prohibited list and 24.07% of the netball players indicated that they had not heard of the WADA prohibited list. The prevalence of being familiar with the anti-doping education resources was calculated with six missing responses.

The netball players' sources of anti-doping information are presented in Table 7. WADA resources and Google/Internet, accounted for 18.75% each.

The prevalence of sources of anti-doping information was calculated with 28 missing responses.

Table 7. Sources of anti-doping information

Reason	Prevalence (%)
NSA	6.25
Coaches	9.38
Athletes	6.25
WADA resources	18.75
Google/Internet	18.75
SAIDs resources	6.25
Qualified professional (Health care provider, doping agent, member of SASCOC)	9.38
Workshops/seminars/courses	15.63
University	6.25
At netball tournaments	3.13

NSA – Netball South Africa WADA – World Anti-doping Agency SAIDs – South African Institute for Drug-Free Sport

SASCOC – South African Sports Confederation and Olympic Committee

The prevalence of answering YES to having verified with a medical care provider if the medication they prescribed is legal to use when participating in sports events was 64.81% and the prevalence of answering NO was 35.19%. Additionally, 11.11% of the survey netball players indicated that they have applied for a TUE for themselves or a family member competing in any sport. The prevalence of asking about the legality of medications and having ever applied for a TUE was calculated with 6 missing responses.

The prevalence of answering YES to being aware of the consequences of violating the anti-doping rules and regulations was 86.79% and the prevalence of answering NO was 13.21%. The prevalence of awareness of the consequences of anti-doping violations was calculated with 7 missing responses.

Discussion

The study aimed to determine the health status, medication use and attitudes towards doping of South African senior netball players. The main findings of the study were: 1) the prevalence of chronic disease was 11.7%, and injury in the past 5 years was 70%. 2) The prevalence of chronic prescription medication use was 8.33%, and receiving any prescription injections, medications or utilising any OTC medications for treating injury or illness suffered 1-6 weeks before or during competition was 66.67% and supplement use was 30%. 3) Most netball players strongly disagreed that doping is necessary to be competitive at a prevalence of 84.31%, and 88.33% of netball players revealed that they are not intentionally doping.

The majority of the netball players fell within the 18-25 year age range at a prevalence of 65%, had more than 10 years of netball playing experience at a prevalence of 86.67% and participated in training more than 3 times per week at a prevalence of 90%. In terms of netball positions; 35% of the netball players played Goal Shooter and 30% played Goal Defence. The most commonly reported competitions that the netball players competed in included university netball competitions, the Telkom Netball League, provincial competitions, and the Spar National Championships. The majority of the netball players reported playing games 2 times a week at a prevalence of 36.67% or 3 times a week at a prevalence of 28.33%.

Asthma, depression and ADHD were the most prevalent chronic diseases reported at a prevalence of 3.3%. These results concur with the literature. The research suggests that asthma is a common chronic disease reported at a prevalence of 8 – 55.7% in elite athletes competing in endurance-based sport, depending on the study population and the diagnostic criteria.[73, 74] However, studies conducted on elite European summer Olympic athletes reported a 16.5% prevalence of asthma across all types of sports. [74] The prevalence of asthma is reported to be significantly higher in elite athletes compared to the general population due to chronic exposure to agents in athletes' exercise environments.[73] Frequent training in these exacerbating environments leads to hyper reactivity of the respiratory mucosa and chronic inflammation and disruption of the bronchial tree.[73] The data has shown that the intensity of elite level sport leads to an increased number of those with asthma, increases in bronchial hyperactivity, respiratory infections and impaired immune response.[73]

A meta-analysis conducted on elite athletes competing in various sports revealed that 33.6% of elite athletes reported experiencing symptoms of anxiety/depression.[75] Athletes are vulnerable to mental health disorders due to risk factors including injury, involuntary termination of an athletic career, pressure to perform, public scrutiny pressure through mainstream and social media, and limited support networks due to relocation and team group dynamics.[76, 77] Additionally, the mental and physical demands imposed on elite athletes increase the likelihood of developing mental illness as the peak competitive years, and the peak age for the onset of mental illness, tend to overlap.[77] However, depression is largely under-reported by athletic populations as athletes tend to perceive mental health disorders as signs of weakness.[76] Additionally, data suggested that athletes lack an understanding of mental health and its influence on athletic performance.[77]

Attention-deficit/hyperactivity disorder, a common brain developmental disorder, is reported in the literature at a worldwide prevalence of 2.5 – 7.2%.[78] The essential features of the disorder include persistent patterns of age-inappropriate inattention and/or hyperactivity/impulsivity causing dysfunction in academic, work and sport settings and interpersonal relationships since before the age of 12.[78] Attention-deficit/hyperactivity disorder is reported to be more common in elite athletes compared to the general population, since children with ADHD tend to be drawn to sport as a function of the positive reinforcement and attentional activating effects afforded by physical activity.[78] In an annual report published on the number of players approved for TUEs, it was reported that 8.4% of players in Major League Baseball had approved TUEs for ADHD medication.[78]

The prevalence of injury in the past 5 years was calculated to be 70% and the prevalence for reoccurrence of the same injury was calculated to be 45%. The findings are in support of what is typically reported in the literature. The upper and lower limbs were the most frequently injured body regions at 11.76% and 74.51%, respectively. In particular, in the lower limb, sprains and strains were the most frequently reported injury occurring in the ankle ligaments, anterior cruciate ligaments, medial collateral ligaments and the gastrocnemius muscle. Furthermore, unspecified hip injuries were also more frequently reported. These findings are comparable to data in the literature reporting muscular strains and ligamentous injuries as the most prevalent injuries reported in netball players.[5] This study reports a higher prevalence of lower limb injuries and a lower prevalence of upper limb injuries compared to other studies conducted on elite South African netball players.[3] In a previous study conducted on elite South African netball players, 16% of injuries were sustained to the hand and wrist, and 0.9 – 2.4% of injuries were sustained to the hip, groin, thigh, feet and toes.[3] The data collected in this study also reported data higher than that reported in Australian netball players, where 68.4%

of injuries were reported to be sustained to the lower limb.[25] Specifically, the ankle and knee were reported as frequent sites of injury.[25] Contact injuries were reported at a higher prevalence of 53.19% compared to non-contact injuries at 46.83%. Collisions with other players on the court accounted for 51.06% of all contact injuries sustained. Poor jumping and landing mechanics accounted for 19.15%and running on the court accounted for 10.64% the most commonly reported mechanisms of injury. These findings are consistent with what was previously reported in elite South African netball players.[25]

Injury severity was evaluated using time-loss until players could resume normal training and/or competition. The survey revealed that 60% of the netball players reported that they had returned to training or competition 3 weeks following injury, 17.5% of players returned the next day, 12.5% of players returned following 2 weeks and 10% of players returned to training or play 1 week following injury. Compared to a previous study conducted on elite South African netball players, 11.4% of injured athletes missed 1-2 games, 2% missed 3-4 games and 3.5% could not return to play for 7 days.[3] Additionally, the study indicated that 12.4% of injured athletes sustained injuries that hindered their return to play for more than 7 days.[3]

The prevalence of chronic prescription medication use was 8.33%. The most common prescription medication utilised was Symbicort turbohaler at 3.33%. Pulmicort, Exsira, Epitec, Pritor, Amloc, Astor, Eltroxin and Concerta were reported at a prevalence of 1.67%. Per the SAIDs medication check database, these prescription medications are permitted in and out of competition, except for Pritor and Concerta.[79] Pritor tablets contain hydrochlorothiazide, a thiazide-type diuretic, and are prohibited in and out of competition.[79, 80] Concerta tablets contain methylphenidate, a stimulant, and are prohibited in competition only.[79]

The prevalence of receiving any prescription injections, medications or utilising any OTC medications for the treatment of injury or illness suffered 1-6 weeks before or during competition was 66.67%. The most prevalent medication used were oral anti-inflammatories at 15%, followed by oral analgesics at 11.67%, PRP injections at 5%, cortisone injections, cold and flu and cough syrup medication at 3.33% and ARV – Ribavirin at 1.67%. Cortisone injections and certain cold, flu and cough syrup medications are prohibited in competition.[79] Cortisone is classified under Section S9 glucocorticosteroids on the WADA 2023 prohibited list and is prohibited for systemic and non-systemic use in competition.[79] Cold, flu and cough syrup medication that contains pseudoephedrine and ephedrine (stimulants) are prohibited in competition only.[79]

Only 31.03% of surveyed netball players reported using nutritional supplements. The most common supplements utilised were vitamins, minerals, caffeine and BCAAs, EPA, gelatin and

collagen, creatine, herbal and other supplements. The prevalence of supplement use in netball players is significantly less compared to other populations reported in the literature. [9] It has been reported that 65% of Canadian Olympic athletes, 89% of American collegiate athletes and 87.5% of Australian athletes use nutritional supplements.[(9)] The netball players further specified anabolic steroids, fat burners and methylsulfonylmethane (MSM) under the other supplements category.

Anabolic steroids are strictly prohibited in and out of competition by WADA.[26] Fat burners and products that promote fat burning effects are more likely to contain high dosages of stimulants like caffeine, ephedrine, and methylhexamine.[81] Caffeine has been included in the WADA 2023 Monitoring Programme, however, it is not considered a prohibited substance.[26] In contrast, ephedrine (urine concentrations greater than 10 micrograms per millilitre) and methylhexamine are prohibited substances in competition.[26, 79] The report of anabolic steroid use as a supplement requires considerable synthesis. If the report is true, the netball player violates the WADA anti-doping rules and risks being suspended or sanctioned from netball if they undergo anti-doping testing. However, it cannot be ignored that the finding may be due to conformity bias wherein the netball player provided an answer they thought the researchers were looking for rather than responding truthfully. This may be further supported by the participant failing to complete the doping section of the survey. However, it is also pertinent to consider that the participant may have not wished to complete the doping section of the survey through conscious choice.

Nutritional supplements lack regulation and may unintentionally contain banned ingredients due to cross-contamination and poor hygiene practices in the production process or intentionally through purposeful inclusion without labelling.[8, 10] Consequently, netball players ingesting nutritional supplements are at an increased risk for unintentional doping.

The onus falls upon athletes to critically evaluate a nutritional supplement's demonstrated effectiveness and safety for ingestion in and out of competition.[81] The Informed Sport website is a trusted online tool that is freely available for athletes to verify whether their nutritional supplement is safe for athlete consumption. Informed Sport is a global testing and certification programme for sports and nutritional supplements that evaluates nutritional supplements for contamination utilising the accredited ISO 17025 methods.[82] Additionally, athletes should seek the Informed Sport quality logo on their nutritional supplement products as they may be assured that the product has passed stringent testing.[82] However, many supplement products may provide their own versions of quality assurance logos that may persuade athletes that the particular product is tested and certified to be free from banned substances.[81] The accredited methods of banned substance testing are expensive and quality assurance other than that of

Informed Sport often includes only a few aspects of safety being tested for on a random, or infrequent basis.[81] Informed Sport ensures that once a product has received the stamp of approval, the product is continually blind tested to safeguard against banned substances.[82] Irrespective of the level of testing a supplement has undergone, athletes cannot be guaranteed that the utilisation of a product will not harm their health, performance, or that they will not test positive for doping unintentionally.

The prevalence of answering NO to doping was 88.33%. However, within the dataset, 7 responses were observed to be incomplete. As discussed earlier, anabolic steroids are doping agents and were reported in the supplement use section of the survey. This may suggest a deliberate omission of intentional doping practice, or the report suggests conformity bias. This may be supported by the prevalence of answering NO to current usage of banned substances or methods to optimise sports performance by 90%. However, it cannot be ignored that the netball player may have chosen not to complete the remainder of the survey. Within the dataset, 6 responses were observed to be incomplete.

The top 3 reasons reported by the netball players as to why they utilise nutritional supplements included for recovery at 33.33%, for boosting immune function at 22.22%, and for addressing mineral and micronutrient deficiencies at 16.67%.

The study demonstrated that most netball players have a strongly negative attitude towards doping. However, 11.76% of the netball players revealed that they slightly agreed that legalising performance enhancements would benefit sport and that the risks related to doping are exaggerated. The study further revealed that 21.57% of netball players strongly disagreed that intentionally taking PEDs with the sole purpose of optimising performance has long term health implications, and 29.41% of the netball players strongly disagreed that the use of chronic medication assists netball players in performing as healthy individuals. These findings may suggest that the netball players are inadequately informed regarding the risks and health implications associated with doping. Additionally, the results revealed that the netball players might not understand that players taking chronic medication to maintain general health does not compromise fair play. This may suggest that the current anti-doping educational guidelines and interventions may need to further emphasise these areas in particular. However, 94.11% of the netball players disagreed that doping is necessary to be competitive, and 88.33% of the netball players revealed that they are not intentionally doping.

The top 3 reported reasons as to why the netball players think that netball players may be more vulnerable to intentional or unintentional doping include pressure to perform at 13.33%, to gain competitive advantage at 10%, and to improve performance at 6.67%. Comparative to data reported in the literature, positive attitudes towards doping include improved physical

performance and energy, reductions of fear of failure through increasing the probability of winning because the playing field is perceived to be levelled, obtaining competitive advantage, modelling after sport heroes and gaining support from peers, relaxation and ability to cope with the pressure to perform well, pain reduction and rehabilitation from injury leading to sooner return to play and weight reduction.[17, 19, 61]

Additional pertinent findings in this section of the survey revealed that some netball players believe that the sport is clean of doping and that the netball players have not been tested for doping since before the outbreak of COVID-19, so there are no repercussions for doping. The latter report raises concern, as this belief may influence a netball player's belief that netball is not being monitored for anti-doping violations and may possibly motivate a player with positive attitudes towards doping to commit intentional doping offences to assist them to compete to win or to gain competitive advantage, to cope with the pressures to perform and to improve performance.

The top 3 reasons reported by the netball players as to why they compete in netball include to enjoy themselves and to have fun at 68.33%, to compete to win at 36.67%, and to travel and gain new experiences at 36.67%. Goal perspective influences how individuals think, feel, and act in achievement situations like sports.[83] Task and ego orientation differentiates how athletes appraise their ability, effort and performance level.[83] Ego-orientated athletes value outperforming their athletic counterparts by utilising minimal effort signifying superior competence.[83] Ego-orientated athletes are more likely to adopt negative achievement behaviours, including deceptive tactics.[83] Therefore, a competing to win mentality combined with positive attitudes towards doping may increase an ego-orientated netball player's likelihood of committing intentional anti-doping violations.

Regarding anti-doping education status, many netball players reported that they were familiar with the WADA website, anti-doping rules, regulations and policies and that they had heard of the WADA prohibited list. However, 25.93% of the netball players reported that they were not familiar with the WADA website, anti-doping rules, regulations and policies, and 24.07% of netball players reporting that they had not heard of the WADA prohibited list. Concerns are further raised with 13.21% of the netball players reporting that they were not aware of the consequences of committing an anti-doping violation. This supports that anti-doping education programmes and interventions in netball, especially following the progression of 'life as usual' following the outbreak of the COVID-19 pandemic, may require a more intensive approach.

Those netball players who reported being familiar with anti-doping rules and regulations maintained that their information sources are mostly credible. The top 3 resources included: WADA resources, Internet sources, and workshops, seminars and courses. Only 6.25% of

netball players use the South African Institute for Drug-Free Sport (SAIDs), the South African anti-doping organisation (ADO) responsible for anti-doping education for South African athletes, as an information source. This may suggest that South African athletes are unaware of the SAIDs and the services and support they can offer South African athletes.

Conclusion

The prevalence of chronic disease in the netball players was low, 11.67%, with asthma, depression and ADHD being reported at a higher prevalence compared to any other disease. The prevalence of injury in the past 5 years was 70% and the prevalence of injury reoccurrence was 45%. The lower limb injury was most frequently reported, with sprains and strains being most frequently reported in the ankle ligaments, anterior cruciate ligaments, medial collateral ligaments and the gastrocnemius muscle. The prevalence of chronic prescription medication use was 8.33% and the prevalence of receiving any prescription injections, medications or utilising any OTC medications for the treatment of injury or illness suffered 1-6 weeks before or during competition was 66.67%. Oral analgesics, oral anti-inflammatories, PRP injections, cortisone injections, cold and flu and cough syrup medication and the ARV – Ribavirin were reported to be the most prevalent medications utilised. Additionally, 31.03% of the netball players reported using nutritional supplements with vitamins, minerals, caffeine and BCAAs, EPA, gelatin and collagen, creatine, herbal and other supplements being most commonly reported. Most netball players disagreed that doping is necessary to be competitive at a prevalence of 94.11%, and 88.33% of netball players revealed that they are not intentionally doping. Only 25.93% of the netball players reported that they were not familiar with the WADA website, anti-doping rules, regulations and policies, and 24.07% of the netball players reported that they had not heard of the WADA prohibited list. This suggests that anti-doping education within this netball player cohort appears insufficient.

Recommendations

Future research needs to include an analysis of training loads and the repetition of this study on larger samples of participants. Training load that is correctly managed increases performance capacity, mismanaged training load increases the risk of maladaptation and injury, decreasing performance capacity.[4] Consequently, prolonged high training loads, maladaptation and injury may motivate an athlete to intentionally dope. Furthermore, a possible strategy on improving anti-doping education in netball could involve the development of a free SAIDs Drug-Free Sport mobile app similar to that of the Australian Sports Anti-Doping Authority (ASADA) Clean Sport mobile app. The ASADA Clean Sport mobile app was designed as a free tool to aid in eliminating doping and protecting the integrity of Australian sport.[84] The mobile app provides a database of supplements sold in Australia to aid athletes

to find low risk products and an in-app quiz to assess the risk and suitability of a supplement not listed in the database. It also provides a medication checker for Australian medication to verify the permissibility of the medication in sport, a portal for anonymous doping reporting, a concise feedback form to ASADA on the testing mission, an education session on any other part of ASADA's work, links to free ASADA education and important information on TUEs, the testing process, and anti-doping rules.[84] A South African equivalent app was available in 2011 but was discontinued. However, a medication check and education resources are made available by SAIDs on their online website. A South African equivalent of the ASADA Clean Sport App should be reintroduced as it could practically assist in addressing the disparities in the anti-doping education status in netball players identified in the study and prevent South African intentional and unintentional doping violations.

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